

Interlaboratory comparison study for microplastics using the upcoming ISO-standard ISO 16094-2:2025

Final report,

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Preface

This report summarises the achievements of Working Group 4 “Nano-and micro scale particulate contaminants” (WG 4) under the NORMAN network, a platform dedicated to advancing knowledge and harmonizing methods for monitoring emerging environmental substances. Building on prior Joint Programme of Activities (JPAs), WG 4 has contributed to NORMAN’s goal of standardising approaches for measuring microplastic particles (MPs) in support of the EU’s Green Deal and Plastics Strategy. In 2022, WG 4 conducted an interlaboratory study (ILS) in collaboration with QUASIMEME and EUROqCHARM to detect MPs in complex matrices. The study revealed significant variability among laboratories, driven by uncertainties in sample preparation and data processing. To address this, the 2023 JPA introduced a novel sandwich filter to target uncertainties in data processing, which was successfully tested by NORMAN members. The present ILS builds on the lessons learned from the 2022 and 2023 JPAs and integrates feedback provided by NORMAN members. It is designed to align with the forthcoming ISO standard method for water sample analysis. The participants in this study include NORMAN network members, the EU PlasticTrace consortium, various PlasticTrace stakeholders, and other interested laboratories from around the world. The ILS was organised by the Norwegian Institute for Water Research (NIVA) and EWAG through the NORMAN network, in collaboration with ISO TG 147/SC2 /JWG1, the PlasticTrace project and Chiron, in connection with the validation of the ISO method (ISO/NP 16094-2 *MP in water – Vibrational spectroscopy).

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1. Introduction

Microplastics, typically defined as plastic particles smaller than 5 mm in diameter, have been detected across virtually all environmental compartments studied to date. Comprising a diverse array of polymer types, morphologies, and sizes, microplastics present substantial analytical challenges, particularly in sampling, isolation, and characterisation. To address these challenges, numerous analytical approaches have been developed to detect and quantify microplastics in complex environmental and biological matrices. These methods seek to improve detection accuracy, enable quantitative assessment, and support the evaluation of potential exposure and risk. However, reliable detection remains difficult due to the ubiquity of microplastics and the persistent risk of contamination throughout sampling and analytical workflows. The diversity of matrices further necessitates the use of tailored extraction and purification techniques, which are often labour-intensive and susceptible to introducing variability or particle degradation. Effective matrix removal therefore requires a careful balance between maintaining microplastic integrity, minimizing contamination, and reducing procedural steps that could introduce analytical bias.

In response to these methodological challenges, the development of reference materials (RMs) has become a key strategy for method validation and quality assurance in microplastic analysis. RMs - available in formats such as suspensions or tablets - contain a known number of particles with defined polymer compositions, sizes, and shapes. These materials enable verification of recovery efficiency and analytical accuracy across all stages of the workflow, from sample preparation to detection. Complementarily, interlaboratory comparison studies (ILS) are frequently used to assess the performance, comparability, and reliability of analytical methods. Yet, substantial variability in results among laboratories has been repeatedly reported, largely attributable to uncertainties arising from both sample preparation and data processing pipelines. Many ILSs are not designed to distinguish the relative contributions of these factors, limiting the ability to identify sources of analytical variability. Consequently, improved experimental design and the ability to disentangle individual components of the analytical pipeline are essential for advancing standardization and ensuring the robustness of microplastic detection methodologies.

The establishment of internationally recognised standards - such as those developed under the International Organisation for Standardisation (ISO) and the European Committee for Standardisation (CEN) - is a critical step toward harmonised protocols. Such standardisation supports regulatory initiatives under the EU Green Deal, the Plastics Strategy, and emerging frameworks for microplastic risk assessment, ensuring that analytical data are robust, comparable, and suitable for informing policy and environmental management. Within ISO's Technical Committee 147 (Water quality) and its working groups, several initiatives are currently underway to establish standardized methods for sampling, extraction, identification, and quantification of microplastics in environmental and biological matrices. These efforts aim to define critical parameters such as particle size classification, polymer identification techniques (e.g., FTIR, Raman spectroscopy), and quality control requirements including the use of blanks, contamination control, and recovery assessment. The adoption of ISO standards ensures that analytical results are generated in accordance with internationally recognized criteria for accuracy and reproducibility, thereby facilitating the comparison of data across studies, jurisdictions, and time scales. Moreover, alignment with ISO standards strengthens the scientific foundation of regulatory frameworks by providing validated and transparent methodologies that can underpin environmental monitoring, risk assessment, and compliance evaluation. As microplastic research progresses toward integration with chemical and ecological risk assessment frameworks, ISO's role in establishing traceable, reproducible, and transparent analytical methods will be essential for supporting evidence-based decision-making and global policy harmonisation.

