Application of Multi-Criteria Analysis for Selecting Solvents in Plastic Recycling

Master's degree in Energy and Environmental Engineering

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Project Report under the supervision of Professor Maria Lizete Lopes Heleno, and Professor Nelson Simões Oliveira

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Originality and Copyright

This project report is original, made only for this purpose, and all authors whose studies and publications were used to complete it are duly acknowledged.

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Abstract

One of the emerging technologies with the greatest potential in plastic recycling is selective dissolution precipitation (SDP). This technique enables the recovery of polymer materials with near-virgin quality. However, the selection of appropriate solvents remains a critical challenge and a key opportunity for improving process efficiency and applicability. In this study, the Analytic Hierarchy Process (AHP) was applied as a multi-criteria decision-making tool for solvent evaluation. The parameters considered were solubility, hazard level, and cost. Solubility was assessed using Hansen Solubility Parameters, hazard was evaluated using GHS H-codes, and cost data were obtained from vendor quotations and commercial sources.

The results identified the most suitable solvents for each polymer: ethyl benzoate (S17) for polystyrene (P1), p-cymene (S5) for polyethylene (P2), cumene (S18) for polypropylene (P3), anisole (S1) for polyethylene terephthalate (P4), and dimethyl isosorbide (S6) for polyvinyl chloride (P5).

Overall, this work provides a structured and practical framework for solvent selection in SDP. The proposed approach supports safer and more sustainable recycling practices and contributes to the advancement and potential industrial implementation of selective dissolution technologies, contributing to the advancement and potential industrial implementation of selective dissolution technologies.

Keywords: Analytic Hierarchy Process, selective dissolution-precipitation, solvent selection, plastic recycling, green solvents.

Resumo

Uma das tecnologias emergentes com maior potencial na reciclagem de plásticos é a dissolução seletiva seguida de precipitação (Selective Dissolution-Precipitation – SDP). Esta técnica permite a recuperação de materiais poliméricos com uma qualidade próxima da do material virgem. No entanto, a seleção de solventes adequados continua a ser um desafio crítico e, simultaneamente, uma oportunidade fundamental para melhorar a eficiência e a aplicabilidade do processo.

Neste estudo, foi aplicado o Processo Analítico Hierárquico (Analytic Hierarchy Process – AHP) como ferramenta de apoio multicritério à decisão para a avaliação de solventes. Os parâmetros considerados foram a solubilidade do solvente, o nível de perigosidade e o custo. A solubilidade foi avaliada com base nos Parâmetros de Solubilidade de Hansen, a perigosidade foi determinada através das classificações de perigo (códigos H) do Sistema Globalmente Harmonizado (GHS), e os dados de custo foram obtidos a partir de cotações de fornecedores e de fontes comerciais.

Os resultados permitiram identificar os solventes mais adequados para cada polímero: benzoato de etilo (S17) para o poliestireno (P1), p-cimeno (S5) para o polietileno (P2), cumeno (S18) para o polipropileno (P3), anisol (S1) para o politereftalato de etileno (P4) e isossorbida de dimetilo (S6) para o policloreto de vinilo (P5).

De forma global, este trabalho apresenta uma metodologia estruturada e prática para a seleção de solventes em processos de SDP. A abordagem proposta promove práticas de reciclagem mais seguras e sustentáveis, contribuindo para o desenvolvimento e para a futura implementação industrial das tecnologias de dissolução seletiva.

Palavras-chave: Processo Analítico Hierárquico, dissolução-precipitação seletiva, seleção de solventes, reciclagem de plásticos, solventes verdes.

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List of Abbreviations and Acronyms

AE	Atom Economy
AHP	Analytic Hierarchy Process
BHET	Bis(2-hydroxyethyl) terephthalate
CI	Carbon Intensity
DEHP	Bis (2-ethylhexyl) phthalate
DMT	Dimethyl terephthalate
ECHA	European Agency Chemicals Agency
EG	Ethylene Glycol
EPS	Expanded Polystyrene
ESTG	School of Technology and Management
EU	European Union
GHS	Greenhouse gas
GVL	Gamma-valerolactone
MEK	Methyl Ethyl Ketone
NMP	N-Methyl-2-pyrrolidone
NIR	Near- infrared radiation
OECD	Organization for Economic Co-operation and Development
PAA	Polyacrylic acid
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinylchloride
REACH	European Registration, Evaluation, Authorization and Restriction of Chemicals
RED	Relative Energy Distance
SDP	Selective dissolution/precipitation
SSG	Standard Spatial Guidance
TPA	Terephthalic Acid
UNCED	United Nations Conference on Environment and Development

UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
XRF	X-ray fluorescence spectroscopy

1. Introduction

Currently, plastics have transformed everyday life and have made an indispensable part of it, so it is unthinkable to live without them (Rodrigues et al., 2019). Plastic emerged as an innovative material to develop low-cost, affordable, functional, and simple manufacturing for industrial sectors, such as packaging, healthcare, fisheries, agriculture, and in households (Patrício Silva et al., 2020).

As with any material, plastics have a defined life cycle. According to the Organization for Economic Co-operation and Development (OECD), only 9% of plastic waste is ultimately recycled. Although approximately 15% is collected for recycling, around 40% of this collected material is discarded as processing residues rather than being successfully recycled. In addition, 19% of plastic waste is incinerated, 50% is disposed of in landfills, and the remaining 22% escapes formal waste management systems, ending up in uncontrolled dumpsites, being burned in open pits, or leaking into terrestrial and aquatic environments, particularly in lower-income countries (OECD, 2022).

According to the current situation, the search for effective plastic waste recycling methods has represented a valuable opportunity for both scientific progress and business development (Leal Filho et al., 2019). Currently, recycling processes are classified into four main types, each with its own advantages and limitations (Idumah & Nwuzor, 2019). Primary recycling focuses on post-industrial waste because these plastics are typically clean and homogeneous, allowing them to be reprocessed without significant loss of quality; however, its scope is limited, (Faust et al., 2023). Secondary recycling, on the other hand, reuses post-consumer plastics, that is, those that have been used and discarded by consumers. Although this method allows plastics to be recovered and their useful life extended, their properties progressively degrade with each cycle, limiting its application and often requiring the addition of virgin polymers to maintain the quality of the recycled material (Li et al., 2024). Tertiary recycling, also known as chemical recycling, transforms plastics into their basic chemical components through processes such as pyrolysis, depolymerization, gasification, and solvolysis (Schyns & Shaver, 2021). This allows the production of monomers or new chemical substances that can be used to remanufacture plastics. However, its application is limited due to high operating

costs, high energy consumption, and the need for advanced infrastructure for large-scale implementation. Finally, quaternary recycling converts plastics into energy through incineration. While this process is efficient at reducing waste volume and recovering energy, it generates polluting emissions, which reduces its viability as a truly sustainable option (Idumah & Nwuzor, 2019; Kosloski-Oh et al., 2021). Figure 1 shows the different approaches to the recycling of plastic, including primary, secondary, tertiary, and quaternary recycling.

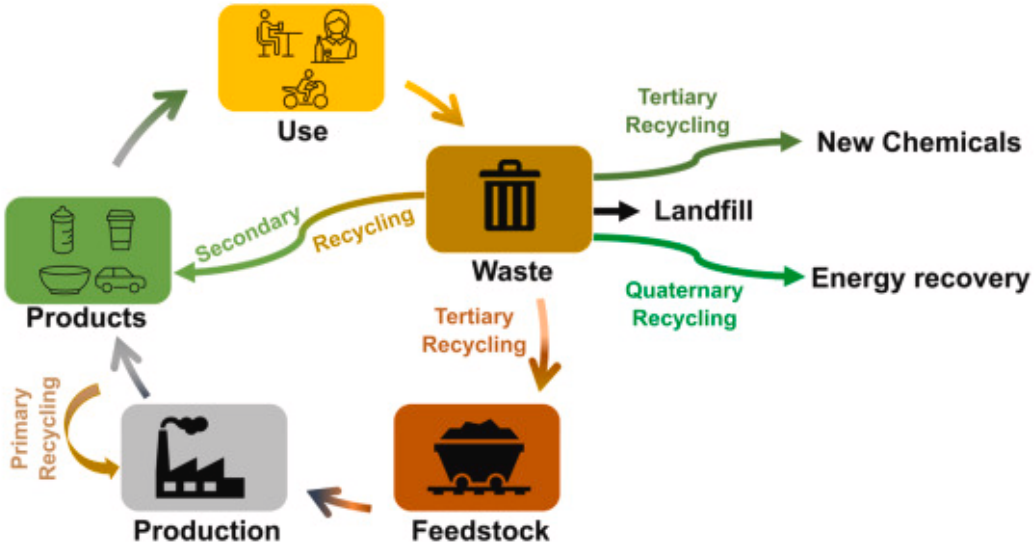


Figure 1: Different approaches to the recycling of plastic (X. Li et al., 2024).

Given the limitations of these methods, Selective Dissolution-Precipitation (SDP) for plastic recycling, also known as solvent separation, is emerging as a promising, more efficient and sustainable alternative for secondary recycling (Ikegwu, Zhou, et al., 2025). Unlike mechanical recycling, which undergoes degradation with each cycle, or chemical recycling, which requires costly and energy-intensive processes, SDP is a physical process that allows the recovery of plastics in their pure and clean state (Aparício et al., 2025). This method involves selectively dissolving polymers in a common solvent at controlled temperatures, ensuring that only the target polymer dissolves while the others remain intact. The polymer is also separated from other chemical elements involved in its manufacture and from contaminants acquired after its useful life (Ügdüler et al., 2020). Subsequently, through controlled cooling or the addition of another substance, the dissolved polymer precipitates and is recovered with a purity comparable to that of virgin material. Furthermore, the process can be optimized through closed solvent circuits, allowing for reuse and reducing the environmental impact. Thanks to its ability to treat

heterogeneous plastic waste without compromising the quality of the recycled material, SDP represents a viable and efficient alternative to address current challenges in plastics recycling (F. Zhang et al., 2021).

One of the most important aspects of this type of recycling is the selection of the solvents used in the process. Traditionally, solvents have been chosen mainly based on their ability to dissolve specific polymers, often overlooking environmental impact, toxicity, and sustainability. With the growing emphasis on green chemistry, there is increasing interest in using eco-friendly solvents that not only enhance the efficiency of recycling but also reduce environmental harm (Sánchez-Rivera et al., 2025). Many conventional solvents used in SDP are highly volatile and toxic, contributing to air pollution and hazardous waste generation. Therefore, integrating green solvents into the SDP process could improve both its environmental and economic viability, making plastic recycling more sustainable (X. Li et al., 2024).

Inspired by these facts, the motivation of this study is to identify suitable criteria for selecting solvents in the SDP recycling process, based on existing scientific literature. The focus will be on solubility, sustainability, and economic feasibility to ensure an efficient and environmentally friendly recycling approach.

The general objective will be to identify the most accurate solvents to use in SDP by applying the analytical hierarchical method (AHP) considering criteria's such as, solubility, solvent price and hazardous. The main objectives defined for this project are the following:

- To carry out a state of art through a bibliographic survey that identifies further contextualization of SDP, current advances, such as scientific research and/or business application.
- To define the evaluation criteria for the selection of solvents that will be applied in the AHP method, establishing the method used for their analysis.
- To select the best solvents for each polymer used after applying the AHP method.

This thesis is structured in five chapters, which contribute to an organized, cohesive, and coherent presentation.

In chapter 1, "Introduction", the motivation and objectives of the case study are

framed, based on the proposal of SDP recycling as an adequate and effective alternative to overcome the problem of plastics, focusing on finding the best way to choose the right solvents for the recycling process.

In chapter 2, “State of the art” includes relevant background necessary to this work, such as plastic waste, green solvents, scientific and commercial SDP and AHP methodology.

In chapter 3, "Methodology," provides a detailed explanation of the evaluation process applied to each solvent, considering three key criteria: solubility, hazard, and price.

In chapter 4, “Results and Discussion”, the methodology applied results are presented, also being made an interpretation and critical analysis of the results achieved in order to finally define which solvent will be chosen in the recycling process.

Finally, chapter 5, “Conclusions”, presents a summary of the results obtained during the development of the project and seeks to answer the questions and objectives raised at the beginning of the work.

2. State of the art

2.1. Plastic waste

Plastic pollution is one of the most alarming environmental crises of our time (MacLeod et al., 2021). Since most plastics are non-biodegradable, these materials have persisted in the environment for decades affecting not only ecosystems but also human health due to the accumulation of pathogens and toxic chemicals on their surfaces (Song et al., 2022). Although plastic recycling legislation has increased the recovery rate of these materials, plastic pollution continues to have a significant environmental impact. This problem not only highlights the lack of proper waste management but also puts biodiversity and human health at risk (McIlwraith et al., 2021).

Over the years, the search for sustainable and effective recycling techniques has become a field of significant importance for scientific, technological, and economic development. Currently, plastics recycling is classified into four main approaches: primary, secondary, tertiary, and quaternary (Schirmeister & Mülhaupt, 2022). Each of these processes has specific characteristics and varying levels of complexity, which determines its applicability based on the type of plastic waste treated.

Primary recycling, also known as closed-loop recycling, involves the reuse of plastic waste without significantly altering its chemical structure. This process is highly efficient for handling clean, uncontaminated plastic waste, which is typically generated during manufacturing. It begins with the collection of post-industrial plastic waste—usually production scraps or defective products—and continues with the reintroduction of this waste directly into the manufacturing process without extensive treatment. It ends with the melting and reshaping of the plastic to create new products with properties like those of the original material (Kumar et al., 2020). One of the advantages of this type of recycling is that it allows the same equipment and facilities used to produce virgin polymers to be used, and it also offers precise knowledge of the raw materials composition without the need for additional analysis. This translates into lower CO_2 emissions and makes it the most cost-effective recycling method compared to other processes. However, primary recycling also has some disadvantages, such as the need for clean, uncontaminated, and homogeneous plastic waste, which limits its application to well-sorted materials (J. E. Lee et al., 2025).

On the other hand, secondary recycling is a method focused on the recovery of post-consumer plastics through physical and mechanical processes without altering their chemical composition. It is the most widespread recycling method worldwide due to its lower cost and ease of implementation compared to other recycling processes (Lamtai et al., 2023). Through secondary recycling, plastic waste is transformed into new raw materials for the manufacture of products. However, this process entails certain challenges, especially related to material degradation and the presence of contaminants. The mechanical properties of the plastic can deteriorate, negatively affecting its performance in subsequent applications. Furthermore, the quality of the recycled product can be inconsistent, making it difficult to use in industrial (Titone et al., 2024).

Several stages are involved in converting plastic waste into reusable products. First, post-consumer plastics are collected from different sources, such as municipal, industrial, and commercial waste (Titone et al., 2024). Next, the plastic enters the shredding stage, where the material is reduced in size after collection and sorting, facilitating its handling and processing. This step improves the effectiveness of subsequent treatments such as washing or drying by increasing the surface area of the material and guarantees more uniform properties for better fusion during extrusion. The shredding equipment typically includes a hopper, rotating blades, a screening system, and a collection container (Bezeraj et al., 2024). Then, the polymer separation stage follows, in which the plastics are sorted according to their physical characteristics and the commercial purpose of the final product. Among the most relevant techniques are near infrared radiation (NIR) separation, which irradiates the plastics with light waves to identify their spectral signature; however, it is not effective for dark-colored plastics (Zhu et al., 2025). Another technique is X-ray fluorescence spectroscopy (XRF), which can identify materials with flame retardants and analyze their chemical composition (Alghamdi et al., 2022). The flotation method, which separates plastics according to their density by using wetting and foaming agents, is also used. This method offers high efficiency, although it requires a lot of space and time (Sun et al., 2025). On the other hand, triboelectric separation allows the classification of plastics according to the electrical charge they acquire upon contact, facilitating the separation of metal parts and different types of polymers (Zhu et al., 2025). Finally, there is manual sorting, which allows plastics to be visually identified by their shape and color. Although it is useful for large parts and represents the most economical option, it is currently the least used due

to its low efficiency and high propensity to human error, as mentioned above (Prochazka et al., 2024). After separation, washing is carried out with detergents and chemicals to remove labels, glue, ink, oils, and other inorganic compounds. In addition, filtration processes are used to eliminate solid particles (Lamtai et al., 2023). After these steps, the plastics are processed and transformed into granules through a pelletizing process. Extrusion is one of the most widely used methods in polymer manufacturing, and single-screw or twin-screw extruders are used in the industry to recycle used materials (Babaremu et al., 2024). This process takes advantage of the rotation of the screw and the heat generated by the heating elements to soften and blend the polymers. The combination of elevated temperature and the mechanical action of the screw generate shear forces that can alter the structure of the material, affecting its thermomechanical properties (Vollmer et al., 2020). However, this impact can be minimized by adjusting the extrusion parameters and adding additives such as carbon black or antioxidants (Babaremu et al., 2024). Finally, the machine melts and homogenizes the material before it passes through the die to be shaped. The secondary recycling process is summarized in Figure 2.

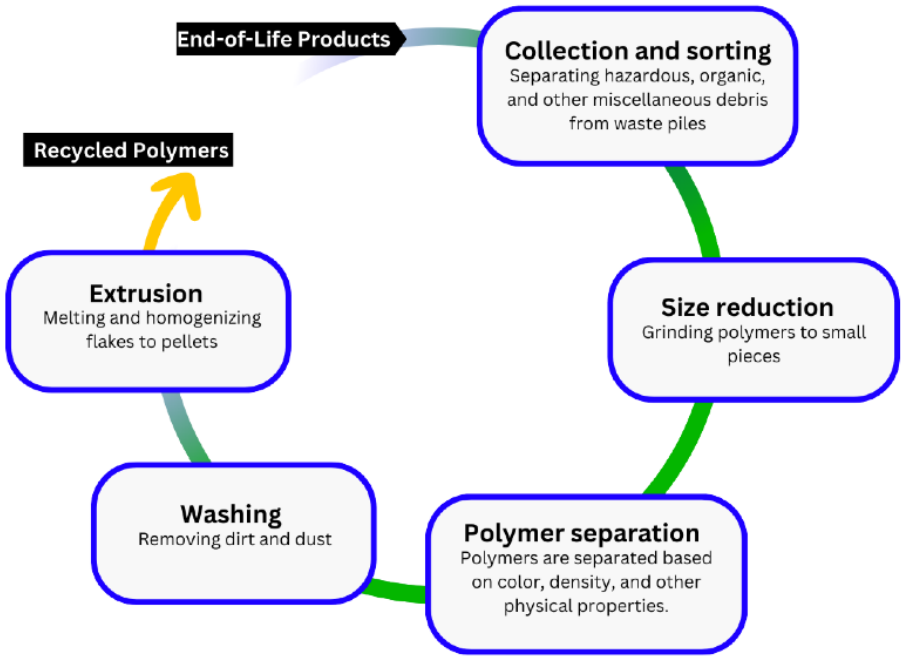


Figure 2: Secondary recycling process (Babaremu et al., 2024).

From a process perspective, tertiary or chemical recycling is characterized by the molecular breakdown of plastics into their basic components, whether monomers, oligomers, or smaller fragments. These techniques break the main hydrocarbon chain of polymers, allowing the recovery of high-value materials, such as high-purity monomers or chemical precursors essential to produce new plastics (A. Lee & Liew, 2021).

Unlike mechanical (secondary) recycling, which presents difficulties with contaminated, complex, or multi-layered plastic waste, tertiary recycling offers a more efficient solution, allowing the processing of heterogeneous mixtures without compromising the quality of the final product. In fact, the products obtained can be reused as raw material in the manufacture of entirely new plastics or even used for other purposes, such as fuel production (Martínez-Narro et al., 2024).

In this context, different technologies have been developed within tertiary recycling, each with its own operational characteristics, benefits, and limitations. One of the most widely used methods is pyrolysis, applicable to plastics such as polypropylene (PP), polyethylene (PE), Polyethylene terephthalate (PET), and Polystyrene (PS). This thermal process, carried out at temperatures close to 500 °C, transforms plastic waste into liquid and gaseous fuels. Its main advantages are that it requires minimum pretreatment of materials, can operate with waste mixtures, and is already in the pilot phase. However, it requires a large amount of energy and does not allow for a complete closure of the plastics cycle, as its application is geared more toward energy production than the manufacture of new polymers (Dai et al., 2022).

On the other hand, there are chemical processes such as methanolysis and glycolysis, both focused on the treatment of PET. Methanolysis, operating between 180 and 280 °C and at pressures of 2–4 MPa, produces dimethyl terephthalate (DMT) and ethylene glycol (EG), with yields close to 90%. Its integration into existing industrial lines is a key advantage, although it faces challenges such as the injection of plastic waste into pressurized reactors and the lower market demand for DMT (H. W. Lee et al., 2024). Glycolysis, on the other hand, transforms PET into bis(2-hydroxyethyl) terephthalate (BHET) under more moderate conditions (190–240 °C; 0.1–0.6 MPa), although it requires additional purification steps and also faces low demand for BHET (Chang et al., 2025). Acid hydrolysis allows the recovery of terephthalic acid (TPA) and EG at temperatures between 70 and 90 °C. Although it operates at lower temperatures and in

shorter times, it requires concentrated acids, corrosion-resistant equipment, and presents complications in the extraction of products such as EG (Qin et al., 2024). Finally, alkaline hydrolysis also allows the recovery of TPA and EG and is especially useful when PET is contaminated with materials such as PVC. It can achieve conversions of 90% using catalysts at temperatures between 210 and 250 °C (or even at 90 °C with a catalyst). Despite its efficiency, it requires prior classification of waste, can be limited by the crystallinity of the polymer and generates catalytic waste that must be properly managed (Qin et al., 2024).