The objective of the current study, based on the previous JPAs from 2022 and 2023 completed by WG 4 in NORMAN network, was to run an ILS based on, but not limited to the upcoming ISO method (ISO/NP 16094-2*MP in water – Vibrational spectroscopy), including in-house methods for those participants not able to use the ISO methods in their respective country. The ISO standard method for water samples provides a rigorous framework for sample preparation and reporting, offering a standardised approach to improve comparability and reliability in microplastic analysis. Utilizing a well-defined protocol on a simple matrix allows for the identification and isolation of potential sources of error or uncertainty within the analytical process. In addition to employing the ISO standard method, incorporating in-house methods from participating laboratories offers insights into the performance and limitations of varying approaches. This dual strategy enables the assessment of whether adherence to a strict protocol is sufficient to reduce uncertainty in reported microplastic counts or if variability arises primarily from other factors, such as analytical techniques, instrumentation, or data processing software. Such evaluations are essential for refining methods and enhancing confidence in microplastic quantification. Soda tablets containing known amounts of different MP types (polypropylene (PP), polyethylene (PE), polystyrene (PS), polyvinyl chloride (PVC), polyethylene terephthalate (PET) and polycarbonate (PC)) were used as the RMs in this study. In addition, a limited number of ‘sandwich filters’ assembled at EAWAG was sent to expert laboratories taking part in the ILS, however this is not reported in the current report.

2. Materials and methods

The ILS was organised through the NORMAN network in collaboration with ISO Technical Group 147/SC2/JWG1 and the PlasticTrace project, as part of the validation process for the ISO method (ISO/NP 16094-2 *Microplastics in Water – Vibrational Spectroscopy*). The study was conducted from August 2024 to December 2024. Participants included members of the NORMAN network, the EU PlasticTrace consortium, stakeholders from the PlasticTrace project, and other interested laboratories worldwide. A registration form and accompanying questionnaire were distributed to collect information about participants’ instrumentation and analytical methods (see Supplementary Materials A and B).

The ILS involved triplicate analyses of soda tablets spiked with microplastics (MPs) within the size range of 50–500 μm . These samples were prepared and shipped in collaboration by Chiron AS, Trondheim, Norway. The provided tablets included:

- Three soda tablets spiked with polyethylene (PE), polyethylene terephthalate (PET), and polystyrene (PS).
- Three soda tablets spiked with polyvinyl chloride (PVC), polypropylene (PP), and polycarbonate (PC).
- Three blank soda tablets acting as controls.

2.1 Methods of dissolving soda tablets

2.1.1 Samples and coding:

The participating laboratories received sample packets in a tablet strip format, as depicted in Figure 1. Prior to use, the tablets were stored in a controlled dry environment, preferably within a desiccator, to prevent moisture exposure. Each tablet was composed of a precise mixture of sodium bicarbonate (NaHCO_3), citric acid ($\text{C}_6\text{H}_8\text{O}_7$), and lactose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$). The sodium bicarbonate component is highly reactive to humidity, which could potentially compromise the chemical stability of the tablets and impact subsequent analyses. Laboratories were instructed to analyse, and report results for all three samples—designated as A, B, and C - independently (e.g., 1, 2, 3).

Table 1. Code and sample types of the spiked and control soda tablets provided for participants in the study.