And finally, quaternary recycling, also known as energy recovery or controlled incineration, is a technique that allows for the recovery of energy from highly contaminated, degraded, or mixed plastic waste, which makes it difficult to process with conventional recycling. The process involves subjecting this waste to controlled combustion, taking advantage of its high calorific value, especially that of thermoplastics, to generate thermal and/or electrical energy (Kasar et al., 2024).

According to (Singh et al., 2017) this technique can reduce the volume of treated plastic waste by up to 90%, making it a practical solution to reduce pressure on landfills and optimize the space allocated to waste management. In addition to energy production, another important benefit is the possibility of recovering minerals and metals contained in the generated ash, which can be reused as construction materials or industrial inputs, thus increasing the added value of the process (R. P. Lee et al., 2020).

However, this form of recycling has serious environmental implications. During incineration, highly toxic compounds such as dioxins, furans, mercury, and polychlorinated biphenyls (PCBs) are released, which pose a significant risk to human health and ecosystems if not properly managed. Kumar et al. (2021) warns that the solid waste generated, such as fly ash and slag, also requires specialized treatment to prevent soil and water contamination.

Furthermore, one of the main challenges facing this method is its contribution to greenhouse gas (GHG) emissions, since carbon-rich materials such as plastics and cardboard, when incinerated, release CO_2 and other compounds that exacerbate global warming. This represents a loss of secondary resources that could have been reincorporated into the production cycle as recycled raw materials, reducing dependence on virgin resources (Keller et al., 2020).

Therefore, although quaternary recycling can be an energy-efficient alternative for reducing plastic volume, its implementation must be accompanied by advanced filtration technologies, material recovery systems, and strict environmental regulations. Only under these conditions is it possible to minimize its negative impact and ensure sustainable management of complex plastic waste (Kasar et al., 2024).

In recent years, SDP has gained attention as an efficient and environmentally friendly alternative for the treatment of plastic waste. This strategy, which is part of physical recycling, consists of selectively dissolving a specific polymer using a suitable solvent at a controlled temperature. Once the mixture has been dissolved, it is filtered to remove insoluble solids. The dissolved polymer can then be recovered by processes that induce its precipitation, either by adding a non-solvent agent, reducing the temperature of the system, or evaporating the solvent. These techniques make it possible to obtain the polymer resin in pure form, effectively separating it from the medium in which it was dissolved (H. Li et al., 2022).

Unlike mechanical recycling, the dissolution-precipitation process produces high-quality polymers that retain most of their original physicochemical properties, except for the material's degree of crystallinity. One of its main advantages is its high selectivity, which allows for the treatment of complex plastic waste, such as multilayer films, and the removal of critical impurities such as metals and dyes, provided appropriate solvents are used. This efficiency translates into a higher recycling rate than conventional mechanical recycling (Aparício et al., 2025). However, this technique also presents challenges. Its implementation is more expensive due to the use of solvents and the energy consumption required for their recovery, which raises operating costs compared to mechanical recycling (Aparício et al., 2024).

On the other hand, compared to chemical recycling, dissolution-precipitation offers a simpler alternative, as it does not involve complex chemical reactions. This translates into lower energy consumption and the additional advantage that the recovered polymers can be directly reused without the need for repolymerization. Although chemical recycling allows for greater versatility in transforming polymers into monomers or other compounds, it requires additional processes that increase its complexity (Jeswani et al., 2021). Table 1 presents a comparative overview of the main plastic recycling methods, summarizing the main characteristics of each type of plastic mentioned in this subsection.

Table 1: Comparison of plastic recycling types (Enache et al., 2025; Klotz et al., 2024; Lamtai et al., 2023).

Criteria / Type	Primary	Secondary	Tertiary	Quaternary	SDP
Final product quality	Very high	Medium/low	Very high	N/A	Very high
Technology development	Medium	High	Medium	Medium	Low
Operation Cost	Low	Medium	High	Medium/High	Very high
Feedstock requirement	Homogeneous	Mixed	Mixed	Mixed	Mixed
Environmental impact	Low	Medium	Medium/High	High	Low/Medium

2.2.Selective Dissolution-Precipitation Plastic Recycling

2.2.1. Scientific studies

SDP has been widely studied in recent years, and comprehensive reviews by Zhao et al. (2018) and Aparício et al. (2025) summarize much of this work by highlighting the different types of plastics and conditions evaluated. Building on these reviews, the present study organizes and expands the available information by incorporating key parameters such as dissolution times and temperatures, separation methods, and polymer recovery percentage, to provide a more complete overview of the results reported in these studies. This approach allowed the construction of a more detailed comparative Table 2, which facilitates a clearer understanding of the conditions and outcomes reported across different studies.

Table 2: Compilation of Scientific Studies on SDP (Aparício et al., 2025; Zhao et al., 2018).

Solvent	Polymer	Time (min)	Dissolution Temperature (°C)	Separation Method	% Plastic recuperation	Ref.
1,4-Butanediol	PA	5	180	Distillation by temperature decrease for 120 °C	96.6	(Mu et al., 2024)
2-MeTHF	LDPE	15	75	Distillation by solvent boiling point	98	(Samorì et al., 2023)
	PVC	30	50	Precipitation by ethanol (N/A)	88	(Carner et al., 2020)
Acetone	ABS	30	RT	Precipitation by water (1:3)	N/A	(Lu & Chen, 2023)
Benzyl Alcohol	PET	30	180	Precipitation by methanol (1:3)	99	(Achilias et al., 2009)
Biodiesel	LDPE	20	150	Precipitation by ethanol (1:2)	99	(Achilias et al., 2009)
Chamomile Essential Oil	PS	15	RT	Precipitation by methanol (N/A)	95	(Gil-Jasso et al., 2019)
Chloroform	PC	N/A	RT	Precipitation by methanol (N/A)	95	(Achilias & Antonakou, 2015)
CPME	LDPE	30	70	Distillation by solvent boiling point	99	(Carner et al., 2020)
Cyclohexanone	LDPE	15	80	Distillation by solvent boiling point	99	(Samorì et al., 2023)
	PVC	N/A	40	Precipitation by ethanol (N/A)	N/A	(Grause et al., 2017)
Cyrene	PU	10	120	Distillation by temperature decrease for RT	N/A	(Boschmeier et al., 2023)

Solvent	Polymer	Time (min)	Dissolution Temperature (°C)	Separation Method	% Plastic recuperation	Ref.
DCM	PVDF	60	100	Distillation by temperature decrease for RT	N/A	(Bai et al., 2020)
	ABS	N/A	RT	Precipitation by methanol (N/A)	95	(Achilias & Antonakou, 2015)
	PC	N/A	RT	Precipitation by methanol (N/A)	95	
	PS	N/A	RT	Precipitation by methanol (N/A)	95	(Achilias & Antonakou, 2015)
	PVC	30	40	Precipitation by methanol (1:3)	90.5	(Achilias, Giannoulis, et al., 2009)
Dibutoxymethane	PP	30	90	Precipitation by methanol (1:2)	90	(Marshall et al., 2022a)
Dimethyl Isosorbide	PET	10	170	N/A	N/A	(H. Yu et al., 2023)
D-Limonene	PVDF	N/A	100	Precipitation by water (N/A)	N/A	(Buken et al., 2021)
	LDPE	20	90	Precipitation by ethanol (N/A)	N/A	(Escasa Karl Vincent et al., 2020)
	HDPE	10	110	Precipitation by ethanol (1:2)	87	(Aparício et al., 2024)
	PP	60	90	Reduce its thickness enough to enable mechanical removal	N/A	(Marshall et al., 2022a)
	PS	4	RT	Steam distillation with added water to strip limonene from the polymer solution	N/A	(Shikata et al., 2011)

Solvent	Polymer	Time (min)	Dissolution Temperature (°C)	Separation Method	% Plastic recuperation	Ref.
DMAc	PUR	10	120	Distillation by temperature decrease for RT	N/A	(Boschmeier et al., 2023)
DMF	PUR	10	120	Distillation by temperature decrease for RT	N/A	(Boschmeier et al., 2023)
DMSO	PA6	RT	125	Precipitation by MEK (1:3)	99	(Kartalis et al., 2002)
	PA 6	N/A	125	Precipitation by MEK (1:3)	97	(Kartalis et al., 2002)
	PUR	10	120	Distillation by temperature decrease for RT	N/A	(Boschmeier et al., 2023)
Dodecane	PE	30	110	Distillation by temperature decrease for RT	N/A	(Sánchez-Rivera et al., 2023)
Ethyl Acetate	ABS	50	70	Precipitation by ethanol (1:4)	94	(Ordonselli et al., 2023)
	PS	10	RT	Precipitation by ethanol (1:20)	N/A	(de Sousa Cunha et al., 2021)
Ethyl Benzoate	PET	N/A	200	Precipitation by ethanol (1:1)	N/A	(Hanschmann, 2023)
Eucalyptus Essential Oil	PS	15	RT	Precipitation by methanol (N/A)	95	(Gil-Jasso et al., 2019)
Formic Acid	PA 66	N/A	RT	Precipitation by MEK (1:3)	97	(Kartalis et al., 2002)
	PU	N/A	75	N/A	N/A	(Ügdüler et al., 2021)
HFIP	PET	N/A	RT	N/A	N/A	(Pulido et al., 2019)

Solvent	Polymer	Time (min)	Dissolution Temperature (°C)	Separation Method	% Plastic recuperation	Ref.
Methyl acetate	ABS	71	50	Precipitation by ethanol (1:4)	94	(Ordonselli et al., 2023)
NMP	PC	60	80	Precipitation by water (1:5)	99	(Ordonselli et al., 2023)
	PET	90	165	Precipitation by n-octane + n-hexane (N/A)	99	(Poulakis & Papaspyrides, 2001)
	PU	10	120	Distillation by temperature decrease for RT	N/A	(Boschmeier et al., 2023)
p-Cymene	PE	N/A	95	Precipitation by acetone (1:1)	78	(Gorre & Tumolva, 2020)
	PP	N/A	120	Precipitation by acetone (1:1)	94	(Gorre & Tumolva, 2020)
Star Anise Essential Oil	PS	15	RT	Precipitation by methanol (N/A)	95	(Shikata et al., 2011)
Terpinen-4-ol	PS	N/A	50	Precipitation by methanol (N/A)	98	(Shikata et al., 2011)
Terpinene (α and γ)	PS	N/A	50	Precipitation by methanol (N/A)	98	(Shikata et al., 2011)
Terpinolene	PS	N/A	50	Precipitation by methanol (N/A)	98	(Shikata et al., 2011)
Terpinyl Acetate	PS	N/A	50	Precipitation by methanol (N/A)	98	(Shikata et al., 2011)
Thyme Essential Oil	PS	15	RT	Precipitation by methanol (N/A)	95	(Shikata et al., 2011)

Solvent	Polymer	Time (min)	Dissolution Temperature (°C)	Separation Method	% Plastic recuperation	Ref.
TMO	PP	60	90	Reduce its thickness enough to enable mechanical removal	N/A	(Gil-Jasso et al., 2019a)
Toluene	ABS	90	100	Precipitation by ethanol (1:4)	94	(Ordonselli et al., 2023)
	LDPE	N/A	75	Precipitation by hexane (N/A)	98	(Hadi et al., 2012)
	HDPE	N/A	100	Precipitation by hexane (N/A)	98	(Hadi et al., 2012)
	PP	N/A	105	Precipitation by hexane (N/A)	98	(Hadi et al., 2012)
	PS	30	25	Precipitation by methanol (1:3)	94.1	(Hadi et al., 2012)
	PVC	30	50	Precipitation by methanol (1:3)	94.6	(Achilias et al., 2009)
Turpentine	LDPE	15	80	Precipitation by hexane (1:1)	99.4	(Hadi et al., 2013)
	HDPE	15	100	Precipitation by hexane (1:1)	92	(Hadi et al., 2013)
	PP	15	118	Precipitation by hexane (1:1)	98	(Hadi et al., 2013)
α-Pinene	HDPE	10	110	Precipitation by ethanol (1:2)	87	(Aparício et al., 2024)
γ-Valerolactone	PET	11	190	N/A	N/A	(Hanschmann, 2023)

N/A: Not Available RT: Room Temperature

To ensure clarity and comparability, only studies reporting complete dissolution in 90 minutes or less were considered, since longer processes are less practical, less energy-efficient, and less representative of conditions that could be realistically scaled up (Klotz et al., 2024). Whenever possible, this compilation prioritized the most up-to-date data, particularly when a given polymer had already been tested with different solvents, to ensure that the table provides the most current overview of achievable results. It is also important to note that priority was given to studies in which dissolution was carried out using a single solvent, avoiding solvent mixtures. The use of combined solvents increases the complexity of both polymer recovery and solvent reuse, making the process less straightforward and efficient. In cases where polymer separation was achieved through precipitation, the values presented in parentheses (e.g., 1:3) correspond to the volume ratio between the solvent and the antisolvent used to induce precipitation.

Several trends can be identified in the selection and application of solvents. A wide range of solvents has been tested, including conventional organic solvents (e.g., acetone, chloroform, DCM, toluene) as well as greener alternatives derived from natural sources (e.g., limonene, p-cymene, α-pinene, biodiesel, and essential oils). While the latter are particularly relevant from a sustainability perspective, their performance data are still limited, and in many cases recovery yields were not reported (Ikegwu, Munguía-López, et al., 2025).

In terms of processing conditions, dissolution times typically ranged between 10 and 60 minutes, though some studies reported near-instantaneous dissolution at room temperature (RT). Dissolution temperatures varied widely depending on the polymer–solvent pair, from RT up to 200 °C, with higher temperatures generally associated with crystalline polymers such as PET and polyamides.

Regarding separation methods, precipitation was the most frequently applied technique, generally induced by the addition of ethanol, methanol, or hexane as antisolvents. In several cases, the solvent: antisolvent ratio was specified, providing insight into the conditions needed for effective precipitation. Distillation based on solvent boiling point or temperature decrease was less common, but particularly relevant for solvents with lower miscibility with typical antisolvents (Mu et al., 2024).

The reported recovery plastic percentage varied considerably, from below 90% to nearly quantitative values (>99%). High recoveries were commonly observed for LDPE, PS, and PET in single-solvent systems, whereas in some cases no yield was provided, reflecting

that the primary goal of the study was proof-of-concept dissolution rather than efficiency evaluation.

Overall, this dataset highlights both the versatility and limitations of dissolution–precipitation recycling. While it demonstrates the feasibility of recovering high-quality polymers under relatively mild conditions, it also underlines the need for further systematic studies, especially using greener solvents and standardized recovery protocols, to better evaluate the scalability and environmental impact of this process.

2.2.2. Commercial developments

The interest in SDP for plastic recycling has grown mainly in recent years, although early technological developments have existed for several decades, as reflected in patents published by certain companies. In 1949, researchers at Standard Oil Development Company disclosed a technique in which polyesters could be purified by dispersing them in paraffinic mineral oils, allowing high–molecular weight fractions to be selectively separated (Young & Sparks, 1949). In the 1970s, DuPont pursued similar concepts for handling thermoplastic offcuts, reporting the solubilization of PET, poly(hexamethylene adipamide), poly(acrylonitrile), and poly(oxymethylene) in hexafluoroisopropanol to facilitate recovery (Teti, 1972). In addition, Sidebotham (1977) proposed another approach for reclaiming fiber-derived polymers such as PET, poly(cyclohexanedimethanol terephthalate), and poly (butylene terephthalate). Their method relied on naphthalene to dissolve the target resins, followed by precipitation triggered through the addition of antisolvents including dimethylformamide, water, or acetone. Although the patents might suggest that companies engaged with SDP in the past, there is no record to show that any of the companies moved past the research phases. They seem to have remained isolated technical proposals rather than established recycling routes. It was only in later years that SDP moved beyond the patent literature, with companies beginning to demonstrate its feasibility at an industrial scale.

VinyLoop®, developed by Solvay, can be considered one of the pioneering commercial companies to use SDP, focusing on recovering PVC from composite waste materials. Their technology involved dissolving PVC in methyl ethyl ketone (MEK), often with n-hexane as a co-solvent, followed by precipitation of the polymer using water vapor (Grause et al., 2017; Kelly et al., 2005). The recycled PVC obtained using this method exhibited quality and consistency comparable to virgin resin (Chanda, 2021). The first plant with a capacity to recover 10,000 tons of PVC was installed in 2002 in Ferrara, Italy, and for over a decade demonstrated the technical feasibility of commercial solvent recycling, recovering approximately 48,743 tons of PVC during the 2002-2016 period, according to its annual reports (VinyLoop, 2010). It was so successful that in 2006, Japanese companies invested in this technology, installing a plant in the city of Futtsu with recycling capacity of 18,000 tons of PVC (Trade Flows & Cultural News, 2006). However, operations at the Ferrara plant were discontinued on June 28, 2018, (Kunststoff Information, 2018). The underlying cause

was regulatory, rather than technological: starting in 2015, the European REACH framework required strict authorization for the use of phthalates such as DEHP, the most widely used PVC plasticizer. Since a substantial portion of available PVC waste streams contained DEHP and other traditional plasticizers, process-compatible feedstock became increasingly limited, limiting both input availability and market acceptance of recycling. Unable to adapt its process and product portfolio to these regulatory changes, VinyLoop® eventually ceased operations (Sherwood, 2020; Vogel et al., 2023).

In 2013, Newcycling entered trial operation managed by the German company APK AG. According to the patent, the New Cycling process can separate polymers from multilayer packaging that also contains aluminum foil by stepwise dissolving PE and PP in a solvent mixture from a group of alkanes, isooctane, or cycloalkanes while increasing the temperature. In 2017, the company plans to start producing more than 10,000 tons a year of pure granules with properties like virgin plastics. Moreover, in 2021, APK's Merseburg plant reached a recycling capacity of 20,000 tons per year, obtained EuCertPlast certification, and successfully integrated post-consumer film waste from household collectors into its operations. According to the company, the initial processing pilot phases delivered "excellent" results, demonstrating smooth operation, strong throughput, and high mechanical recycling performance (Global Recycling, 2021). The company plans to build about eight plants in Europe by 2030 to apply New Cycling on a large scale (Pestana et al., 2021). In the most recent news, at the end of 2024, LyondellBasell (LYB) acquired APK AG, fully integrating it into its Circular & Low Carbon Solutions division. This acquisition supports LYB's broader goal of producing and marketing at least 2 million tons of recycled and renewable-based polymers by 2030 (Recycling Today, 2024).

In collaboration with Creacycle GmbH, the Fraunhofer Institute for Process Engineering and Packaging IVV developed the CreaSolv® process which has undergone testing for a variety of applications and plastics including post-consumer polyolefins, PS, and PET; styrene copolymers from electrical devices; and EPS from insulation materials (Ardolino et al., 2021). Beyond the lab-scale tests, the Fraunhofer Institute and its partners have implemented many demonstrations and pilot prototypes across Europe and Asia as outlined in Table 3.

Table 3: Overview of CreaSolv® Pilot and Demonstration Plants (Ardolino et al., 2021).

Project	Start Operation	Close Operation	Target plastic	Estimated capacity	Current Status
PolyStyreneLoop	2021	N/A	EPS/XPS with HBCD (insulation)	3,300 t/year (~5 t/week in 2024)	Commercial success
Circular Flooring	2020	2023	PVC flooring with phthalates	15–20 kg/h (prototype)	Pilot proven, not commercialized
MultiCycle	2018–2019	2022	Multilayer packaging (polyolefins, PET)	700 t/year (pilot)	Pilot proven, not commercialized
Unilever	2018	2020	Multilayer sachets (flexibles)	Not reported (pilot plant)	Commercial failure

The outcomes of these projects, as the table demonstrates, are varied. Having a clear success, PolyStyreneLoop in the Netherlands, has demonstrated tangible success in efficiently recovering and recycling complex materials such as EPS/XPS without containing plasticizers banned by European regulations. This has facilitated its implementation on an industrial scale (Wagner & Schlummer, 2024). One project led by Unilever in Indonesia highlights the difficulty of scaling in low-value waste streams, for it ultimately failed due to the collection of multilayer sachets being economically and logistically unfeasible (Soemadijo et al., 2022). The Circular Flooring and MultiCycle projects demonstrated in their pilot tests that multi-layer packaging and PVC flooring can be properly recycled using the CreaSolv process. However, as it was only created to verify its viability, these projects remained mere prototypes. With private investment, operations can be resumed on an industrial scale (Martinez Sanz et al., 2022). Overall, these examples show both the achievements and challenges faced by CreaSolv during this time.

On the other hand, PureCycle Technologies, in collaboration with Procter & Gamble (P&G), has developed a patented SDP process that has been able to purify and recycle post-consumer PP, obtaining a product remarkably similar to virgin resin (Xu et al.,

2025). The company has not specifically disclosed the solvents used in its commercial process; however, one of the patents filed by P&G for treating contaminated PP mentions n-butane or propane at controlled application temperatures (between 80 °C and 220 °C) and elevated pressure (typically above ambient pressure and up to 6.9 MPa), then recovers the polymer by evaporation/boiling and recirculation of the solvent, without using antisolvents (Williams & Weymouth, 2017). Among its most relevant achievements are: in 2017, its first pilot plant was inaugurated in Lawrence County, Ohio (USA), to verify the viability of the process with various streams of plastic waste; it was not until 2019 that discarded carpets could be successfully transformed on an industrial scale, with estimates of producing nearly 47,600 tons of virgin-like PP per year (PureCycle, 2019). This served as the technical basis for venturing into a commercial plant. Thanks to the technical foundation obtained in the pilot plant, PureCycle formally announced the development of its commercial plant in Ironton, Ohio (USA), which was completed in December 2022. Currently, the company has only reported results for 2025, producing 1,542 tons of pure resin, with initial commercial revenues of $1.6 million (PureCycleTechnologies, 2025). The company has also announced the company's global growth plans which are further enabled by their $2 billion investment in creating additional facilities in Thailand, Europe and the United States where PureCycle plans to reach an estimated total capacity of 450,000 t/y by 2030 (Tullo, 2025). This is good news for the development of more similar projects because it demonstrates the economic and technical viability of SDP.

Founded in 2011, Polystyvert Inc.’s patented SDPR technology enables the recycling of post-consumer and post-industrial PS into a resin of comparable quality to virgin resin (H. Li et al., 2022). The solvent used for dissolving PS is p-cymene. This solvent prioritizes the concept of sustainability by being classified as a green solvent of natural origin that is friendly to the environment. In addition, the temperatures required to dissolve plastics are relatively low compared to other similar SDP processes, which is a benefit in economic and energy terms (Kara Ali et al., 2023). In 2018, Polystyvert inaugurated its first pilot plant in Anjou, Montreal, Canada with a capacity of about 600 tons per year to test the technology with various waste streams, including EPS (Polystyvert, 2018). Tullo (2023) reports that due to the results obtained with the pilot facility, the firm announced in 2023 the construction of their first full-scale commercial plant in Greater Montreal, Canada with an investment of $40 million, and an expected

operational capacity of 9,000 tons per year by 2026. Polystyvert is also diversifying its platform through a $3 million pilot project on ABS recycling and has recently rebranded its process under the UpSolv platform to expand applications to additional thermoplastics such as PE, PP and PC (Bioplastic magazine, 2025). Worn Again Technologies, founded in London in 2005, has developed a recycling process based on selective solvent dissolution (SDP) to simultaneously recover polyester (PET) and cellulose from mixed textile waste such as poly-cotton fabrics. The technology allows the PET dissolved in a proprietary solvent to be separated and purified, removing dyes, additives, and contaminants, and recovered as virgin-quality recycled resin through evaporation/precipitation and solvent recirculation. At the same time, the cellulose is obtained as pulp suitable to produce new fibers (Enking et al., 2025). The company has not publicly disclosed the formulation used in its process for reasons of confidentiality; however, some of its patents mention compounds such as methyl benzoate or 1,3-dimethyl-2-imidazolidinone (DMI) as selective solvents for PET. As for polymer recovery, these patents mainly describe the evaporation of the solvent under vacuum with recirculation, although the option of precipitation by cooling the system is also considered (Worn Again Tech, 2019). After years of laboratory research, the company opened a demonstration plant in 2019 with the support of strategic partners such as Sulzer Chemtech, H&M Group, and Kering (Worn Again Technologies, 2018). In 2022, the company, in partnership with Sulzer Chemtech, announced the construction of a demonstration plant in Winterthur, Switzerland, with a capacity of around 1,000 tons per year, aimed at validating its textile recycling technology on an industrial pilot scale (Sulzer, 2022). Subsequently, in 2025, the company presented the Textile-to-Fibre Accelerator concept, an advanced demonstration facility designed as a bridge to the commercial and industrial adoption of its process, marking the transition from the pilot stage to global scaling (Worn Again Technology., 2025). Although still in the study stages, it is a good sign that they are moving forward with advanced demonstrations.

In summary, although early SDP remained limited to patents and laboratory concepts, in recent years several companies have advanced to the industrial scale, positioning SDP as a viable commercial model. The industrial record shows both successes and failures. VinyLoop® demonstrates that it can achieve commercial success, but also how regulatory bans can determine continuity. Unlike PureCycle, which was able to achieve technical viability and reach the commercial stage with reports on its production and

profits by complying with the regulations that led to VinyLoop® ceasing operations. Beyond these cases, it is noteworthy that other companies analyzed in this chapter have already moved beyond pilot demonstrations and are currently in the process of constructing commercial-scale plants. A persistent limitation is the confidentiality surrounding the technology developed and the solvent selection in the final stage; however, patent literature provides enough evidence to infer solvent applied and understand their operating principles. Therefore, the coming years will be decisive for all companies involved in this field of plastic recycling, as long-term economic viability will determine whether SDP will consolidate its role as a sustainable and competitive industrial and commercial route. Finally, Table 4 shows an overview of the commercial developments analyzed in this chapter.

Table 4: Overview of Commercial developments (H. Li etal.,2022; WornAgainTech,2019).

Company / Process	Plastic treated	Solvents used	Recovery plastic method	Status
VinyLoop®	PVC	MEK, n-hexane	Precipitation	Commercial failure
APK AG – Newcycling	PE, PP (multilayer with aluminum; post-consumer films)	Alkanes, isooctane, cycloalkanes	Precipitation or Evaporation	Pilot proven, not commercialized
Fraunhofer IVV – CreaSolv®	EPS/XPS (HBCD), PVC (flooring), multilayers (polyolefins/PET)	Proprietary formulation	Precipitation or Evaporation	Mixed results (Table 3)
PureCycle Technologies	PP (post-consumer: carpets, residues)	n-butane or propane	Evaporation	Commercial success
Polystyvert Inc.	PS (post-consumer & industrial, including EPS)	p-cymene	Precipitation	Pilot proven, not commercialized
Worn Again Technologies	Polyester-cotton textiles: PET + cellulose	Methyl benzoate, DMI	Evaporation	Pilot proven, not commercialized

2.3.Green Solvents

The global commitment expressed in SDG 12 of the 2030 Agenda requires responsible management of chemicals and a substantial reduction in waste generation (Sah et al., 2025). In line with this objective, SDP is a process whose sustainability depends largely on the choice of solvent. In fact, the solvent not only enables the selective dissolution of the target polymer, but also determines the amount of waste generated, the efficiency of recovery, and the potential impacts on human health and the environment (Srivastava et al., 2023).

In this context, Winterton (2021) compile and review the existing literature on the background of the concept, analyzing how the notion of "green" solvents arose and what criteria have historically been used to justify them. Following this approach, the author then discusses different families of compounds often promoted as green solvents (water, ionic liquids, deep eutectic solvents, bio-based solvents, and supercritical CO_2) placing their supposed advantages into context.

The author remarks that the term "green solvent" must take into account multiple aspects such as production, use, recycling, and final disposal, and not only its toxicity or biodegradability, perhaps these must be carefully analyzed to determine whether a solvent can truly be considered green. For example, ionic liquids can present problems of toxicity, biodegradability, and high production costs, yet despite these facts, they are called green solvents (Maciel et al., 2019). That is why it is important to use the term "green solvent" with accuracy, as it can be used as a buzzword or a form of greenwashing. This critical reflection naturally raises a key question: after reviewing the terminology and its potential misuse, what should define a green solvent, and which criteria, parameters, or scientific evidence should support this definition?

Capello et al. (2007) introduced a multi-criteria framework to assess the ecology of a solvent by combining Environmental, Health and Safety (EHS) assessment with life cycle assessment (LCA). The EHS method assigns scores in nine categories: safety (flammability, reactivity, release potential), health (acute and chronic toxicity, irritation), and environment (persistence, air and water hazards) to capture the intrinsic risks of each substance. In parallel, the LCA quantifies the cumulative energy demand and emissions associated with solvent production, their recovery by distillation, and their disposal by incineration, thus reflecting the indirect environmental burden of a solvent's life cycle.

The results of both assessments are integrated and presented in comparative tables and a diagram EHS method vs LCA method (Figure 3). This representation provides a practical basis for identifying which solvents can be considered truly "green" in comparison to conventional alternatives.

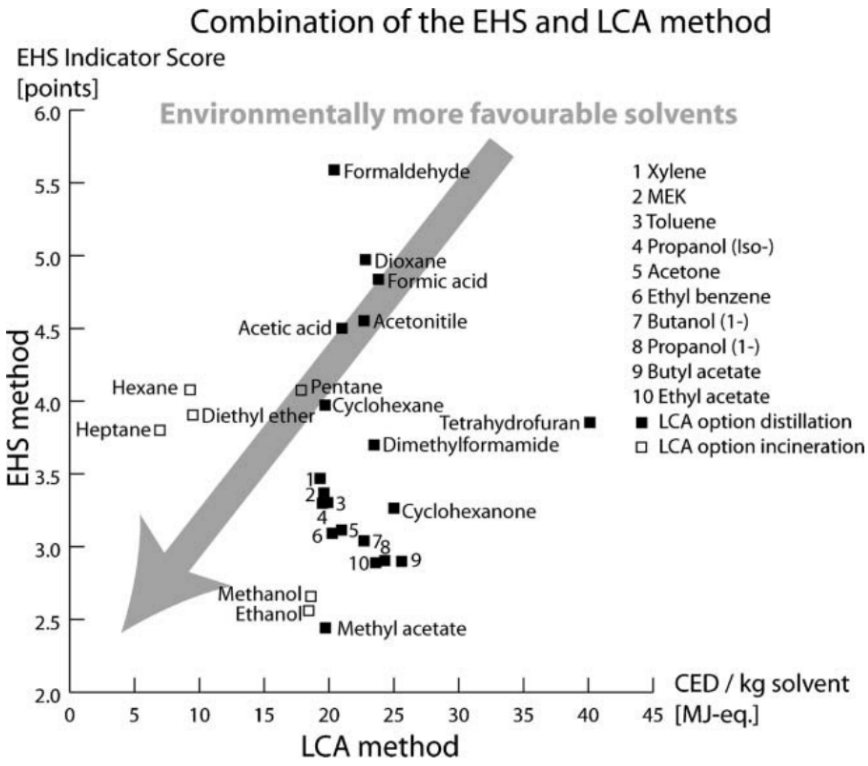


Figure 3: Environmental assessment of the 10 organic solvents: combination of the EHS method Gu & Jérôme (2013).

Gu & Jérôme (2013) and their work are considered a key starting point in the modern discussion on green solvents, as it was one of the first to explicitly formulate 12 specific criteria that must be taken into account when evaluating the "greenness" of a solvent. These criteria, inspired by the 12 principles of green chemistry (Anastas & Warner, 1998) (Table 5), are summarized in Figure 4 and sought to bring greater rigor to a term that had previously been used quite loosely. An interesting aspect of the article is that the authors focused their attention on bio-based solvents as a new generation with eco-efficient potential. When applying the 12 criteria, they observed that biomass-derived compounds such as glycerol, ethyl lactate, and limonene showed significant advantages in areas such as renewability, low toxicological impact, and biodegradability, although they also presented challenges related to purity, stability, and production costs (Albasri & Adham, 2025). This critical view allowed them to conclude that, although no solvent perfectly

meets all 12 criteria, bio solvents offer a promising path toward more sustainable processes, provided they continue to be evaluated holistically.

Table 5: 12 principles of green chemistry (Anastas & Warner, 1998).

No.	Principle	Description
1	Prevention	It is better to prevent waste generation in order to reduce the harm caused by waste to the environment.
2	Atom economy	Designing a reaction method to maximize the number of product atoms and reduce the number of by-product atoms, to reduce waste to the environment.
3	Less hazardous chemical syntheses	Chemical reaction conditions should be designed to use hazardous substances to a minimum extent to prevent harm to human health.
4	Safer chemical design	Products should be designed to be as effective as possible while at the same time reducing their hazardous characteristics.
5	Use of safe solvents and auxiliaries	The use of additional agents such as solvents, separation agents, or auxiliary chemicals should be avoided or minimized as much as possible; if used, they should have minimal toxicity and environmental impact.
6	Energy efficiency	The process should reduce energy consumption by being carried out at low temperature and pressure or under environmentally friendly conditions.
7	Use of renewable materials	Raw materials should be renewable instead of being depleted; waste products should be used as input materials for chemical processes if possible.
8	Reduction of derivatives	The need for additional chemicals such as protective groups should be avoided as much as possible to reduce the use of auxiliary materials.
9	Catalysis	Instead of using stoichiometric reagents, catalysis should be used to ensure higher selectivity and lower consumption of auxiliary materials.

No.	Principle	Description
10	Degradation product design	Chemical products should be designed in such a way that they degrade after use into non-harmful degradation products that do not pollute the environment.
11	Analytical methods for pollution prevention	Development of real-time analytical methods in order to control and monitor chemical reactions, prevent the formation of hazardous substances, and ensure process efficiency.
12	Accident risk prevention	Chemicals and chemical processes should be selected to minimize the potential for chemical accidents, such as leaks, explosions, and fires.

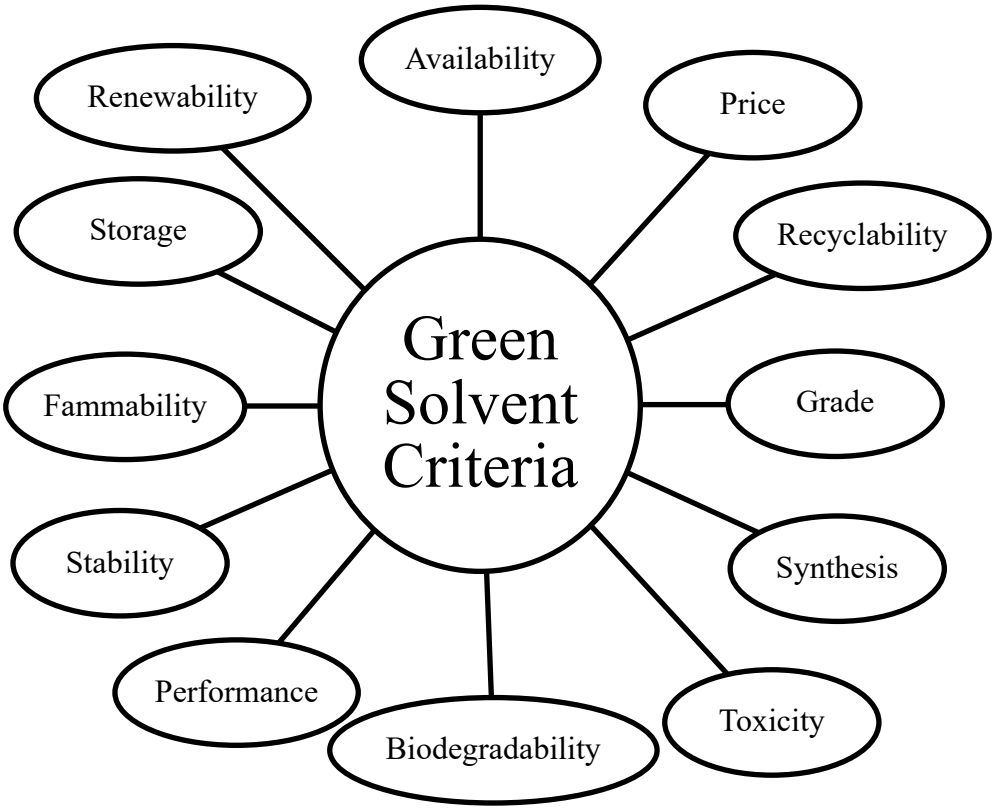


Figure 4: Green Solvent Criteria by (Gu & Jérôme, 2013).

Cseri & Szekely (2019) focused on evaluating the sustainability of PolarClean (a biodegradable polar aprotic solvent) as a greener alternative to toxic aprotic solvents such as DMF, DMAc, or NMP. To determine whether it can be considered an environmentally friendly solvent, they applied quantitative green chemistry metrics such as atomic economy (AE) to measure how efficiently atoms are used in the synthesis, comprehensive E factor (cEF) to quantify how "clean" the process is and link it to the generation of waste that will affect the environment, and carbon intensity (CI) to evaluate the climate and energy impact, along with an assessment of the hazards of the reagents used in its synthesis. By comparing different industrial and novel synthetic routes, they demonstrated that conventional multi-step processes offer poor performance, while a newly designed one-step route significantly improves all metrics: AE increases, cEF is reduced by up to 80%, and CI by nearly 90%, while eliminating the use of hazardous reagents. In this case study, the solvent was declared green because it performed better than conventional solvents.

Finally, there are several Solvent Selection Guides (SSG) created by companies such as Pfizer, Sanofi, and GlaxoSmithKline (GSK) and specialty groups such as the ACS Green Chemistry Institute Pharmaceutical Roundtable (GCI-PR) and Innovative Medicines Initiative (IMI)-CHEM21 to help scientists and industries choose solvents in an informed manner, minimizing risks and maximizing sustainability (Clarke et al., 2018). The metrics are generally divided into safety (process), human health, and environmental categories. GSK has also added categories for waste generation and life cycle assessment (Soh & Eckelman, 2016).

Most companies have a similar vision of safety, health, and environmental hazards, as well as industrial constraints, so one may consider that the overall rankings will be similar. However, the cultures, and particularly the approaches to constructing the guides differ. For instance, in AstraZeneca's guide, environmental issues are represented by seven criteria (Tobiszewski et al., 2015). The comparison is further complicated by the fact that only the Pfizer and Sanofi guides explicitly provide a clear preference ranking for solvents, whereas other guides do not specify this hierarchy as clearly. The "CHEM21 Solvent Selection Guide" was developed separately, based on existing solvent selection guides and Safety, Health, and Environment (SHE) criteria aligned with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) and European regulations (Prat et al., 2015).

Pfizer's guide includes three categories (preferred, usable, undesirable), while Sanofi's guide defines four, including a list of "banned" solvents. GSK also maintains a list of solvents not to be used on their internal solvent selection site, and these were excluded from early versions of their solvent guide (Henderson et al., 2011).

A common feature across all these SSGs is the use of a color-coded system (typically green, yellow, and red) to provide an intuitive visual ranking of solvent desirability. This facilitates comparison, although the application differs slightly among companies for example, Pfizer's three-tier scale maps directly to green, amber, and red, whereas Sanofi includes an additional category, creating a more nuanced gradation.

Summarizing, Table 6 shows the criteria repeated in the main SSGs, and Table 7 presents the key characteristics of the principal selection guides (Alfonsi et al., 2008; Henderson et al., 2011; Prat et al., 2013, 2015; Tobiszewski et al., 2015).

Table 6: Criteria for green solvent form different Solvent Guides (Alfonsi et al., 2008; Henderson et al., 2011; Prat et al., 2013, 2015; Tobiszewski et al., 2015).

SSG / Criteria	Pfizer	Sanofi	GSK	AstraZeneca
Flammability	X	X	X	X
Explosion Risk	X	X	X	
Vapor pressure (emissions)	X	X	X	
Electrical Conductivity/Static charge	X	X	X	X
Peroxide formation potential	X	X	X	
Carcinogenicity	X	X	X	X
Mutagenicity	X	X	X	X
Reprotoxicity	X	X	X	X
Skin absorption/Sensitization	X	X		X
Acute toxicity	X	X		X
Hazard: Boiling Point		X		
Water Contamination	X			X
Ecotoxicology	X		X	
Ozone depletion	X	X		
Impact in Air		X		X
Biodegradability		X	X	

Table 7: SSG main characteristics (Alfonsi et al., 2008; Henderson et al., 2011; Prat et al., 2013, 2015; Tobiszewski et al., 2015).

Guide	Number of solvents	Parameters				Classification Method		
		Process Safety	Human Health	Environment	LCA	Appropriate solvents	Impartial solvents	Inappropriate solvents
Pfizer	39	1	1	1	No	Preferred	Usable	Undesirable
AstraZeneca	46	2	1	6	Yes	1-3	4-7	8-10
GlaxoSmithKline	110	2	1	2	Yes	Few known issues	Some known issues	Major known issues
ACS GCI-PR	63	1	1	3	No	1-3	4-7	8-10
Sanofi	96	1	1	1	No	Recommended	Substitution requested	Substitution advisable / Banned
CHEM21	75	1	1	1	No	Recommended / Recommended or problematic?	Problematic / Problematic or hazardous?	Hazardous / Highly hazardous

In summary, the literature review shows that the concept of green solvent is complex and depends largely on the context and criteria used to evaluate it. This means that defining a solvent as 100% green is a complex challenge, but also an opportunity to continue building more inclusively. Gu & Jérôme (2013) shows us perhaps one of the most holistic methodologies for determining how green a solvent is, as it combines several dimensions: environmental, economic, technological, and safety/health. Among the recommendations that could improve this methodology is the need to find a way to quantify the criteria. For example, it is not possible to assume that all criteria have the same degree of importance; some may have greater or lesser weight when evaluating a solvent. In addition, proposing measurable and comparable indicators for each criterion would allow for a greater degree of objectivity and quantification.

For example, the parameters used in Cseri & Szekely (2019) can help quantify some criteria. AE and cEF are best suited to quantify the Synthesis criterion, as they directly capture the efficiency of the reaction pathway and the amount of waste generated. In turn, Carbon Intensity CI aligns most naturally with the Renewability criterion, since it reflects the carbon footprint associated with the raw materials and energy inputs used in solvent production. LCA criteria provide clear indicators of resource consumption and emissions throughout the life cycle, which directly aligns with criteria such as renewability, recyclability, and synthesis efficiency (Bisinella et al., 2021; Capello et al., 2007). On the other hand, the information derived from the EHS of SSGs facilitates the evaluation of aspects related to toxicity, biodegradability, flammability, stability, and storage conditions, since these risks are intrinsic to the solvent and can be measured using experimental or regulatory parameters. Moreover, data provided by solvent selection guides (SSGs) on EHS aspects give a useful picture of hazards criteria such as toxicity, biodegradability, flammability, stability, and storage requirements (Alfonsi et al., 2008; Henderson et al., 2011; Prat et al., 2013, 2015; Tobiszewski et al., 2015). These properties are intrinsic to the solvent and can usually be tracked through experimental tests or official safety classifications. At the same time, adopting the color-coded ranking widely used in industry could make the evaluation far more accessible. A simple visual scale helps distinguish solvents that are preferable from those that should be restricted or avoided, adding clarity and making the framework easier to apply in research environments as well as in industrial decision-making.

2.4. The Hierarchical Analysis Process (AHP)

The Analytic Hierarchy Process (AHP), developed by Thomas L. Saaty (Wind & Saaty, 1980), is a multicriteria decision analysis (MCDA) methodology designed to identify the most appropriate solution when multiple evaluation criteria must be considered. Its main strength lies in its ability to integrate subjective judgments with objective measures within a single analytical framework (Pinheiro & de Mello Sant́Ana, 2025).

Consistent with these applications, understanding the hierarchical structure of the method is key to appreciating how AHP integrates criteria and alternatives into a logical decision-making process. The method structures the problem as a hierarchy: the overall goal is placed at the top, the evaluation criteria are defined in the intermediate levels, and the set of alternatives is located at the bottom (Alipour et al., 2022). The AHP method begins with the first stage constructing a decision hierarchy, organizing the overall goal, *n* criteria, and *m* alternatives into a structured model, as illustrated in Figure 5. The hierarchy is constructed so that the elements at each level are of comparable magnitude and can be related to some or all the elements at the next level. For these reasons, AHP has become one of the most effective and widely applied methods in MCDA (Grošelj et al., 2024).

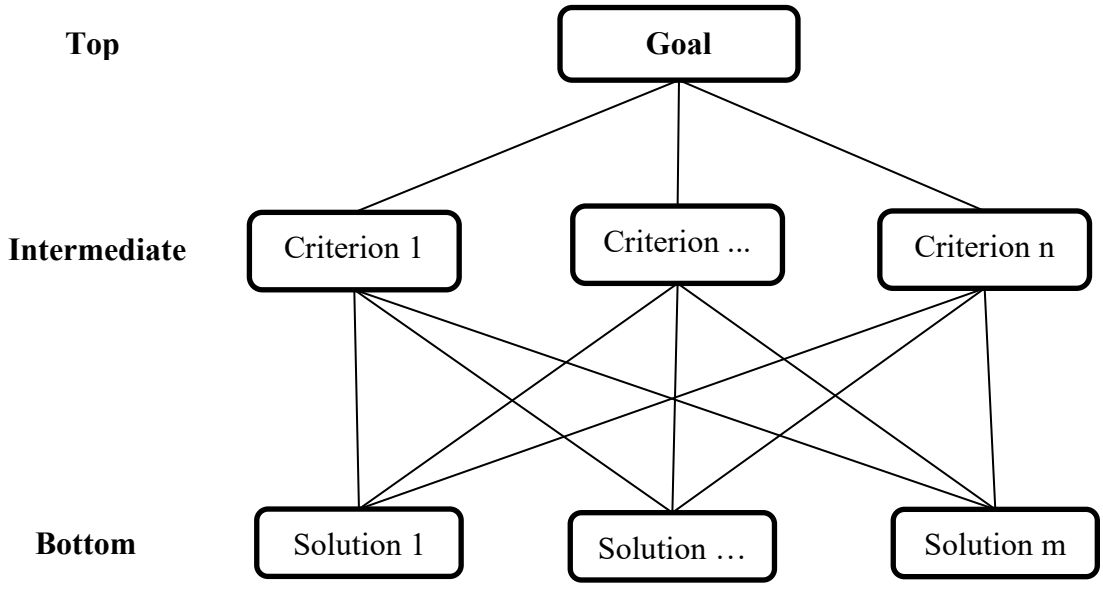


Figure 5: Hierarchical structure of AHP (Chaube et al., 2024; R. W. Saaty, 1987).

Once the hierarchical model has been constructed, the second stage of the AHP methodology begins: the assessment of the elements or evaluation of the hierarchy. To carry out this step, pairwise comparisons are made between the different elements. The procedure involves comparing, in pairs, all the elements associated with a given node at the higher level in order to establish a preference order among the evaluated elements with respect to their predecessor.

Pairwise comparisons in the Analytic Hierarchy Process (AHP) are performed using the numerical scale proposed by Saaty, which ranges from 1 to 9. This scale is based on the premise that experts' assessments and preferences can be represented by numerical values, thus allowing the quantification of each element's contribution within the hierarchy relative to the level immediately above it (T. L. Saaty, 2002). Table 8 shows the Saaty´s scale.

Table 8: Saaty's scale by (R. W. Saaty, 1987).

Intensity of importance	**Definition**
1	Equal importance
3	Moderate importance
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values
Reciprocals	Values for inverse comparison

A pairwise comparison matrix A of size $n \times n$ is used to represent the relative importance among a set of (n) criteria through comparative judgments. In this matrix, where, $i, j \in \{1,2,\ldots,n\}$, each element a_{ij} represents how strongly the criterion in row i is preferred over the criterion in column j, using Saaty's fundamental scale of 1 to 9. The elements on the main diagonal $(a_{11}, a_{22}, a_{33}, \ldots, a_{nn})$ are always equal to 1, since a criterion compared to itself has equal importance. Furthermore, the matrix satisfies the reciprocity property, such that each comparison satisfies the relation $a_{ij} = 1/a_{ji}$; that is, the elements below the main diagonal are the reciprocals of the corresponding elements above it. This reciprocal structure guarantees the logical consistency of the judgments made. Equation 1 shows the pairwise

comparison matrix A. Pairwise comparisons are an essential element of AHP, as they allow complex problems to be broken down into simple and systematic evaluations, thus improving the accuracy and reliability of expert assessments (Fernando et al., 2019).

$$M_A = \begin{vmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2n} \\ . & . & . & \dots & a_{3n} \\ a_{n1} & a_{n2} & a_{n3} & \dots & a_{nn} \end{vmatrix} \qquad \textbf{Equation 1}$$

For the third stage, the weights of the criteria are calculated using the eigenvalue method.

The procedure can be summarized as follows:

- Summation of the values in each column of the pairwise comparison matrix.
- Division of each element by the total of its column to obtain the normalized matrix.
- Calculation of the average of each row in the normalized matrix. The resulting averages form the Relative Weight Vector.

To do this, Equation 2 is applied:

$$A\, w^* = \lambda_{\max} w^* \qquad \textbf{Equation 2}$$

where $\lambda_{\max}$ corresponds to the largest eigenvalue of the comparison matrix (also called the principal eigenvalue) and w^* is the associated principal eigenvector. Subsequently, the components of this eigenvector are normalized so that their sum equals one, thus obtaining the final weights of the criteria. This process is expressed mathematically in Equation 3:

$$w_i = \frac{w_i^*}{\sum_{i=1}^{n} w_i^*} \qquad \textbf{Equation 3}$$

where w_i is the normalized weight of criterion i, w_i^* is the estimated weight obtained from the normalized matrix, and n is the total number of criteria.

Final stage, an essential aspect of the AHP methodology is the Consistency Analysis, which ensures that the pairwise judgments made by the decision-makers are logically coherent. Because these comparisons are based on human judgment, achieving perfect consistency is extremely difficult. However, AHP tolerates moderate inconsistency; problems arise only when inconsistency becomes excessive, as it indicates a lack of understanding of the method

and can lead to unreliable results. To evaluate consistency, Saaty introduced the Consistency Ratio (CR), defined in Equation 4:

$$\boldsymbol{CR = \frac{CI}{RI}} \qquad \textbf{Equation 4}$$

where CI is the Consistency Index, representing the degree of deviation from perfect consistency, and RI is the Random Index, which depends on the matrix size (n).

The Consistency Index is calculated in Equation 5:

$$\boldsymbol{CI = \frac{\lambda_{max} - n}{n-1}} \qquad \textbf{Equation 5}$$

where $\lambda_{max}$is obtained from the equation 2, and n is the number of elements in the matrix.

The values of the Random Index (RI) for different matrix sizes are typically obtained from Saaty's empirical table. Once the Consistency Ratio is computed, results are considered acceptable if CR ≤ 0.10. Values above this threshold indicate inconsistent judgments, and the pairwise comparisons should be reviewed, focusing particularly on those most responsible for the inconsistency.

Pairwise comparisons are an essential element of AHP, as they allow complex problems to be broken down into simple and systematic evaluations, thus improving the accuracy and reliability of expert assessments (Fernando et al., 2019).

3. Methodology

This chapter describes the methodology for each criterion to be applied for solvent selection in SDP plastic recycling.

In accordance with the objective of this study, the first criterion presented, solubility, was selected as the project's main scientific basis, not only for its inherent relevance to SDP recycling process, but also because, through the use of Hansen's Solubility Parameters (HSP), it is possible to systematically quantify and compare the affinity between the polymer and the solvents evaluated. The HSP approach will be the methodology for evaluating this criterion, as it allows the solubility phenomenon, traditionally treated qualitatively, to be translated into a set of measurable physicochemical parameters, facilitating the theoretical identification of each solvent's dissolving capacity. In this context, the solubility criterion acquires a practical, objective, and scientifically sound character, justifying its selection as the central axis for the evaluation and comparison of solvents for this project (Novaes et al., 2023). Subchapter 3.1 explains the methodology of this criterion in more detail.

For the second criterion the hazard assessment of the solvents will be carried out within the framework of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) of the United Nations (UN), which serves as the fundamental framework for the global identification and communication of chemical hazards. The GHS classification system provides standardized hazard categories that are directly derived from health, physical, and environmental data. The selection of GHS as the basis for the hazard criterion is primarily motivated by its strong alignment with widely used Solvent Selection Guides (SSG), as discussed in Subchapter 2.3. Some established SSGs are fundamentally built upon GHS hazard classifications, reorganizing and weighting GHS-based information to support solvent comparison and selection in chemical process design (Prat et al., 2014, 2015). Subchapter 3.2 explains the methodology of this criterion in more detail.

Finally, the third criterion, solvent price, was selected to represent the project's economic factors. It will be a more direct parameter, using the price of each solvent analyzed (euros per liter), reflecting the realities of the local market in Portugal. This criterion addresses the need for a clear, direct, and comparable indicator for the different solvents evaluated. Subchapter 3.3 explains the methodology of this criterion in more detail.

The choice of the solvents listed in Table 9 was based primarily on the HSP method, where theoretically the solvents presented a dissolution potential for the 5 most common types of plastics that were chosen for this project. Additionally, it also depended on other factors such as price, and, as far as possible, that they be of organic origin and have real availability from local suppliers, in order to put the theory into practice in future projects through laboratory tests. In order to facilitate a clearer and more straightforward interpretation of the results, abbreviations were introduced for easier reference throughout the analysis. Table 9 presents the abbreviations used for the 18 solvents, 5 polymers, and the criteria selected in this work. This approach ensures a simpler and more consistent handling of the information in the subsequent discussion.

Table 9: Abbreviation list for this work.

Abbreviation	Polymer/Solvent	Abbreviation	Criterion
P1	Polystyrene (PS)	Cr1	Solubility
P2	Polyethylene (PE)	Cr2	Hazard
P3	Propylene (PP)	Cr3	Cost
P4	Polyethylene terephthalate (PET)		
P5	Polyvinyl chloride (PVC)		
S1	Anisole		
S2	Triacetin		
S3	Terpineol		
S4	Limonene		
S5	p-Cymene		
S6	Dimethyl isosorbide (DMI)		
S7	2-Methyltetrahydrofuran		
S8	γ-Valerolactone		
S9	Eucalyptol (1,8-Cineole)		
S10	Methyl lactate		
S11	Diacetin		
S12	Estasol (DBE)		
S13	Trifluoroacetic acid (TFA)		
S14	Hexafluoro-2-propanol		
S15	o-Chlorophenol		
S16	1,2,3,4-Tetrahydronaphthalene		
S17	Ethyl benzoate		
S18	Cumene		

3.1.Solubility

The methodology used for the criterion of solubility is developed through the following steps:

1. Collection of three-dimensional Hansen Solubility Parameters (HSP) for the selected solvents and polymers.
2. Application of the HSP methodology to calculate the Relative Energy Difference (RED) values.
3. Definition of solubility levels based on the RED values.
4. Application of the AHP methodology to compare solvent solubility for a given polymer,

Based on Hildebrand's work, the history of HSP methodology can be traced back to 1967, when in his doctoral thesis, Charles Hansen developed a practical guide for the selection of solvents for coating systems. Hansen observed that solubility depends on three main types of intermolecular interactions mentioned in the first step and not solely on relatively nonpolar molecules, as was the case in Hildebrand's method. The introduction of these three parameters allowed for more accurate predictions of solubility (Sánchez-Camargo et al., 2019).

Based on this theoretical foundation, the potential solubility between a solvent i and solute j could exist when the HSP values of both the solvent i [δ_{Li} (dispersion parameter of solvent i), δ_{Pi} (polar parameter of solvent i), δ_{Hi} (hydrogen-bonding parameter of solvent i)] and the solute j [δ_{Li} (dispersion parameter of solute j), δ_{Pi} (polar parameter of solute j), δ_{Hi} (hydrogen-bonding parameter of solute j)] are similar. For this, a distance (Ra) is calculated between the two compounds that will be studied through Equation 6. The lower the value of Ra, greater the probability that a dissolution will occur.

$$Ra = \sqrt{4(\delta_{Li} - \delta_{Lj})^2 + (\delta_{Pi} - \delta_{Pj})^2 + (\delta_{Hi} - \delta_{Hj})^2} \qquad \textbf{Equation 6}$$

For better and easier to understand analysis, the Relative Energy Difference (RED) is used to determine if the compound is in the three-dimensional solubility space of the solute. This value is obtained between the relationship between Ra and Ro (Equation 7).

$$RED = \frac{Ra}{Ro} \qquad \textbf{Equation 7}$$

The value of the interaction radius (Ro) appears when several solvents are to be studied for a solute. It is usually obtained experimentally after plotting Ra values, of which the highest values for miscible solvents will make up the Ro value of the solute. Another way to obtain this value is through the estimation of a solubility database of a variety of solvents using computational tools, where a correlation is made that uses the HSP of these solvents with that of the solute in question and the Ro is proposed (Novaes et al., 2023).

If a RED value is less than 1, it indicates high affinity to dissolve and the more it tends to zero, it will become an ideal solvent for solvation due to the close HSP values that represent a minimum energy difference between soluble i and solute j. On the other hand, values greater than 1 indicate low dissolutive affinity that worsens each time it moves away from 1. For this project, a comprehensive analysis is carried out using all selected solvents for each of the five polymers under study, to identify which solvents are most likely to dissolve a specific plastic and which may be capable of dissolving more than one polymer simultaneously.

Figure 6 shows a three-dimensional representation of the solubility sphere based on Hansen's parameters. In this model, Ro corresponds to the radius of the experimental sphere defined for the solute, while Ra is the distance between the soluble and solute. When Ra/Ro < 1 (RED < 1), the soluble is located within the sphere and is therefore considered a good solvent (soluble). On the other hand, when Ra/Ro> 1 (RED > 1), soluble is outside the sphere and is classified as unsuitable (insoluble). In the illustrated example, one solute (black dot), two soluble solvents (blue dots inside the sphere), and one insoluble solvent (red box outside the sphere) are observed. In this way, the solubility sphere allows us to visually and practically identify which solvents are compatible with the solute studied (Novaes et al., 2023).

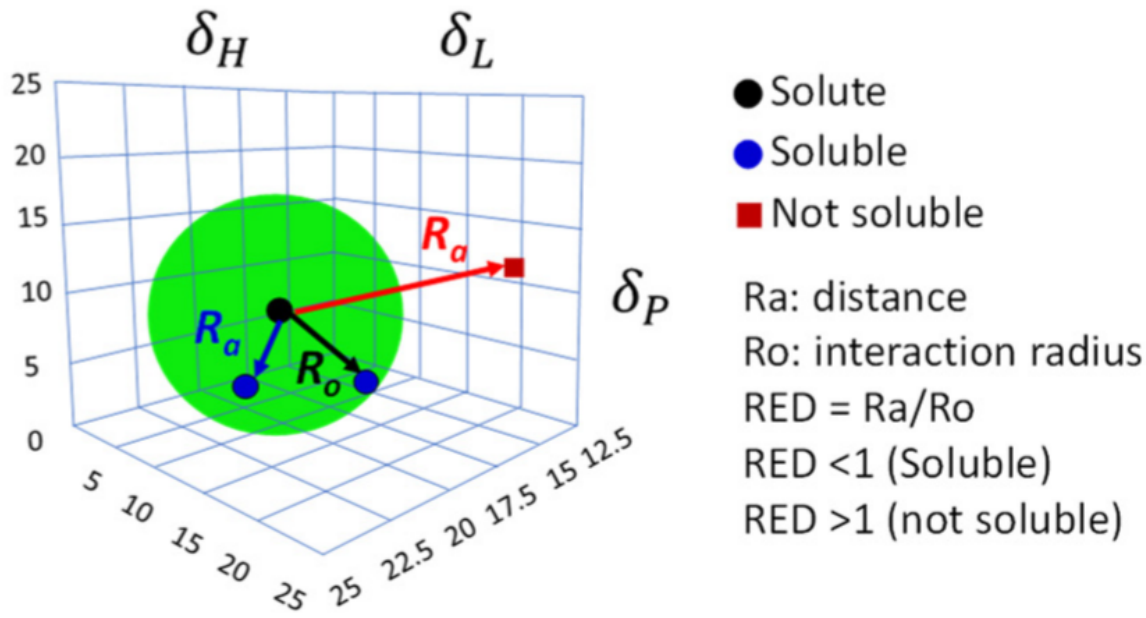


Figure 6: Example of three-dimensional spherical representation of HSP (Novaes et al.,2023).

Based on these results, the RED values obtained using the Hansen method will be incorporated into the AHP framework to select the solvents with the greatest capacity to dissolve a specific polymer.

As a first step, the data required to perform the corresponding calculations are the three-dimensional parameters which are polar (δ_P), dispersive (δ_D) and hydrogen bonding (δ_H), considering the three types of intermolecular interactions involved in solubility in HSP methodology (Gao et al., 2021). For this project, these values were obtained primarily from the Excel spreadsheet developed by Steven Abbott in 2013, available on website (Abbott, 2025). The spreadsheet contains an extensive database of solvent and polymer parameters reported in the literature. In cases where the parameters for a solvent used in the project were not listed, they were found in scientific articles (Díaz de los Ríos & Hernández Ramos, 2020) or Steven Abbott web page (Abbott, 2017). Thus, ensuring the availability of solid information to feed the model.

Due to its balance between accuracy and ease of application, the HSP method was selected to evaluate these criteria. Specifically, the previously mentioned Excel spreadsheet, which not only contains a comprehensive database of Hansen solubility parameters, also integrates the mathematical formulas of the HSP method (J. L. Lee et al., 2024). This approach not only enables precise solubility assessments but also allows for parameter customization to

fit specific needs, making it more adaptable than other methods. Furthermore, the HSP method is widely recognized and utilized in various scientific studies, reinforcing its reliability as a valuable tool for research in both synthetic and organic contexts (Ma et al., 2024).

For clarity and consistency, the terms “solvent” and “polymer” will be used throughout the remainder of this study to refer to the substances previously described as soluble and solute, respectively.

After collecting the data, the second step involves a detailed examination of the AHP methodology, from its initial setup to the calculation of RED values, which are essential for the subsequent step. In the third step, the RED values are organized into a scale of five solubility levels, rather than applying a strict soluble/insoluble classification, the RED values were grouped into multiple ranges, as shown in Table 10, in order to capture intermediate levels of affinity between the solvent and the compound of interest. This approach enables a more nuanced assessment of solvent performance, distinguishing between very high, high, medium, low, and very low solubility tendencies. The adoption of expanded RED ranges provides greater flexibility and interpretative resolution within the solvent evaluation process, while remaining fully consistent with the theoretical basis of the Hansen solubility model. This classification will allow for standardized analysis criteria and consistent comparison of the degree of compatibility, moving from a quantitative to a qualitative approach for the AHP methodology.

Table 10: Solubility levels for Cr1.

Solubility	RED
Very High	≤ 0.25
High	> 0.25 – ≤ 0.50
Medium	> 0.50 – ≤ 1.00
Low	1.00 – ≤ 1.25
Very Low	> 1.25

To facilitate the interpretation of the results, a color scheme will also be implemented, with the most favorable levels represented in light green and the least favorable in deep red, generating a visual gradient that clearly illustrates solvent-polymer compatibility.

For the four steps, following the procedure described in Subsection 2.4, the AHP methodology is applied to compare the selected solvents.

The pairwise comparison matrix that will be created will evaluate solubility capacity of two solvents with respect to a given polymer, based on their corresponding solubility level, using Saaty's scale values.

Because the solubility levels are hierarchically ordered, the relative position of each solvent within this hierarchy determines the magnitude of preference expressed on the Saaty scale. When one solvent is several levels above another, this indicates a significantly higher ability to dissolve the polymer, and therefore a higher Saaty value is assigned.

When the comparison is performed in the opposite direction, when a solvent with lower solubility is compared to one with higher solubility, the reciprocal value of the Saaty scale is used. This ensures that the pairwise comparison matrix remains reciprocal and mathematically consistent, as required by the AHP methodology.

Then, the normalized matrix is created by Equation 2 and. Equation 3. And finally calculate the CR, with the objective of verifying the coherence and validity of the judgments used in the AHP matrix. It is important to remember that this methodology will be applied to all hazard classes found in the project solvents.

Therefore, the solvent with the highest weight is identified as the most suitable option, while lower weights indicate the least desirable solvents because they would be the most insoluble solvent. Since this project considers five different polymers, the analysis will be carried out using this methodology to identify the best solvents to dissolve in each plastic studied.

3.2.Hazard metrics

The methodology used for this criterion is developed through the following steps:

1. Collection of all H-codes associated with the solvents included in the project.
2. Identification of Hazard Classes corresponding to the H-codes found in the solvent set.
3. Definition of hazard levels within each Hazard Class.
4. Application of the AHP methodology to rank solvents within each Hazard Class.
5. Application of penalization factor.
6. Calculation of a global solvent hazard weight.

To understand the methodology used in this criterion, it is important to explain how the GHS works, GHS applies a hierarchical classification structure to each chemical substance analyzed, allowing for systematic progression from general hazard identification to detailed characterization. At the highest level of this structure, chemical hazards are classified into three general groups according to the nature of their potential effects: physical hazards, health hazards, and environmental hazards. At the next level of classification, each hazard domain is subdivided into Hazard Classes or subclasses, which qualitatively define the nature of the hazard associated with a substance or mixture. Finally, at the lowest level, each hazard class is specified in greater detail through hazard categories, which define the level of severity based on quantitative or qualitative criteria established in the GHS, these categories establish a ranked scale of hazard severity, where Category 1 represents the highest level of danger, and increasing category numbers correspond to progressively lower hazard levels. These categories are expressed through standardized Hazard Statements, which provide a clear and unambiguous description of the hazard and constitute the primary element of hazard communication within the GHS framework (Parker et al., 2025).

To ensure universal identification and harmonized communication, each hazard statement is assigned a unique alphanumeric Hazard Statement code (H-code**)**. The structure of this code reflects the internal logic of the GHS classification system: the letter H denotes a hazard statement, the first digit identifies the general hazard domain (H2xx for physical hazards, H3xx for health hazards, and H4xx for environmental hazards), and the two subsequent digits correspond to a sequential numbering system linked to specific intrinsic properties of the substance, expressed by the Hazard Statement (United Nations, 2023).

In many hazard classes, there is a clear and consistent correspondence between hazard categories and H-codes, allowing a direct interpretation of severity. For example, the code H225 corresponds to the hazard statement “Highly flammable liquid and vapor”, which is assigned to the Hazard Class “Flammable liquids”, Category 2. This hazard class includes additional H-codes (H224, H226, and H227), each associated with a distinct category and, consequently, with a different degree of severity. In this case, the classification is well structured, as each H-code reflects a specific position within the severity scale, as illustrated in Table 11 (United Nations, 2025).

Table 11: Flammable liquids Hazard Statements (United Nations, 2025).

Hazard Group	Hazard Class	Hazard statement	Hazard Category	H-code
Physical Hazard	Flammable liquids	Extremely flammable	1	H224
		Highly flammable	2	H225
		Flammable	3	H226
		Combustible	4	H227

However, this one-to-one correspondence is not always preserved across all hazard classes. In several cases, multiple categories or subcategories are represented by the same H-code, which reduces the degree of differentiation that can be achieved using H-codes alone. For instance, within the skin corrosion hazard class, subcategories 1A, 1B, and 1C are all associated with the same H-code (H314), while in eye irritation, both categories 2A and 2B correspond to H319. Additionally, in aquatic toxicity, oral subclass different severity categories are represented by one H-code (H300) for Category 1 and Category 2, but the level of differentiation remains limited compared to the full theoretical structure defined by the GHS.

In this context, H-codes play a central role in methodology, as they constitute the primary identifiers of the hazards associated with each solvent. They not only indicate the presence of a hazard but also implicitly reflect its relative severity through their correspondence with hazard categories. Therefore, both the number of H-codes and their associated categories define the hazard profile of each solvent.

Based on this framework, the first step will allow us to determine the risk level of each solvent within a given hazard class. To collect the H-Codes for the solvents in this study, the

European Chemicals Agency (ECHA) database was used (*ECHA CHEM*, 2026). This website provides official information on chemical hazards, including the hazard statements assigned to each substance under the GHS system. Using ECHA ensures that the H-Codes are reliable, up-to-date, and based on recognized European regulations, making it a trustworthy source for this work.

After collecting all the H-codes, proceed to the second step which will identify what hazard classes the analyzed solvents are involved in.

In the third step, hazard risk levels are defined based on the number of H codes associated with each hazard class or subclass. Each hazard class or subclass can include several H codes, each representing a different degree of hazard severity. As a result, a single hazard class can correspond to multiple hazard risk levels. Furthermore, if a solvent does not have an assigned H code within a given hazard class, this is considered the most favorable situation, as it indicates that no hazard has been identified for that class. This means that an additional level would be added. Therefore, the number of hazard risk levels depends on the specific H codes defined for each hazard class and can vary from class to class. The definition of the hazard levels for each class will be analyzed and determined in Subchapter 4.2.

For the fourth step, following the procedure described in Subsection 2.4, the AHP methodology is applied to compare the selected solvents for each hazard class identified.

The pairwise comparison matrix to be created will evaluate the relative hazard risk (based on H codes) and solubility (based on solubility levels) of two solvents with respect to a given polymer and hazard class, using Saaty's scale values. A value of 1 is assigned when both solvents present the same hazard risk level, indicating equal importance. Higher values are assigned as the difference in hazard risk levels increases, reflecting a progressively greater preference for the solvent with the lower hazard risk.

Since hazard risk levels are hierarchically ordered, the relative position of each solvent within this hierarchy determines its preference level on the Saaty scale. When a solvent is several levels above another, it indicates that it poses a much lower hazard risk, or at best, no hazard at all in that hazard class; therefore, it is assigned a higher Saaty value.

When the comparison is performed in the opposite direction, when a solvent with higher hazard risk is compared to one with lower hazard risk, the reciprocal value of the Saaty scale

is used. This ensures that the pairwise comparison matrix remains reciprocal and mathematically consistent, as required by the AHP methodology.

Then, for each hazard class considered, the normalized matrix is obtained using Equation 2 and Equation 3, and the consistency ratio (CR) is calculated to verify the coherence and validity of the judgments used in the AHP matrix.

In this study, higher hazard levels correspond to lower weights. Therefore, criteria associated with greater hazard receive smaller weights and are considered less suitable in the evaluation process.

Through this procedure, a weight is obtained for each hazard class identified. However, in order to assign a single hazard weight to each solvent, it is necessary to combine the weights corresponding to the different hazard classes. To achieve this, the average value of the weights associated with the hazard classes present for each solvent is calculated. This process is expressed mathematically in Equation 8**.**

$$w_i = \frac{1}{n} \sum_{j=1}^{n} w_{ij} \; ; \forall j \in \{1,2, \dots, n\} \qquad \textbf{Equation 8}$$

where:

- n is the number of criterion or sub criterion considered,
- w_{ij} is the normalized AHP weight of solvent i in criterion or sub criterion j
- w_i is the final weight of solvent i in criterion or sub criterion j

In this case, the hazard class is the sub criterion j.

To enhance the methodological robustness of the hazard criterion, due to a no explicit hierarchy or prioritization between hazard classes, an additional penalization factor based on the cumulative number of H-codes associated with each solvent was incorporated into the model.

For, the fifth step, while the AHP procedure provides a structured weighting of hazard classes according to their relative severity, it does not explicitly account for the cumulative burden resulting from the simultaneous presence of multiple hazard statements in a single solvent. In order to strengthen the discriminatory capacity of the model and ensure a more

conservative evaluation, a proportional term was introduced. The penalization factor P_i is defined by Equation 9:

$$P_i = 1 - \frac{n_i}{n_{max}+1} \quad \textbf{Equation 9}$$

Where:

P_i= penalization factor

n_i= total number of H-codes associated with solvent i

n_{max}= maximum number of H-codes identified among all evaluated solvents

This formulation ensures that:

- Solvents with no hazard statements ($n_i = 0$) receive no penalization ($P_i = 1$).
- The penalization increases proportionally with the number of H-codes.
- The inclusion of $n_{max} + 1$ prevents the factor from reaching zero, thus maintaining mathematical stability and preserving comparability among alternatives.

The adjusted hazard score is then calculated by Equation 10:

$$W_{Pi} = W_{i,j} \times P_i \quad \textbf{Equation 10}$$

After applying the penalization factor, the last step is the adjusted hazard scores are renormalized to preserve comparability and maintain the weights within a probabilistic scale.

The final hazard weight for each solvent is calculated by Equation 3:

This operation divides each solvent's penalized score by the total sum of penalized scores across all solvents. This step does not modify the relative ranking among solvents, but it restores proportionality and ensures that the hazard criterion remains consistent with the normalization properties of the AHP framework and with the aggregation procedure used in the multi-criteria evaluation.

3.3. Solvent Price

The methodology used for this criterion is developed through the following steps:

1. Collection of all prices (euro per liter) associated with the solvents included in the project.
2. Definition of prices levels based on solvent prices.
3. Application of the AHP methodology to compare solvent prices.

As a first step, the data required is the prices for the 18 project solvents. The prices for each solvent were taken from invoices or quotes that the Polytechnic University of Leiria issued to its chemical suppliers or external suppliers. The prices are euros per liter. If the price of a solvent could not be determined using this method, an internet search was also conducted to obtain real market values, at laboratory scale. This study, by focusing on the preliminary selection of a solvent, considers only the purchase price per liter as a direct and objective economic parameter. Other factors, such as transportation, storage, and waste management costs, also influence economic viability, but have been left out at this initial stage because they can vary significantly depending on the negotiation and supply conditions established with each company. For this reason, the present analysis prioritized a simple and comparable reference value, leaving a more detailed study of the overall economic viability for later phases, considering the specificities of trade agreements and the specific conditions of each case.

In the second step, the solvent prices are organized into a scale of three price levels presented in Table 12. The price categorization was established using arbitrarily defined thresholds; the most favorable level (<€50/L), the intermediate level (€50–100/L) and the least favorable (>€100/L) to serve as an initial, functional framework for this specific analysis. These benchmarks are not prescriptive; they are intended as a modifiable template. Future projects or researchers can readily adjust these ranges according to their distinct budgetary contexts, market conditions, or cost-sensitivity requirements, thereby customizing the scale to their own analytical needs.

Table 12: Cost interval for Cr3.

Price	Price (€/liter)
Cheap	<50
Medium	50-100
Expensive	>100

As with the previous criteria, to facilitate the interpretation of the results, a color scheme will also be implemented, with the most favorable levels represented in light green and the least favorable in intense red, generating a visual gradient that clearly illustrates the different prices levels.

For the third step, following the procedure described in Subsection 2.4**,** the AHP methodology is applied to compare the selected solvents.

The pairwise comparison matrix that will be created will evaluate the price level of two solvents based on their corresponding price level, using Saaty's scale values.

The prices levels were hierarchically ordered, then the relative position of each solvent within this hierarchy determines the magnitude of preference expressed on the Saaty scale. When one solvent is several levels above another, this indicates has significantly economic price, and therefore a higher Saaty value is assigned.

When the comparison is performed in the opposite direction, when a solvent with lower cost is compared to one with higher cost, the reciprocal value of the Saaty scale is used. This ensures that the pairwise comparison matrix remains reciprocal and mathematically consistent, as required by the AHP methodology.

Then, the normalized matrix is created by Equation 2 and. Equation 3. And finally calculate the CR, with the objective of verifying the coherence and validity of the judgments used in the AHP matrix.

Therefore, the solvent with the highest weight is identified as the most suitable option, while lower weights indicate the least desirable solvents because they would be the most expensive.

3.4. Best Solvent

Since no explicit hierarchy or objective prioritization was established among the selection criteria considered (solubility, hazard, and price), and in the absence of a universally accepted criterion that would allow assigning greater importance to one over another, all criteria were weighted with equal importance.

Consequently, the final weight of the solvent, considering the three evaluation criteria, is defined in Equation 8:

Where for this calculation:

- n is the number of criteria considered (in this case, n = 3: solubility, hazard and price),
- w_{ij} is the normalized weight obtained by AHP for solvent.i with respect to criterion j
- w_i= final weight of the solvent

Thus, the solvent with the highest final weight w_i is identified as the most suitable option from a comprehensive perspective that combines technical performance (solubility), safety impact (hazard), and economic viability (price). Conversely, lower values indicate less recommended solvents due to limitations in one or more of the evaluated criteria.

4. Results and Discussion

This section presents and discusses the results obtained by applying the AHP methodology (Section 2.4), using the criteria defined in Section 3.1, to evaluate 18 different solvents for the dissolution of 5 different plastics considered in this study.

4.1. Solubility

As a result of the first step**,** the three-dimensional Hansen solubility parameters (dispersive (δ_D), polar (δ_P), and hydrogen bonding (δ_H)), for the polymers and solvents selected for this analysis are presented in Table 13.

Table 13: Hansen Solubility parameters for Cr1.

Polymer/Solvent	δ_D	δ_P	δ_H	Ref
P1	18.7	5.9	3.5	(Abbot, 2017)
P2	17.6	0	0	(Abbot, 2017)
P3	18	0	0	(Abbot, 2017)
P4	18.2	7.3	7.9	(Abbot, 2017)
P5	18.6	8.8	5.8	(Abbot, 2017)
S1	17.8	4.4	6.9	(Deneme et al., 2024)
S2	16.5	4.5	9.1	(Mphateng et al., 2022)
S3	19	14	8	(Mphateng et al., 2022)
S4	17.2	1.8	4.3	(Trivedi et al., 2024)
S5	16.7	0.4	0	(Achira & Washiya, 2024)
S6	17.6	7.1	7.5	(Deneme et al., 2024)
S7	16.9	5	4.3	(Deneme et al., 2024)
S8	15.5	4.7	6.6	(Novaes et al., 2023)
S9	16.7	4.6	3.4	(Abbot, 2017)
S10	15.5	7.2	7.6	(Novaes et al., 2023)
S11	16.4	8.9	14	(Rasool & Vankelecom, 2021)
S12	16.2	7.4	8.5	(Abbot, 2017)
S13	15.6	9.7	11	(Abbot, 2017)
S14	17.2	4.5	15	(Abbot, 2017)
S15	19	5.5	14	(Abbot, 2017)
S16	19.6	2	2.9	(Luning Prak et al., 2024)
S17	17.9	6.2	6	(Abbot, 2017)
S18	18.1	1.2	1.2	(Enache et al., 2025)

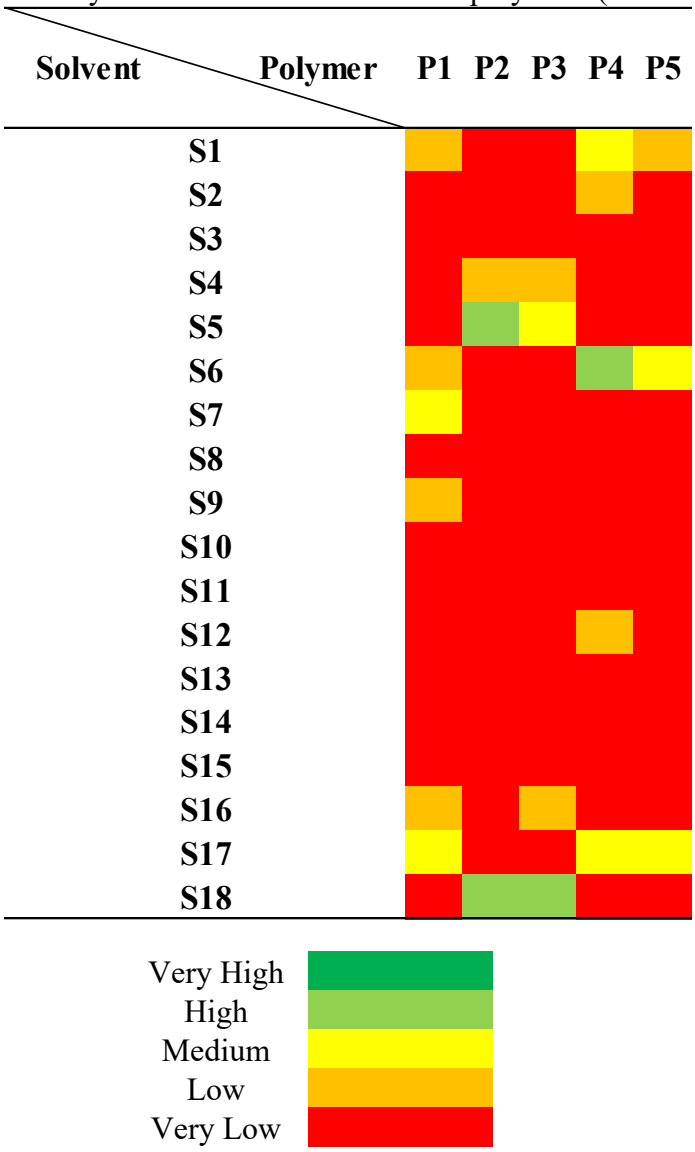
In the second step, the Relative Energy Difference (RED) values were calculated for each solvent-polymer combination. To determine which solvent has the greatest solubility for a specific polymer, calculations were performed using an Excel spreadsheet developed by Steven Abbott, based on Hansen's solubility parameters. To optimize data management, a value of Ro=4 was set, which reduces the radius of the sphere under study and allows for more manageable values. The results, which indicate the thermodynamic affinity between each solvent and the selected polymers, are summarized in Table 14.

Table 14: RED values between polymers and solvent.

Solvent \ Polymer	P1	P2	P3	P4	P5
S1	1.03	2.05	2.05	0.79	1.20
S2	1.81	2.60	2.65	1.14	1.71
S3	2.30	4.07	4.04	1.70	1.40
S4	1.29	1.18	1.23	1.72	1.92
S5	1.93	0.47	0.67	2.74	2.74
S6	1.18	2.58	2.59	0.32	0.78
S7	0.95	1.69	1.74	1.25	1.33
S8	1.80	2.28	2.38	1.53	1.87
S9	1.05	1.50	1.57	1.51	1.54
S10	1.93	2.82	2.90	1.35	1.66
S11	3.01	4.23	4.27	1.86	2.37
S12	1.82	2.91	2.97	1.03	1.44
S13	2.68	3.87	3.93	1.68	2.06
S14	2.92	3.85	3.86	1.91	2.57
S15	2.61	3.80	3.77	1.62	2.20
S16	1.08	1.33	1.19	1.95	1.91
S17	0.75	2.16	2.16	0.57	0.74
S18	1.34	0.49	0.43	2.27	2.23

In the third step, the RED values are organized into a scale of five solubility levels. Table 15 shows how, qualitatively, the different solvents are classified according to their solubility level.

Table 15: Solubility classification of solvents in polymers (RED-based scale).



In the fourth step, the fundamental Saaty scale, whose interpretation is summarized in Table 16, is first introduced.

Table 16: Saaty scale interpretation for Cr1.

Saaty Value	Interpretation
1	Both solvents show the same solubility (equal importance).
3	One solvent is moderately more soluble than the other.
5	One solvent is strongly more soluble than the other.
7	One solvent is very strongly more soluble than the other.
9	One solvent is much more soluble than the other.
1/3,1/5,1/7,1/9	Reciprocal values

Subsequently, pairwise comparison matrices were constructed for each polymer, where the solvents were evaluated against each other based on their relative solubility level. Normalized eigenvectors were calculated from these matrices, yielding the relative weights of each solvent. The consistency of the matrices was also verified using the consistency index and ratio, ensuring the validity of the applied model. To maintain clarity in the presentation of the results, this chapter presents only the final weights obtained through AHP, while the pairwise comparison matrices and detailed calculations are provided in Appendices 1–15.

Table 17 presents the normalized weights obtained by applying the AHP methodology to the solubility results. In this case, the procedure does not modify the qualitative classification previously established in Table 16 (Very Low, Low, Medium, High), but rather formalizes this information in quantitative terms, maintaining the proportionality between the assigned levels.

Table 17: Final weights for Cr1.

Solvent \ Plastic	P1	P2	P3	P4	P5
S1	0.081	0.031	0.030	0.138	0.101
S2	0.029	0.031	0.030	0.074	0.000
S3	0.029	0.031	0.030	0.027	0.035
S4	0.029	0.087	0.086	0.027	0.035
S5	0.029	0.225	0.157	0.027	0.035
S6	0.081	0.031	0.030	0.227	0.184
S7	0.165	0.031	0.030	0.027	0.035
S8	0.029	0.031	0.030	0.027	0.035
S9	0.081	0.031	0.030	0.027	0.035
S10	0.029	0.031	0.030	0.027	0.035
S11	0.029	0.031	0.030	0.027	0.035
S12	0.029	0.031	0.030	0.074	0.035
S13	0.029	0.031	0.030	0.027	0.035
S14	0.029	0.031	0.030	0.027	0.035
S15	0.029	0.031	0.030	0.027	0.035
S16	0.081	0.031	0.086	0.027	0.035
S17	0.165	0.031	0.030	0.138	0.184
S18	0.029	0.225	0.245	0.027	0.035

Therefore, the values obtained represent the relative importance of the solubility criterion for each solvent in relation to each polymer. In subchapter 4.4, these values will directly

influence the calculation of the final weight of each solvent when combined with the other evaluated criteria, thus contributing to the determination of the final classification.

In general, considering the set of plastics evaluated, it is observed that two of them, Polystyrene (P1) and Polyvinyl chloride (P5), only exhibit medium solubility levels, with no solvent reaching the high solubility category. This implies that the probability of effective dissolution for these materials is limited within the group of solvents studied. Consequently, it can be inferred that dissolving P1 and P5 could be more difficult, given that none of the solvents evaluated demonstrate an outstanding capacity to promote their complete solubilization under the analyzed conditions.

In contrast, the other polymers do have at least one solvent classified within the high solubility level. In the case of Polyethylene (P2), the solvents P-cymene (S5) and Cumene (S8) show high dissolving capacity. For Polypropylene (P3), the solvent Cumene (S18) reaches a high solubility level. Polyethylene terephthalate (P4), on the other hand, exhibits high solubility in Dimethyl isosorbide (S6). These results indicate that, for these polymers, there are alternative solvents with a high probability of effective dissolution.

It is particularly relevant to highlight that Cumene (S18) shows high solubility for both Polyethylene (P2), and Polypropylene (P3), suggesting that this solvent has a structural affinity with both polyolefins. However, no universal solvent capable of efficiently dissolving all the evaluated polymers was identified, demonstrating a marked solvent-polymer selectivity.

In general, the number of solvents of interest (those classified as having high or very high dissolution potential) is small compared to the total number evaluated. These results indicate that, within the set of solvents analyzed, only a limited group possesses characteristics suitable for efficient dissolution applications, which may have significant implications for the development of this project. In addition, a positive aspect is that there are solvents capable of simultaneously dissolving two types of plastics, such as cumene (S18) for Polyethylene (P2), and Polypropylene (P3). This characteristic represents an operational advantage, as it allows for a reduction in the number of solvents required in the process, avoiding the use of a specific solvent for each polymer and promoting greater efficiency in terms of system simplification and potential resource optimization.

4.2.Hazard

As a result of the first step, the H-Codes for the solvents selected for this analysis are presented in Table 18.

Table 18: H-codes for Cr2.

Solvent \ Hazard	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14
S1	H226	-	-	-	-	-	-	-	H336	-	-	-	-	-
S2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S3	-	-	-	-	H315	-	H319	-	-	-	-	-	-	-
S4	H226	-	-	-	H315	H317	-	-	-	-	-	-	H400	H410
S5	H226	-	H304	-	-	-	-	H331	-	-	-	-	-	H411
S6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S7	H225	H302	-	-	H315	-	H318	-	-	-	-	-	-	-
S8	-	-	-	-	H315	-	H319	-	-	-	-	-	-	-
S9	H226	-	-	-	-	H317	-	-	-	-	-	-	-	-
S10	H226	-	-	-	-	-	H319	-	H335	-	-	-	-	-
S11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S13	-	-	-	-	H314	-	-	H332	-	-	-	-	-	H412
S14	-	-	-	-	H314	-	H318	-	-	-	H361	H373	-	-
S15	-	H302	-	H312	-	-	-	H332	-	-	-	-	-	H411
S16	-	-	-	-	H315	-	H319	-	-	-	-	-	-	H411
S17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S18	H226	-	H304	-	-	-	-	-	H335	H350	-	-	-	H411

For Step 2, the H codes associated with the solvents evaluated in this project were identified and analyzed. Based on this evaluation, 14 hazard classes or subclasses were identified, 11 correspond to health hazards, 2 to environmental hazards, and 1 to physical hazards, indicating that the hazard profile of the evaluated solvents is mainly associated with potential impacts on human health.

Table 19 summarizes the hazard classes, together with their corresponding H-codes and hazard categories according to the GHS framework considered in this study,

Table 19: GHS hazard classes for Cr2 (United Nations, 2025).

Hazard Class ID	Hazard Class; Sub-Class	Nº hazard categories	Identified H-codes	Hazard category	Nº Hazard risk levels	Nº AHP Hazard risk levels
H1	Flammability	4	H225	2	4	5
			H226	3		
H2	Acute toxicity; oral	5	H302	4	4	5
H3	Aspiration hazard	2	H304	1	2	3
H4	Acute toxicity; dermal	5	H312	4	4	5
H5	Skin corrosion/irritation	3	H314	1	3	4
			H315	2		
H6	Skin sensitization	1	H317	1	1	2
H7	Eyes corrosion/irritation	3	H318	1	3	4
			H319	2		
H8	Acute toxicity; inhalation	5	H331	3	4	5
			H332	4		
H9	STOT, single exposure	3	H335	3	3	4
			H336	3		
H10	Carcinogenicity	2	H350	1	2	3
H11	Reproductive toxicity	2	H361	2	2	3
H12	STOT, repeated exposure	2	H373	2	2	3
H13	Hazardous to the aquatic environment, acute hazard	3	H400	1	3	4
H14	Hazardous to the aquatic environment, long-term hazard	4	H410	1	4	5
			H411	2		
			H412	3		

*STOT (Specific Target Organ Toxicant)

A detailed analysis of the hazard classes considered in this study shows that the number of hazard categories and the number of H-codes is not uniform but rather depends on how each hazard class is structured within the GHS framework. As mentioned in Chapter 3.2, in several cases there is direct correspondence in which the number of H-codes is equal to the number of hazard categories. This one-to-one relationship allows for a clearer interpretation of the number of hazard risk levels within each hazard class or subclass. Such correspondence is observed in hazard classes including flammability, aspiration hazard, skin corrosion/irritation, skin sensitization, eye corrosion/irritation, carcinogenicity, reproductive toxicity, STOT—repeated exposure, hazardous to the aquatic environment, acute hazard, and hazardous to the aquatic environment, long-term hazard.

On the other hand, there are cases where a single H-code represents more than one hazard category. This happens in hazard sub-classes such us: acute toxicity; oral; acute toxicity; dermal; acute toxicity; inhalation) where the same hazard statement may correspond to both Category 1 and Category 2 depending on the classification criteria. In this case, the H-code still indicates a very high level of hazard, but the distinction between the most severe categories is not reflected at the hazard risk levels.

Another relevant situation is observed in hazard classes where different H-codes correspond to the same hazard category. This occurs, for instance, in STOT single exposure, where H-codes such as H335 and H336 both correspond to Category 3. Although the H-codes are different, they do not represent different hazard risk levels, but rather different types of effects within the same category.

Consequently, the number of hazard risk levels for the AHP methodology that can be achieved in this study depend not only on the number of categories defined in the GHS, but also on how these categories are effectively represented through H-codes. For this reason, the present work adopts an approach based primarily on H-codes, as they provide the most consistent and operational basis for comparing hazards across solvents, while still reflecting the underlying classification principles of the GHS.

As mentioned in subchapter 3.2, particularly in Step 3, the number of hazard risk levels were defined according to the H codes associated with each hazard class or subclasses. Since each hazard class may include multiple H codes reflecting different degrees of severity, the number of hazard risk levels varies depending on the specific classification.

Based on this analysis, different hazard classes were found to contain four, three, two, or one intrinsic hazard levels, depending on the severity gradation defined by their corresponding H codes. Additionally, as previously stated, when a solvent does not present any H code within a given hazard class, this condition is considered the most favorable scenario. Consequently, an additional level is incorporated to represent the absence of hazard (no category), resulting in an expanded comparison scale for each class.

Therefore, the total number of AHP hazard risk levels for each hazard class or subclasses depends on the hazard risk levels identified plus one additional level corresponding to the non-categorized case.

In the third step, the fundamental Saaty scale, whose interpretation is summarized in Table 20, is introduced as the basis for establishing the pairwise comparisons from the number of hazard risk levels per hazard class and further category of hazard risk of the attributed H-code within the AHP framework.

Table 20: Saaty scale interpretation for Cr2.

Nº Hazard risk levels	**Saaty Value**	**Interpretation for Hazard categories**
4	1	Both solvents show the same severity.
	3	One solvent is moderately less severe than the other.
	5	One solvent is clearly less severe than the other.
	7	One solvent is much less severe than the other.
	9	One solvent is extremely less severe than the other.
	1/3,1/5,1/7,1/9	Reciprocal values
3	1	Both solvents show the same severity.
	3	One solvent is moderately less severe than the other.
	6	One solvent is much less severe than the other.
	9	One solvent is extremely less severe than the other.
	1/3,1/6,1/9	Reciprocal values
2	1	Both solvents show the same severity.
	5	One solvent is clearly less severe than the other.
	9	One solvent is extremely less severe than the other.
	1/5,1/9	Reciprocal values
1	1	Both solvents show the same severity.
	9	One solvent is extremely less severe than the other.
	1/9	Reciprocal values

Subsequently, for the fourth step pairwise comparison matrices were constructed for each hazard class, in which the solvents were compared against each other according to their defined hazard risk level. From these matrices, normalized eigenvectors were calculated, providing the relative weights of each solvent with respect to each hazard class. The consistency of the judgments was verified through the consistency index (CI) and consistency ratio (CR), ensuring the reliability and robustness of the applied AHP model.

For clarity and readability, Table 21 presents only the weights obtained for each solvent in every hazard class, while the pairwise comparison matrices and detailed calculations are provided in Appendices 16–57.

Then, the hazard weight of each solvent was determined using Equation 8. By assuming equal weight for all solvents, the calculated results are summarized in Table 22.

Analyzing the results in Table 22, the maximum and minimum weights were very close, making the classification insufficiently discriminating. Solvents with no H codes and those with up to five H codes received risk weights within a narrow range. From a safety perspective, this situation is not entirely representative, as a solvent with five risk classifications should not be considered almost equivalent to one with none.

To address this limitation and strengthen this criterion, the fifth step involves applying a penalization factor. First, the maximum number of H codes identified among all solvents was determined, corresponding to S4 (Limonene) and S18 (Cumene) with 5 H codes each. Since the most favorable condition corresponds to zero H codes, the penalization factor was defined considering six possible states (from 0 to 5 H codes). By applying Equation 9, the following penalization factors were obtained according to the number of H codes that a solvent may have; these factors are shown in Table 23.

Subsequently, after determining the penalization factors, the final hazard weights for each solvent are computed by applying Equation 8. The results of this calculation are summarized in Table 24.

Table 21: Solvents weights for Hazard categories.

Solvent \ Hazard	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14
S1	0.017	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.021	0.058	0.058	0.058	0.058	0.077
S2	0.081	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S3	0.081	0.061	0.062	0.058	0.015	0.062	0.014	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S4	0.017	0.061	0.062	0.058	0.015	0.007	0.077	0.064	0.063	0.058	0.058	0.058	0.006	0.007
S5	0.017	0.061	0.007	0.058	0.083	0.062	0.077	0.009	0.063	0.058	0.058	0.058	0.058	0.011
S6	0.081	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S7	0.009	0.012	0.062	0.058	0.015	0.062	0.008	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S8	0.081	0.061	0.062	0.058	0.015	0.062	0.014	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S9	0.017	0.061	0.062	0.058	0.083	0.007	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S10	0.017	0.061	0.062	0.058	0.083	0.062	0.014	0.064	0.021	0.058	0.058	0.058	0.058	0.077
S11	0.081	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S12	0.081	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S13	0.081	0.061	0.062	0.058	0.008	0.062	0.077	0.014	0.063	0.058	0.058	0.058	0.058	0.021
S14	0.081	0.061	0.062	0.058	0.008	0.062	0.008	0.064	0.063	0.058	0.012	0.012	0.058	0.077
S15	0.081	0.012	0.062	0.012	0.083	0.062	0.077	0.014	0.063	0.058	0.058	0.058	0.058	0.011
S16	0.081	0.061	0.062	0.058	0.015	0.062	0.014	0.064	0.063	0.058	0.058	0.058	0.058	0.011
S17	0.081	0.061	0.062	0.058	0.083	0.062	0.077	0.064	0.063	0.058	0.058	0.058	0.058	0.077
S18	0.017	0.061	0.007	0.058	0.083	0.062	0.077	0.064	0.021	0.006	0.058	0.058	0.058	0.011

Table 22: Final weights for Cr2.

Solvent	Hazard weight
S1	0.058
S2	0.066
S3	0.056
S4	0.044
S5	0.049
S6	0.066
S7	0.047
S8	0.056
S9	0.057
S10	0.054
S11	0.066
S12	0.066
S13	0.053
S14	0.049
S15	0.051
S16	0.052
S17	0.066
S18	0.046

Table 23: Penalization factors for Cr2.

Nº hazard	Penalization factor
0	1.00
1	0.83
2	0.67
3	0.50
4	0.33
5	0.17

Table 24: Final weights for Cr2.

Solvent	Hazard weight	Nº H-Codes	Penalization	Penalization hazard weight	Final hazard weight
S1	0.058	2	0.67	0.039	0.061
S2	0.066	0	1.00	0.066	0.103
S3	0.056	2	0.67	0.038	0.059
S4	0.044	5	0.17	0.007	0.011
S5	0.049	4	0.33	0.016	0.025
S6	0.066	0	1.00	0.066	0.103
S7	0.047	4	0.33	0.016	0.025
S8	0.056	2	0.67	0.038	0.059
S9	0.057	2	0.67	0.038	0.060
S10	0.054	3	0.50	0.027	0.042
S11	0.066	0	1.00	0.066	0.103
S12	0.066	0	1.00	0.066	0.103
S13	0.053	3	0.50	0.026	0.041
S14	0.049	4	0.33	0.016	0.025
S15	0.051	4	0.33	0.017	0.026
S16	0.052	3	0.50	0.026	0.040
S17	0.066	0	1.00	0.066	0.103
S18	0.046	5	0.17	0.008	0.012

Based on the final hazard weights after applying the penalization factor, a clearer separation between the safest and most hazardous solvents can be observed.

Solvents Triacetin (S2), Dimethyl isosorbide (S6), Diacetin (S11), Estasol (S12), and Ethyl benzoate (S17) obtained the highest final weight (0.102). These solvents do not present H-codes within the evaluated hazard classes, which explains their favorable position. In contrast, Limonene (S4) and Cumene (S18) show the lowest values (0.012), as they contain the highest number of H-codes in the dataset.

Although this trend is expected, the penalization step is important because it increases the differentiation between alternatives. Without this adjustment, solvents with several H-codes could remain too close to safer options in the ranking. Therefore, the penalized hazard weight strengthens the impact of safety in the overall solvent selection, especially when it is later combined with other criteria such as solubility and cost.

4.3. Price

As a result of Step 1, the commercial prices of the solvents selected for this analysis were collected. In Step 2, these price values were organized into a three-level scale to facilitate their evaluation. Table 25 presents the commercial prices together with their classification into this scale, enabling a more nuanced assessment of solvent cost by distinguishing between expensive, moderate, and cheap price tendencies.

Table 25: Prices for Cr3.

Solvents	Price (€/liter)	Interval cost
S1	43.2	Cheap
S2	30.1	Cheap
S3	139.2	Expensive
S4	83.2	Moderate
S5	26.3	Cheap
S6	161	Expensive
S7	82.4	Moderate
S8	222	Expensive
S9	130.2	Expensive
S10	159.2	Expensive
S11	80.7	Moderate
S12	56.3	Moderate
S13	364	Expensive
S14	1648.71	Expensive
S15	58	Moderate
S16	40.8	Cheap
S17	116	Expensive
S18	27.6	Cheap

In the third step, the fundamental Saaty scale, whose interpretation is summarized in Table 26, is introduced as the basis for establishing the pairwise comparisons within the AHP framework.

Table 26: Saaty scale interpretation for Cr3.

Saaty Value	Interpretation
1	Both solvents belong to the same cost interval
5	One solvent is clearly less expensive than the other.
9	One solvent is extremely less expensive than the other.

Subsequently, pairwise comparison matrices were constructed, where the solvents were evaluated against each other based on their price level. Normalized eigenvectors were calculated from these matrices, yielding the relative weights of each solvent. The consistency of the matrices was also verified using the consistency index and ratio, ensuring the validity of the applied model. To maintain clarity in the presentation of results, this chapter presents only the final weights obtained through AHP.

For clarity and readability, Table 27 presents only the final weights obtained for each solvent in every hazard class, while the pairwise comparison matrices and detailed calculations are provided in Appendices 58–60.

In total, of the 18 solvents used, 8 solvents are classified as Expensive, 5 solvents as Cheap and 5 solvents as Moderate. For this criterion, the cheapest solvents are Anisole (S1), Triacetin (S2), P-cymene (S5), 1,2,3,4-Tetrahydronaphthalene (S16), Cumene (S18). It was expected that the areas corresponding to the lowest cost range would concentrate the greatest weighting, since they represent the most favorable alternative from an economic point of view.

Table 27: Final weights for Cr3.

Solvents	Weight
S1	0.136
S2	0.136
S3	0.012
S4	0.045
S5	0.136
S6	0.012
S7	0.045
S8	0.012
S9	0.012
S10	0.012
S11	0.045
S12	0.045
S13	0.012
S14	0.012
S15	0.045
S16	0.136
S17	0.012
S18	0.136

4.4. Best solvent

Finally, Equation 8 presented in Section 3.4 is applied to determine the weight of the optimal solvent. In accordance with the project objectives, a detailed analysis of each plastic evaluated in this study is subsequently carried out.

For Polystyrene (P1), the best option is Ethyl benzoate (S17). It is closely followed by Anisole (S1) and Triacetin (S2), which stand out as very well-balanced options, completing the top three. At the opposite end of the spectrum, Hexafluoro-2-propanol (S14) is indisputably the worst candidate. It is joined in this group of low-performing solvents by Trifluoroacetic acid, TFA (S13) and Methyl lactate (S10). Table 28 presents a compilation of all the criteria and their final weighting for plastic Polystyrene (P1).

Table 28: Final weights for P1.

Solvent \ Criterion	Cr1	Cr2	Cr3	Final Weight
S1	0.081	0.061	0.136	0.092
S2	0.029	0.103	0.136	0.089
S3	0.029	0.059	0.012	0.033
S4	0.029	0.011	0.045	0.029
S5	0.029	0.025	0.136	0.063
S6	0.081	0.103	0.012	0.065
S7	0.165	0.025	0.045	0.078
S8	0.029	0.059	0.012	0.033
S9	0.081	0.060	0.012	0.051
S10	0.029	0.042	0.012	0.028
S11	0.029	0.103	0.045	0.059
S12	0.029	0.103	0.045	0.059
S13	0.029	0.041	0.012	0.027
S14	0.029	0.025	0.012	0.022
S15	0.029	0.026	0.045	0.033
S16	0.081	0.040	0.136	0.086
S17	0.165	0.103	0.012	0.093
S18	0.029	0.012	0.136	0.059

For Polyethylene (P2), the best option is P-cymene (S5). The remaining solvents lag considerably behind, with Cumene (S18) and Triacetin (S2) rounding out the top 3 positions. On the other hand, Hexafluoro-2-propanol (S14) is the worst-performing solvent, followed by Trifluoroacetic acid (S13) and Methyl lactate (S10). Table 29 presents a compilation of all the criteria and their final weighting for plastic Polyethylene (P2).

Regarding Polypropylene (P3), the solvent with the highest weight is Cumene (S18). It is followed in the rankings by P-cymene (S5) and Triacetin (S2), which complete the top three. In contrast, Hexafluoro-2-propanol (S14) proves to be the least effective option, with Trifluoroacetic acid (S13) and Methyl lactate (S10) among the poorest performers. Table 30 presents a compilation of all the criteria and their final weighting for plastic Polypropylene (P3).

Table 29: Final weights for P2.

Solvent \ Criterion	Cr1	Cr2	Cr3	Final Weight
S1	0.031	0.061	0.136	0.076
S2	0.031	0.103	0.136	0.090
S3	0.031	0.059	0.012	0.034
S4	0.087	0.011	0.045	0.048
S5	0.225	0.025	0.136	0.129
S6	0.031	0.103	0.012	0.048
S7	0.031	0.025	0.045	0.034
S8	0.031	0.059	0.012	0.034
S9	0.031	0.060	0.012	0.034
S10	0.031	0.042	0.012	0.028
S11	0.031	0.103	0.045	0.060
S12	0.031	0.103	0.045	0.060
S13	0.031	0.041	0.012	0.028
S14	0.031	0.025	0.012	0.023
S15	0.031	0.026	0.045	0.034
S16	0.031	0.040	0.136	0.069
S17	0.031	0.103	0.012	0.048
S18	0.225	0.012	0.136	0.124

Table 30: Final weights for P3.

Solvent \ Criterion	Cr1	Cr2	Cr3	Final Weight
S1	0.030	0.061	0.136	0.076
S2	0.030	0.103	0.136	0.090
S3	0.030	0.059	0.012	0.034
S4	0.086	0.011	0.045	0.048
S5	0.157	0.025	0.136	0.106
S6	0.030	0.103	0.012	0.048
S7	0.030	0.025	0.045	0.033
S8	0.030	0.059	0.012	0.034
S9	0.030	0.060	0.012	0.034
S10	0.030	0.042	0.012	0.028
S11	0.030	0.103	0.045	0.059
S12	0.030	0.103	0.045	0.059
S13	0.030	0.041	0.012	0.028
S14	0.030	0.025	0.012	0.023
S15	0.030	0.026	0.045	0.034
S16	0.086	0.040	0.136	0.087
S17	0.030	0.103	0.012	0.048
S18	0.245	0.012	0.136	0.131

In the case of Polyethylene terephthalate (P4), the highest-performing solvent is Dimethyl isosorbide (S6). It is followed in the rankings by Anisole (S1) and Triacetin (S2), which together form the top three. Conversely, Hexafluoro-2-propanol (S14) proves to be the least effective option, with Trifluoroacetic acid (S13) and Methyl lactate (S10) among the poorest performers. Table 31 presents a compilation of all the criteria and their final weighting for plastic Polyethylene terephthalate (P4).

Regarding Polyvinyl chloride (P5), a tie is observed for the top position between Dimethyl isosorbide (S6) and Ethyl benzoate (S17), both exhibiting comparable performance. The next highest-ranked solvent is Anisole (S1), which also demonstrates similar performance. In contrast, Hexafluoro-2-propanol (S14) once again emerges as the least suitable candidate, closely followed by Trifluoroacetic acid (S13) and Methyl lactate (S10), which occupy the lowest positions in the ranking. Table 32 presents a compilation of all the criteria and their final weighting for plastic Polyvinyl chloride (P5).

Table 31: Final weights for P4.

Solvent / Criterion	Cr1	Cr2	Cr3	Final Weight
S1	0.138	0.061	0.136	0.111
S2	0.074	0.103	0.136	0.104
S3	0.027	0.059	0.012	0.033
S4	0.027	0.011	0.045	0.028
S5	0.027	0.025	0.136	0.063
S6	0.227	0.103	0.012	0.114
S7	0.027	0.025	0.045	0.032
S8	0.027	0.059	0.012	0.033
S9	0.027	0.060	0.012	0.033
S10	0.027	0.042	0.012	0.027
S11	0.027	0.103	0.045	0.058
S12	0.074	0.103	0.045	0.074
S13	0.027	0.041	0.012	0.027
S14	0.027	0.025	0.012	0.021
S15	0.027	0.026	0.045	0.033
S16	0.027	0.040	0.136	0.068
S17	0.138	0.103	0.012	0.084
S18	0.027	0.012	0.136	0.058

Table 32: Final weights for P5.

Solvent \ Criterion	Cr1	Cr2	Cr3	Final Weight
S1	0.101	0.061	0.136	0.099
S2	0.000	0.103	0.136	0.079
S3	0.035	0.059	0.012	0.035
S4	0.035	0.011	0.045	0.031
S5	0.035	0.025	0.136	0.065
S6	0.184	0.103	0.012	0.099
S7	0.035	0.025	0.045	0.035
S8	0.035	0.059	0.012	0.035
S9	0.035	0.060	0.012	0.036
S10	0.035	0.042	0.012	0.030
S11	0.035	0.103	0.045	0.061
S12	0.035	0.103	0.045	0.061
S13	0.035	0.041	0.012	0.030
S14	0.035	0.025	0.012	0.024
S15	0.035	0.026	0.045	0.036
S16	0.035	0.040	0.136	0.070
S17	0.184	0.103	0.012	0.099
S18	0.035	0.012	0.136	0.061

When analyzing the solvents for each polymer, certain similarities become evident. For Polyethylene (P2) and Polypropylene (P3), the top three solvents are Cumene (S18), P-cymene (S5), and Triacetin (S2), differing only in their order of preference. This shows that polymers Polyethylene (P2) and Polypropylene (P3) are very similar in terms of their solubility parameters and chemical nature. In contrast, Polyethylene terephthalate (P4) and Polyvinyl chloride (P5) show greater affinity for solvents with significant polar contribution, such as Dimethyl isosorbide (S6) and Anisole (S1), suggesting that these polymers have a more polar character compared to Polyethylene (P2) and Polypropylene (P3).

On the other hand, the solvents Hexafluoro-2-propanol (S14), Trifluoroacetic acid (S13) and Methyl lactate (S10) are the least favorable, consistently ranking last in all criteria evaluated for each type of plastic. They do not exhibit high Cr1 (Solubility) values, or do they stand out in Cr2 (Hazard) or Cr3 (Price), indicating that, structurally, they are the least compatible with most plastics. If solvents were to be eliminated across the board, these would be the most obvious candidates.

It is also relevant to analyze the influence of criterion Cr2 (Hazard) or Cr3 (Price) on the final solvent selection. An illustrative case is observed for Polystyrene (P1), where 2-Methyltetrahydrofuranand (S7) and Ethyl benzoate (S17) achieved the same overall weight. Although 2-Methyltetrahydrofuranand (S7) obtained a higher weight in Cr3 (Price), its low performance in Cr2 (Hazard) ultimately relegated it to fifth place. In contrast, Ethyl benzoate (S17), due to its better performance in Cr2 (Hazard), managed to consolidate itself as the best option. This behavior demonstrates that an outstanding score in a single parameter does not guarantee the best result if it is not accompanied by solid performance in the criteria that are decisive in the final evaluation.

On the other hand, when analyzing the results, the best solvents for each polymer for a selection are: Ethyl benzoate (S17) is the winner for Polystyrene (P1); P-cymene (S5) stands out for Polyethylene (P2); Cumene (S18) is the most suitable for Polypropylene (P3); while Dimethyl isosorbide (S6) ranks first for Polyethylene terephthalate (P4) and Polyvinyl chloride (P5). This variability was expected, since each polymer has its own solubility profile, determined by its parameters and the type of molecular interactions that predominate in its structure.

One solvent that deserves special attention is Triacetin (S2), as it ranks among the top three for all the polymers analyzed, with the sole exception of Polyvinyl chloride (P5), where it ranks fourth. This consistency suggests that triacetin possesses a balance of properties that confers broad and versatile compatibility with different materials. Similar behavior is observed in Anisole (S1), which appears in the top three for P1 (Polystyrene), Polyethylene terephthalate (P4) and Polyvinyl chloride (P5). In terms of practical selection, an interesting combination would be to select Anisole (S1) for Polyethylene terephthalate (P4), given that it is the second-best option for this polymer, and reserve Dimethyl isosorbide (S6) for Polyvinyl chloride (P5), where it exhibits better performance.

5. Conclusions

This work aimed to provide a deeper understanding of the Selective Dissolution Precipitation (SDP) process, define appropriate solvent selection criteria, and identify the most suitable solvents for different polymers using a structured methodology. To achieve this, a comprehensive state-of-the-art review was conducted through an extensive literature review, which highlighted recent advances in SDP and its growing potential as a sustainable recycling technology, particularly when combined with green solvents.

Three criteria were used to select the solvents: solubility, hazard, and cost. Solubility was evaluated using Hansen solubility parameters, hazard based on GHS H-codes, and cost using supplier data and commercial sources. These were then combined within the Analytic Hierarchy Process (AHP) to compare the solvents in a clear and systematic way.

The results showed that ethyl benzoate (S17) was identified as the best solvent for polystyrene (P1), p-cymene (S5) for polyethylene (P2), cumene (S18) for polypropylene (P3), anisole (S1) for polyethylene terephthalate (P4), and dimethyl isosorbide (S6) for polyvinyl chloride (P5). On the other hand, solvents such as hexafluoro-2-propanol (S14), trifluoroacetic acid (S13), and methyl lactate (S10) were consistently ranked among the least suitable for this project.

Overall, this work proposes a more comprehensive and realistic approach to solvent selection for the Selective Dissolution Precipitation (SDP) process. By integrating scientific, environmental, and economic considerations, the methodology developed in this study offers a structured and practical decision-making tool for selecting suitable solvents in selective dissolution processes. This approach not only supports more informed solvent selection but also contributes to the development of safer and more sustainable recycling practices. In this way, the work helps advance selective dissolution technologies and supports their potential implementation in current and future recycling markets.

However, some limitations should be acknowledged. The ranking is based on theoretical parameters and weighted criteria, meaning that experimental validation is still necessary. In practice, the efficiency of the dissolution process depends on operational conditions such as temperature, contact time, solid-to-solvent ratio, agitation, and pressure. In addition, variations in supplier data and solvent availability may also influence the results.

Future work should focus on experimentally validating the selected solvents and improving the methodology by including additional criteria, such as solvent recyclability, environmental impact, and energy consumption. Expanding the analysis to other polymers and solvent families would also strengthen the applicability of the proposed approach.

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Appendix

Appendix 1: Pairwise comparison matrix for P1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	3	3	3	3	1	1/3	3	1	3	3	3	3	3	3	1	1/3	3
S2	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S3	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S4	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S5	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S6	1	3	3	3	3	1	1/3	3	1	3	3	3	3	3	3	1	1/3	3
S7	3	5	5	5	5	3	1	5	3	5	5	5	5	5	5	3	1	5
S8	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S9	1	3	3	3	3	1	1/3	3	1	3	3	3	3	3	3	1	1/3	3
S10	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S11	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S12	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S13	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S14	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S15	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1
S16	1	3	3	3	3	1	1/3	3	1	3	3	3	3	3	3	1	1/3	3
S17	3	5	5	5	5	3	1	5	3	5	5	5	5	5	5	3	1	5
S18	1/3	1	1	1	1	1/3	1/5	1	1/3	1	1	1	1	1	1	1/3	1/5	1

Appendix 2: Normalised comparison matrix for P1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.071	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.071	0.088	0.088	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.081
S2	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S3	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S4	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S5	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S6	0.071	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.071	0.088	0.088	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.081
S7	0.214	0.147	0.147	0.147	0.147	0.214	0.174	0.147	0.214	0.147	0.147	0.147	0.147	0.147	0.147	0.214	0.174	0.147	0.165
S8	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S9	0.071	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.071	0.088	0.088	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.081
S10	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S11	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S12	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S13	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S14	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S15	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029
S16	0.071	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.071	0.088	0.088	0.088	0.088	0.088	0.088	0.071	0.058	0.088	0.081
S17	0.214	0.147	0.147	0.147	0.147	0.214	0.174	0.147	0.214	0.147	0.147	0.147	0.147	0.147	0.147	0.214	0.174	0.147	0.165
S18	0.024	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.024	0.029	0.029	0.029	0.029	0.029	0.029	0.024	0.035	0.029	0.029

Appendix 3: Consistency ratio comparison matrix for P1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.081	0.086	0.086	0.086	0.086	0.081	0.055	0.086	0.081	0.086	0.086	0.086	0.086	0.086	0.086	0.081	0.055	0.086
S2	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S3	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S4	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S5	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S6	0.081	0.086	0.086	0.086	0.086	0.081	0.055	0.086	0.081	0.086	0.086	0.086	0.086	0.086	0.086	0.081	0.055	0.086
S7	0.243	0.144	0.144	0.144	0.144	0.243	0.165	0.144	0.243	0.144	0.144	0.144	0.144	0.144	0.144	0.243	0.165	0.144
S8	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S9	0.081	0.086	0.086	0.086	0.086	0.081	0.055	0.086	0.081	0.086	0.086	0.086	0.086	0.086	0.086	0.081	0.055	0.086
S10	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S11	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S12	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S13	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S14	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S15	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029
S16	0.081	0.086	0.086	0.086	0.086	0.081	0.055	0.086	0.081	0.086	0.086	0.086	0.086	0.086	0.086	0.081	0.055	0.086
S17	0.243	0.144	0.144	0.144	0.144	0.243	0.165	0.144	0.243	0.144	0.144	0.144	0.144	0.144	0.144	0.243	0.165	0.144
S18	0.027	0.029	0.029	0.029	0.029	0.027	0.033	0.029	0.027	0.029	0.029	0.029	0.029	0.029	0.029	0.027	0.033	0.029

Matrix Size	18
Random Index	1.61
CI	0.006
CR	0.004

Appendix 4: Pairwise comparison matrix for P2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S2	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S3	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S4	3	3	3	1	1/5	3	3	3	3	3	3	3	3	3	3	3	3	1/5
S5	7	7	7	5	1	7	7	7	7	7	7	7	7	7	7	7	7	1
S6	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S7	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S8	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S9	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S10	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S11	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S12	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S13	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S14	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S15	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S16	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S17	1	1	1	1/3	1/7	1	1	1	1	1	1	1	1	1	1	1	1	1/7
S18	7	7	7	5	1	7	7	7	7	7	7	7	7	7	7	7	7	1

Appendix 5: Normalised comparison matrix for P2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S2	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S3	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S4	0.094	0.094	0.094	0.063	0.046	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.046	0.087
S5	0.219	0.219	0.219	0.313	0.230	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.230	0.225
S6	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S7	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S8	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S9	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S10	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S11	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S12	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S13	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S14	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S15	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S16	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S17	0.031	0.031	0.031	0.021	0.033	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.033	0.031
S18	0.219	0.219	0.219	0.313	0.230	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.230	0.225

Appendix 6: Consistency ratio comparison matrix for P2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S2	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S3	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S4	0.093	0.093	0.093	0.087	0.045	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.045
S5	0.216	0.216	0.216	0.434	0.225	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.225
S6	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S7	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S8	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S9	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S10	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S11	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S12	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S13	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S14	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S15	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S16	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S17	0.031	0.031	0.031	0.029	0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.032
S18	0.216	0.216	0.216	0.434	0.225	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.225

Matrix Size	18
Random Index	1.61
CI	0.003
CR	0.002

Appendix 7: Pairwise comparison matrix for P3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S2	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S3	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S4	3	3	3	1	1/3	3	3	3	3	3	3	3	3	3	3	1	3	1/5
S5	5	5	5	3	1	5	5	5	5	5	5	5	5	5	5	3	5	1/3
S6	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S7	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S8	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S9	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S10	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S11	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S12	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S13	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S14	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S15	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S16	3	3	3	1	1/3	3	3	3	3	3	3	3	3	3	3	1	3	1/5
S17	1	1	1	1/3	1/5	1	1	1	1	1	1	1	1	1	1	1/3	1	1/7
S18	7	7	7	5	3	7	7	7	7	7	7	7	7	7	7	5	7	1

Appendix 8: Normalised comparison matrix for P3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S2	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S3	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S4	0.094	0.094	0.094	0.068	0.045	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.068	0.094	0.054	0.086
S5	0.156	0.156	0.156	0.205	0.134	0.156	0.156	0.156	0.156	0.156	0.156	0.156	0.156	0.156	0.156	0.205	0.156	0.089	0.157
S6	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S7	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S8	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S9	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S10	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S11	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S12	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S13	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S14	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S15	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S16	0.094	0.094	0.094	0.068	0.045	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.068	0.094	0.054	0.086
S17	0.031	0.031	0.031	0.023	0.027	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.023	0.031	0.038	0.030
S18	0.219	0.219	0.219	0.341	0.402	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.341	0.219	0.268	0.245

Appendix 9: Consistency ratio comparison matrix for P3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S2	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S3	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S4	0.091	0.091	0.091	0.086	0.052	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.086	0.091	0.049
S5	0.152	0.152	0.152	0.258	0.157	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.258	0.152	0.082
S6	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S7	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S8	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S9	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S10	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S11	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S12	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S13	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S14	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S15	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S16	0.091	0.091	0.091	0.086	0.052	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.086	0.091	0.049
S17	0.030	0.030	0.030	0.029	0.031	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.029	0.030	0.035
S18	0.213	0.213	0.213	0.430	0.470	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.213	0.430	0.213	0.245

Matrix Size	18
Random Index	1.61
CI	0.006
CR	0.004

Appendix 10: Pairwise comparison matrix for P4.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	3	5	5	5	1/3	5	5	5	5	5	3	5	5	5	5	1	5
S2	1/3	1	3	3	3	1/5	3	3	3	3	3	1	3	3	3	3	1/3	3
S3	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S4	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S5	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S6	3	5	7	7	7	1	7	7	7	7	7	5	7	7	7	7	3	7
S7	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S8	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S9	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S10	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S11	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S12	1/3	1	3	3	3	1/5	3	3	3	3	3	1	3	3	3	3	1/3	3
S13	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S14	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S15	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S16	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1
S17	1	3	5	5	5	1/3	5	5	5	5	5	3	5	5	5	5	1	5
S18	1/5	1/3	1	1	1	1/7	1	1	1	1	1	1/3	1	1	1	1	1/5	1

Appendix 11: Normalised comparison matrix for P4.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.121	0.173	0.139	0.139	0.139	0.085	0.139	0.139	0.139	0.139	0.139	0.173	0.139	0.139	0.139	0.139	0.121	0.139	0.138
S2	0.040	0.058	0.083	0.083	0.083	0.051	0.083	0.083	0.083	0.083	0.083	0.058	0.083	0.083	0.083	0.083	0.040	0.083	0.074
S3	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S4	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S5	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S6	0.363	0.288	0.194	0.194	0.194	0.255	0.194	0.194	0.194	0.194	0.194	0.288	0.194	0.194	0.194	0.194	0.363	0.194	0.227
S7	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S8	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S9	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S10	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S11	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S12	0.040	0.058	0.083	0.083	0.083	0.051	0.083	0.083	0.083	0.083	0.083	0.058	0.083	0.083	0.083	0.083	0.040	0.083	0.074
S13	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S14	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S15	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S16	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027
S17	0.121	0.173	0.139	0.139	0.139	0.085	0.139	0.139	0.139	0.139	0.139	0.173	0.139	0.139	0.139	0.139	0.121	0.139	0.138
S18	0.024	0.019	0.028	0.028	0.028	0.036	0.028	0.028	0.028	0.028	0.028	0.019	0.028	0.028	0.028	0.028	0.024	0.028	0.027

Appendix 12: Consistency ratio comparison matrix for P4..

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.138	0.222	0.135	0.135	0.135	0.076	0.135	0.135	0.135	0.135	0.135	0.222	0.135	0.135	0.135	0.135	0.138	0.135
S2	0.046	0.074	0.081	0.081	0.081	0.045	0.081	0.081	0.081	0.081	0.081	0.074	0.081	0.081	0.081	0.081	0.046	0.081
S3	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S4	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S5	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S6	0.413	0.370	0.188	0.188	0.188	0.227	0.188	0.188	0.188	0.188	0.188	0.370	0.188	0.188	0.188	0.188	0.413	0.188
S7	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S8	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S9	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S10	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S11	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S12	0.046	0.074	0.081	0.081	0.081	0.045	0.081	0.081	0.081	0.081	0.081	0.074	0.081	0.081	0.081	0.081	0.046	0.081
S13	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S14	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S15	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S16	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027
S17	0.138	0.222	0.135	0.135	0.135	0.076	0.135	0.135	0.135	0.135	0.135	0.222	0.135	0.135	0.135	0.135	0.138	0.135
S18	0.028	0.025	0.027	0.027	0.027	0.032	0.027	0.027	0.027	0.027	0.027	0.025	0.027	0.027	0.027	0.027	0.028	0.027

Matrix Size	18
Random Index	1.61
CI	0.009
CR	0.006

Appendix 13: Pairwise comparison matrix for P5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	3	3	3	3	1/3	3	3	3	3	3	3	3	3	3	3	1/3	3
S2	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S3	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S4	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S5	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S6	3	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	1	5
S7	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S8	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S9	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S10	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S11	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S12	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S13	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S14	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S15	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S16	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1
S17	3	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	1	5
S18	1/3	1	1	1	1	1/5	1	1	1	1	1	1	1	1	1	1	1/5	1

Appendix 14: Normalised comparison matrix for P5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.083	0.107	0.107	0.107	0.107	0.063	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.063	0.107	0.101
S2	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S3	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S4	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S5	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S6	0.250	0.179	0.179	0.179	0.179	0.188	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.188	0.179	0.184
S7	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S8	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S9	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S10	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S11	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S12	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S13	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S14	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S15	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S16	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035
S17	0.250	0.179	0.179	0.179	0.179	0.188	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.188	0.179	0.184
S18	0.028	0.036	0.036	0.036	0.036	0.038	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.038	0.036	0.035

Appendix 15: Consistency ratio comparison matrix for P5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.101	0.106	0.106	0.106	0.106	0.061	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.061	0.106
S2	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S3	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S4	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S5	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S6	0.303	0.177	0.177	0.177	0.177	0.184	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.184	0.177
S7	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S8	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S9	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S10	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S11	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S12	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S13	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S14	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S15	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S16	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035
S17	0.303	0.177	0.177	0.177	0.177	0.184	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.184	0.177
S18	0.034	0.035	0.035	0.035	0.035	0.037	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.037	0.035

Matrix Size	18
Random Index	1.61
CI	0.002
CR	0.001

Appendix 16: Pairwise comparison matrix for H1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1
S2	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S3	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S4	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1
S5	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1
S6	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S7	1/3	1/7	1/7	1/3	1/3	1/7	1	1/7	1/3	1/3	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3
S8	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S9	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1
S10	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1
S11	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S12	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S13	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S14	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S15	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S16	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S17	5	1	1	5	5	1	7	1	5	5	1	1	1	1	1	1	1	5
S18	1	1/5	1/5	1	1	1/5	3	1/5	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1

Appendix 17: Normalised comparison matrix for H1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S2	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S3	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S4	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S5	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S6	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S7	0.005	0.012	0.012	0.005	0.005	0.012	0.010	0.012	0.005	0.005	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.005	0.009
S8	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S9	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S10	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S11	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S12	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S13	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S14	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S15	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S16	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S17	0.082	0.081	0.081	0.082	0.082	0.081	0.073	0.081	0.082	0.082	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.082	0.081
S18	0.016	0.016	0.016	0.016	0.016	0.016	0.031	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017

Appendix 18: Consistency ratio comparison matrix for H1.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S2	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S3	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S4	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S5	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S6	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S7	0.006	0.012	0.012	0.006	0.006	0.012	0.009	0.012	0.006	0.006	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.006
S8	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S9	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S10	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017
S11	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S12	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S13	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S14	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S15	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S16	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S17	0.085	0.081	0.081	0.085	0.085	0.081	0.066	0.081	0.085	0.085	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.085
S18	0.017	0.016	0.016	0.017	0.017	0.016	0.028	0.016	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.017

Matrix Size	18
Random Index	1.61
CI	0.007
CR	0.005

Appendix 19: Pairwise comparison matrix for H2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S2	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S3	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S4	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S5	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S6	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S7	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5
S8	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S9	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S10	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S11	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S12	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S13	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S14	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S15	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5
S16	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S17	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1
S18	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	1

Appendix 20: Normalised comparison matrix for H2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S2	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S3	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S4	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S5	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S6	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S7	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S8	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S9	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S10	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S11	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S12	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S13	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S14	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S15	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S16	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S17	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S18	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061

Appendix 21: Consistency ratio comparison matrix for H2.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S2	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S3	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S4	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S5	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S6	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S7	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S8	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S9	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S10	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S11	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S12	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S13	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S14	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S15	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S16	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S17	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
S18	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.005

Appendix 22: Pairwise comparison matrix for H3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S2	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S3	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S4	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S5	1/9	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1
S6	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S7	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S8	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S9	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S10	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S11	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S12	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S13	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S14	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S15	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S16	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S17	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	9
S18	1/9	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1

Appendix 23: Normalised comparison matrix for H3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S2	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S3	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S4	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S5	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S6	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S8	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S9	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S10	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S11	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S12	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S13	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S14	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S15	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S16	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S17	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S18	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

Appendix 24: Consistency ratio comparison matrix for H3.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S2	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S3	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S4	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S5	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S6	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S8	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S9	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S10	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S11	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S12	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S13	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S14	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S15	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S16	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S17	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S18	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 25: Pairwise comparison matrix for H4.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S15	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5
S16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1
S18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1

Appendix 26: Normalised comparison matrix for H4.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Appendix 27: Consistency ratio comparison matrix for H4.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 28: Pairwise comparison matrix for H5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S2	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S3	1/6	1/6	1	1	1/6	1/6	1	1	1/6	1/6	1/6	1/6	3	3	1/6	1	1/6	1/6
S4	1/6	1/6	1	1	1/6	1/6	1	1	1/6	1/6	1/6	1/6	3	3	1/6	1	1/6	1/6
S5	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S6	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S7	1/6	1/6	1	1	1/6	1/6	1	1	1/6	1/6	1/6	1/6	3	3	1/6	1	1/6	1/6
S8	1/6	1/6	1	1	1/6	1/6	1	1	1/6	1/6	1/6	1/6	3	3	1/6	1	1/6	1/6
S9	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S10	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S11	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S12	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S13	1/9	1/9	1/3	1/3	1/9	1/9	1/3	1/3	1/9	1/9	1/9	1/9	1	1	1/9	1/3	1/9	1/9
S14	1/9	1/9	1/3	1/3	1/9	1/9	1/3	1/3	1/9	1/9	1/9	1/9	1	1	1/9	1/3	1/9	1/9
S15	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S16	1/6	1/6	1	1	1/6	1/6	1	1	1/6	1/6	1/6	1/6	3	3	1/6	1	1/6	1/6
S17	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1
S18	1	1	6	6	1	1	6	6	1	1	1	1	9	9	1	6	1	1

Appendix 29: Normalised comparison matrix for H5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S2	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S3	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.026	0.026	0.014	0.014	0.014	0.014	0.015
S4	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.026	0.026	0.014	0.014	0.014	0.014	0.015
S5	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S6	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S7	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.026	0.026	0.014	0.014	0.014	0.014	0.015
S8	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.026	0.026	0.014	0.014	0.014	0.014	0.015
S9	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S10	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S11	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S12	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S13	0.009	0.009	0.005	0.005	0.009	0.009	0.005	0.005	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.005	0.009	0.009	0.008
S14	0.009	0.009	0.005	0.005	0.009	0.009	0.005	0.005	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.005	0.009	0.009	0.008
S15	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S16	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.026	0.026	0.014	0.014	0.014	0.014	0.015
S17	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083
S18	0.083	0.083	0.084	0.084	0.083	0.083	0.084	0.084	0.083	0.083	0.083	0.083	0.078	0.078	0.083	0.084	0.083	0.083	0.083

Appendix 30: Consistency ratio comparison matrix for H5.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S2	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S3	0.014	0.014	0.015	0.015	0.014	0.014	0.015	0.015	0.014	0.014	0.014	0.014	0.024	0.024	0.014	0.015	0.014	0.014
S4	0.014	0.014	0.015	0.015	0.014	0.014	0.015	0.015	0.014	0.014	0.014	0.014	0.024	0.024	0.014	0.015	0.014	0.014
S5	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S6	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S7	0.014	0.014	0.015	0.015	0.014	0.014	0.015	0.015	0.014	0.014	0.014	0.014	0.024	0.024	0.014	0.015	0.014	0.014
S8	0.014	0.014	0.015	0.015	0.014	0.014	0.015	0.015	0.014	0.014	0.014	0.014	0.024	0.024	0.014	0.015	0.014	0.014
S9	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S10	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S11	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S12	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S13	0.009	0.009	0.005	0.005	0.009	0.009	0.005	0.005	0.009	0.009	0.009	0.009	0.008	0.008	0.009	0.005	0.009	0.009
S14	0.009	0.009	0.005	0.005	0.009	0.009	0.005	0.005	0.009	0.009	0.009	0.009	0.008	0.008	0.009	0.005	0.009	0.009
S15	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S16	0.014	0.014	0.015	0.015	0.014	0.014	0.015	0.015	0.014	0.014	0.014	0.014	0.024	0.024	0.014	0.015	0.014	0.014
S17	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083
S18	0.083	0.083	0.091	0.091	0.083	0.083	0.091	0.091	0.083	0.083	0.083	0.083	0.071	0.071	0.083	0.091	0.083	0.083

Matrix Size	18
Random Index	1.61
CI	0.010
CR	0.006

Appendix 31: Pairwise comparison matrix for H6.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S2	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S3	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S4	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9
S5	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S6	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S7	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S8	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S9	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9
S10	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S11	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S12	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S13	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S14	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S15	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S16	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S17	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1
S18	1	1	1	9	1	1	1	1	9	1	1	1	1	1	1	1	1	1

Appendix 32: Normalised comparison matrix for H6.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S2	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S3	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S4	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S5	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S6	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S8	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S9	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S10	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S11	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S12	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S13	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S14	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S15	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S16	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S17	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S18	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062

Appendix 33: Consistency ratio comparison matrix for H6.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S2	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S3	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S4	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S5	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S6	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S8	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S9	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
S10	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S11	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S12	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S13	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S14	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S15	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S16	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S17	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
S18	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 34: Pairwise comparison matrix for H7.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S2	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S3	1/6	1/6	1	1/6	1/6	1/6	3	1	1/6	1	1/6	1/6	1/6	3	1/6	1	1/6	1/6
S4	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S5	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S6	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S7	1/9	1/9	1/3	1/9	1/9	1/9	1	1/3	1/9	1/3	1/9	1/9	1/9	1	1/9	1/3	1/9	1/9
S8	1/6	1/6	1	1/6	1/6	1/6	3	1	1/6	1	1/6	1/6	1/6	3	1/6	1	1/6	1/6
S9	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S10	1/6	1/6	1	1/6	1/6	1/6	3	1	1/6	1	1/6	1/6	1/6	3	1/6	1	1/6	1/6
S11	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S12	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S13	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S14	1/9	1/9	1/3	1/9	1/9	1/9	1	0.3	1/9	1/3	1/9	1/9	1/9	1	1/9	1/3	1/9	1/9
S15	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S16	1/6	1/6	1	1/6	1/6	1/6	3	1	1/6	1	1/6	1/6	1/6	3	1/6	1	1/6	1/6
S17	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1
S18	1	1	6	1	1	1	9	6	1	6	1	1	1	9	1	6	1	1

Appendix 35: Normalised comparison matrix for H7.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S2	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S3	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.014
S4	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S5	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S6	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S7	0.009	0.009	0.004	0.009	0.009	0.009	0.008	0.004	0.009	0.004	0.009	0.009	0.009	0.008	0.009	0.004	0.009	0.009	0.008
S8	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.014
S9	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S10	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.014
S11	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S12	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S13	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S14	0.009	0.009	0.004	0.009	0.009	0.009	0.008	0.004	0.009	0.004	0.009	0.009	0.009	0.008	0.009	0.004	0.009	0.009	0.008
S15	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S16	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.013	0.013	0.025	0.013	0.013	0.013	0.013	0.014
S17	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077
S18	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.078	0.078	0.074	0.078	0.078	0.078	0.078	0.077

Appendix 36: Consistency ratio comparison matrix for H7.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S2	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S3	0.013	0.013	0.014	0.013	0.013	0.013	0.023	0.014	0.013	0.014	0.013	0.013	0.013	0.023	0.013	0.014	0.013	0.013
S4	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S5	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S6	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S7	0.009	0.009	0.005	0.009	0.009	0.009	0.008	0.005	0.009	0.005	0.009	0.009	0.009	0.008	0.009	0.005	0.009	0.009
S8	0.013	0.013	0.014	0.013	0.013	0.013	0.023	0.014	0.013	0.014	0.013	0.013	0.013	0.023	0.013	0.014	0.013	0.013
S9	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S10	0.013	0.013	0.014	0.013	0.013	0.013	0.023	0.014	0.013	0.014	0.013	0.013	0.013	0.023	0.013	0.014	0.013	0.013
S11	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S12	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S13	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S14	0.009	0.009	0.005	0.009	0.009	0.009	0.008	0.005	0.009	0.005	0.009	0.009	0.009	0.008	0.009	0.005	0.009	0.009
S15	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S16	0.013	0.013	0.014	0.013	0.013	0.013	0.023	0.014	0.013	0.014	0.013	0.013	0.013	0.023	0.013	0.014	0.013	0.013
S17	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077
S18	0.077	0.077	0.086	0.077	0.077	0.077	0.069	0.086	0.077	0.086	0.077	0.077	0.077	0.069	0.077	0.086	0.077	0.077

Matrix Size	18
Random Index	1.61
CI	0.009
CR	0.005

Appendix 37: Pairwise comparison matrix for H8.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S2	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S3	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S4	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S5	1/7	1/7	1/7	1/7	1	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3	1/7	1/3	1/7	1/7	1/7
S6	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S7	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S8	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S9	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S10	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S11	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S12	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S13	1/5	1/5	1/5	1/5	3	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1	1/5	1/5	1/5
S14	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S15	1/5	1/5	1/5	1/5	3	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1	1/5	1/5	1/5
S16	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S17	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1
S18	1	1	1	1	7	1	1	1	1	1	1	1	5	1	5	1	1	1

Appendix 38: Normalised comparison matrix for H8.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S2	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S3	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S4	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S5	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.004	0.009	0.004	0.009	0.009	0.009	0.009
S6	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S7	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S8	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S9	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S10	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S11	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S12	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S13	0.013	0.013	0.013	0.013	0.027	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.014
S14	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S15	0.013	0.013	0.013	0.013	0.027	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.014
S16	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S17	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064
S18	0.064	0.064	0.064	0.064	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.065	0.064	0.065	0.064	0.064	0.064	0.064

Appendix 39: Consistency ratio comparison matrix for H8.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S2	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S3	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S4	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S5	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.005	0.009	0.005	0.009	0.009	0.009
S6	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S7	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S8	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S9	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S10	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S11	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S12	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S13	0.013	0.013	0.013	0.013	0.026	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.014	0.013	0.014	0.013	0.013	0.013
S14	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S15	0.013	0.013	0.013	0.013	0.026	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.014	0.013	0.014	0.013	0.013	0.013
S16	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S17	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064
S18	0.064	0.064	0.064	0.064	0.060	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.068	0.064	0.068	0.064	0.064	0.064

Matrix Size	18
Random Index	1.61
CI	0.009
CR	0.005

Appendix 40: Pairwise comparison matrix for H9.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1
S2	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S3	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S4	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S5	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S6	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S7	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S8	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S9	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S10	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1
S11	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S12	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S13	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S14	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S15	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S16	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S17	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	3
S18	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1

Appendix 41: Normalised comparison matrix for H9.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
S2	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S3	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S4	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S5	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S6	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S7	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S8	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S9	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S10	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
S11	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S12	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S13	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S14	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S15	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S16	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S17	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S18	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021

Appendix 42: Consistency ratio comparison matrix for H9.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
S2	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S3	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S4	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S5	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S6	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S7	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S8	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S9	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S10	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
S11	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S12	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S13	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S14	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S15	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S16	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S17	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
S18	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 43: Pairwise comparison matrix for H10.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
S18	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1

Appendix 44: Normalised comparison matrix for H10.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

Appendix 45: Consistency ratio comparison matrix for H10.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 46: Pairwise comparison matrix for H11.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S2	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S3	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S4	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S5	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S6	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S7	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S8	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S9	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S10	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S11	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S12	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S13	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S14	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5
S15	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S16	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S17	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S18	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1

Appendix 47: Normalised comparison matrix for H11.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Appendix 48: Consistency ratio comparison matrix for H11.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 49: Pairwise comparison matrix for H12.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S2	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S3	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S4	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S5	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S6	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S7	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S8	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S9	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S10	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S11	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S12	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S13	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S14	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5
S15	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S16	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S17	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1
S18	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1

Appendix 50: Normalised comparison matrix for H12.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Appendix 51: Consistency ratio comparison matrix for H12.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 52: Pairwise comparison matrix for H13.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S2	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S3	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S4	1/9	1/9	1/9	1	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/9
S5	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S6	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S7	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S8	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S9	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S10	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S11	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S12	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S13	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S14	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S15	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S16	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S17	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S18	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix 53: Normalised comparison matrix for H13.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Appendix 54: Consistency ratio comparison matrix for H13.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S2	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S3	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S4	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
S5	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S6	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S7	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S8	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S9	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S10	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S11	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S12	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S13	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S14	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S15	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S16	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S17	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
S18	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058

Matrix Size	18
Random Index	1.61
CI	0.000
CR	0.000

Appendix 55: Pairwise comparison matrix for H14.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S2	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S3	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S4	1/9	1/9	1/9	1	1/3	1/9	1/9	1/9	1/9	1/9	1/9	1/9	1/5	1/9	1/3	1/3	1/9	1/3
S5	1/7	1/7	1/7	3	1	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3	1/7	1	1	1/7	1
S6	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S7	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S8	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S9	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S10	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S11	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S12	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S13	1/5	1/5	1/5	5	3	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	3	3	1/5	3
S14	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S15	1/7	1/7	1/7	3	1	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3	1/7	1	1	1/7	1
S16	1/7	1/7	1/7	3	1	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3	1/7	1	1	1/7	1
S17	1	1	1	9	7	1	1	1	1	1	1	1	5	1	7	7	1	7
S18	1/7	1/7	1/7	3	1	1/7	1/7	1/7	1/7	1/7	1/7	1/7	1/3	1/7	1	1	1/7	1

Appendix 56: Normalised comparison matrix for H14.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S2	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S3	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S4	0.009	0.009	0.009	0.008	0.004	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.003	0.009	0.004	0.004	0.009	0.004	0.007
S5	0.011	0.011	0.011	0.024	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.005	0.011	0.011	0.011	0.011	0.011	0.011
S6	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S7	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S8	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S9	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S10	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S11	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S12	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S13	0.016	0.016	0.016	0.040	0.033	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.033	0.033	0.016	0.033	0.021
S14	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S15	0.011	0.011	0.011	0.024	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.005	0.011	0.011	0.011	0.011	0.011	0.011
S16	0.011	0.011	0.011	0.024	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.005	0.011	0.011	0.011	0.011	0.011	0.011
S17	0.078	0.078	0.078	0.071	0.077	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.080	0.078	0.077	0.077	0.078	0.077	0.077
S18	0.011	0.011	0.011	0.024	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.005	0.011	0.011	0.011	0.011	0.011	0.011

Appendix 57: Consistency ratio comparison matrix for H14.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S2	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S3	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S4	0.009	0.009	0.009	0.007	0.004	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.004	0.009	0.004	0.004	0.009	0.004
S5	0.011	0.011	0.011	0.022	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.007	0.011	0.011	0.011	0.011	0.011
S6	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S7	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S8	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S9	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S10	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S11	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S12	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S13	0.015	0.015	0.015	0.036	0.034	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.021	0.015	0.034	0.034	0.015	0.034
S14	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S15	0.011	0.011	0.011	0.022	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.007	0.011	0.011	0.011	0.011	0.011
S16	0.011	0.011	0.011	0.022	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.007	0.011	0.011	0.011	0.011	0.011
S17	0.077	0.077	0.077	0.065	0.080	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.104	0.077	0.080	0.080	0.077	0.080
S18	0.011	0.011	0.011	0.022	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.007	0.011	0.011	0.011	0.011	0.011

Matrix Size	18
Random Index	1.61
CI	0.015
CR	0.009

Appendix 58: Pairwise comparison matrix for Pr.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	1	1	9	5	1	9	5	9	9	9	5	5	9	9	5	1	9	1
S2	1	1	9	5	1	9	5	9	9	9	5	5	9	9	5	1	9	1
S3	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S4	1/5	1/5	5	1	1/5	5	1	5	5	5	1	1	5	5	1	1/5	5	1/5
S5	1	1	9	5	1	9	5	9	9	9	5	5	9	9	5	1	9	1
S6	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S7	1/5	1/5	5	1	1/5	5	1	5	5	5	1	1	5	5	1	1/5	5	1/5
S8	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S9	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S10	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S11	1/5	1/5	5	1	1/5	5	1	5	5	5	1	1	5	5	1	1/5	5	1/5
S12	1/5	1/5	5	1	1/5	5	1	5	5	5	1	1	5	5	1	1/5	5	1/5
S13	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S14	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S15	1/5	1/5	5	1	0.2	5	1	5	5	5	1	1	5	5	1	1/5	5	1/5
S16	1	1	9	5	1	9	5	9	9	9	5	5	9	9	5	1	9	1
S17	1/9	1/9	1	1/5	1/9	1	1/5	1	1	1	1/5	1/5	1	1	1/5	1/9	1	1/9
S18	1	1	9	5	1	9	5	9	9	9	5	5	9	9	5	1	9	1

Appendix 59: Normalised comparison matrix for Pr.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	Weight
S1	0.145	0.145	0.115	0.158	0.145	0.115	0.158	0.115	0.115	0.115	0.158	0.158	0.115	0.115	0.158	0.145	0.115	0.145	0.136
S2	0.145	0.145	0.115	0.158	0.145	0.115	0.158	0.115	0.115	0.115	0.158	0.158	0.115	0.115	0.158	0.145	0.115	0.145	0.136
S3	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S4	0.029	0.029	0.064	0.032	0.029	0.064	0.032	0.064	0.064	0.064	0.032	0.032	0.064	0.064	0.032	0.029	0.064	0.029	0.045
S5	0.145	0.145	0.115	0.158	0.145	0.115	0.158	0.115	0.115	0.115	0.158	0.158	0.115	0.115	0.158	0.145	0.115	0.145	0.136
S6	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S7	0.029	0.029	0.064	0.032	0.029	0.064	0.032	0.064	0.064	0.064	0.032	0.032	0.064	0.064	0.032	0.029	0.064	0.029	0.045
S8	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S9	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S10	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S11	0.029	0.029	0.064	0.032	0.029	0.064	0.032	0.064	0.064	0.064	0.032	0.032	0.064	0.064	0.032	0.029	0.064	0.029	0.045
S12	0.029	0.029	0.064	0.032	0.029	0.064	0.032	0.064	0.064	0.064	0.032	0.032	0.064	0.064	0.032	0.029	0.064	0.029	0.045
S13	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S14	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S15	0.029	0.029	0.064	0.032	0.029	0.064	0.032	0.064	0.064	0.064	0.032	0.032	0.064	0.064	0.032	0.029	0.064	0.029	0.045
S16	0.145	0.145	0.115	0.158	0.145	0.115	0.158	0.115	0.115	0.115	0.158	0.158	0.115	0.115	0.158	0.145	0.115	0.145	0.136
S17	0.016	0.016	0.013	0.006	0.016	0.013	0.006	0.013	0.013	0.013	0.006	0.006	0.013	0.013	0.006	0.016	0.013	0.016	0.012
S18	0.145	0.145	0.115	0.158	0.145	0.115	0.158	0.115	0.115	0.115	0.158	0.158	0.115	0.115	0.158	0.145	0.115	0.145	0.136

Appendix 60: Consistency ratio comparison matrix for Pr.

Solvent	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
S1	0.136	0.136	0.107	0.227	0.136	0.107	0.227	0.107	0.107	0.107	0.227	0.227	0.107	0.107	0.227	0.136	0.107	0.136
S2	0.136	0.136	0.107	0.227	0.136	0.107	0.227	0.107	0.107	0.107	0.227	0.227	0.107	0.107	0.227	0.136	0.107	0.136
S3	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S4	0.027	0.027	0.060	0.045	0.027	0.060	0.045	0.060	0.060	0.060	0.045	0.045	0.060	0.060	0.045	0.027	0.060	0.027
S5	0.136	0.136	0.107	0.227	0.136	0.107	0.227	0.107	0.107	0.107	0.227	0.227	0.107	0.107	0.227	0.136	0.107	0.136
S6	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S7	0.027	0.027	0.060	0.045	0.027	0.060	0.045	0.060	0.060	0.060	0.045	0.045	0.060	0.060	0.045	0.027	0.060	0.027
S8	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S9	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S10	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S11	0.027	0.027	0.060	0.045	0.027	0.060	0.045	0.060	0.060	0.060	0.045	0.045	0.060	0.060	0.045	0.027	0.060	0.027
S12	0.027	0.027	0.060	0.045	0.027	0.060	0.045	0.060	0.060	0.060	0.045	0.045	0.060	0.060	0.045	0.027	0.060	0.027
S13	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S14	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S15	0.027	0.027	0.060	0.045	0.027	0.060	0.045	0.060	0.060	0.060	0.045	0.045	0.060	0.060	0.045	0.027	0.060	0.027
S16	0.136	0.136	0.107	0.227	0.136	0.107	0.227	0.107	0.107	0.107	0.227	0.227	0.107	0.107	0.227	0.136	0.107	0.136
S17	0.015	0.015	0.012	0.009	0.015	0.012	0.009	0.012	0.012	0.012	0.009	0.009	0.012	0.012	0.009	0.015	0.012	0.015
S18	0.136	0.136	0.107	0.227	0.136	0.107	0.227	0.107	0.107	0.107	0.227	0.227	0.107	0.107	0.227	0.136	0.107	0.136

Matrix Size	18
Random Index	1.61
CI	0.039
CR	0.024