	Colour code
Sample A1	Blue
Sample A2	Blue
Sample A3	Blue
Sample B1	Green
Sample B2	Green
Sample B3	Green
Sample C1	Yellow
Sample C2	Yellow
Sample C3	Yellow

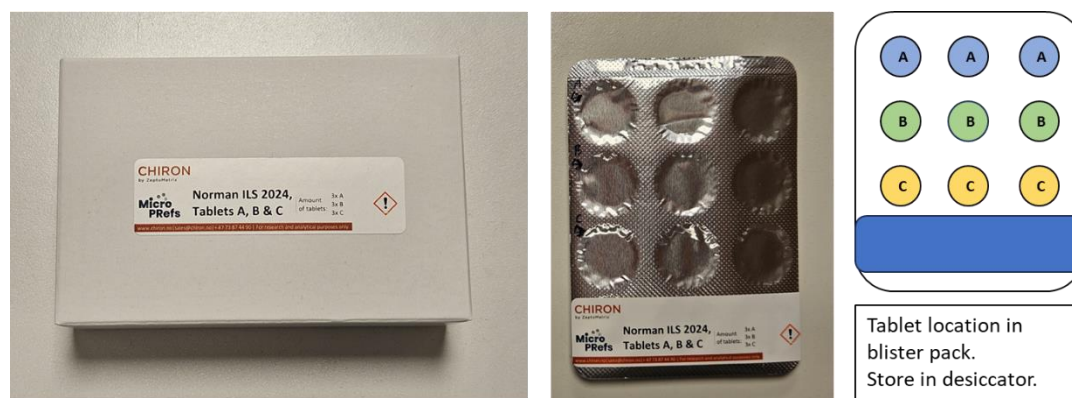


Figure 1. Example of samples sent to participants and the colour coding with the tablet location of each mix (to the right)

2.1.2 Dissolving the tablets

Participants were instructed to open the tablet strip by carefully cutting through the aluminium foil on the designated side. The tablet was to be removed with care and transferred into a suitable container or beaker containing a minimum of 30 mL of filtered water. To minimise losses caused by effervescence during the dissolution process, the use of tall containers with a secure covering was recommended. Participants were required to allow the tablet to fully dissolve, which typically took at least 10 minutes. The resulting solution, simulating a water sample, was then ready for further analysis. Analytical procedures could be carried out using either the ISO/NP 16094-2 MP standard method or the laboratory's established in-house protocol.

2.1.3 Reporting the results

The ISO method encompasses a particle size range of 1–5000 µm; however, the focus of this study was on microplastics within the 50–500 µm size range and the six most commonly used polymers: polyethylene (PE), polyethylene terephthalate (PET), polystyrene (PS), polypropylene (PP), polycarbonate (PC), and polyvinyl chloride (PVC). Microplastics outside this size range (<50 µm or >500 µm), as well as additional polymers such as polyamide (PA), polytetrafluoroethylene (PTFE), polymethyl methacrylate (PMMA), and polyurethane (PU), could also be reported using the provided Excel reporting template. An example of the reporting form is presented in Table 2.

Participants were instructed to document the number of particles for each polymer and size class. Additionally, they were required to report relevant methodological details, including the type of filters used, the specifications of FTIR or Raman spectroscopic instrumentation, the Hit Quality Index, the Limit of Detection (LoD), and recovery rates achieved during the analysis.

Table 2. Example of the reporting form distributed to the participants.

Sample A1		<50µm	50-100µm	100-500µm	>500µm
Polyethylene	PE				
Polyethylene Terephthalate	PET				
Polystyrene	PS				
Polypropylene	PP				
Polycarbonate	PC				
Polyvinyl Chloride	PVC				
Polytetrafluoroethylene	PTFE				
Polyamide	PA				
Methylpolymethacrylate	PMMA				
Polyurethane	PU				
Other					

3. Results

A total of 32 laboratories registered for the ILS, with reported results from 23 laboratories (68%). Out of the participating laboratories, 19 used the ISO/NP 16094-2 MP standard method, and 4 used their in-house methods. All individual results are presented in the Appendices (appendix) and are summarised in the following section for the size range from 50 – 500 μm for sample A and B, to which PE, PET, PS (samples A1, A2 and A3) and PP, PC, PVC (samples B1, B2 and B3) were added. For the blank samples, not only the results for the size range 50 – 500 μm is given, but also the results for the particles < 50 μm . The results for the other polymers highlighted in the ISO method, such as PFTA, PA, PMMA and PU are not discussed in this section as these polymers were not added to the tablets but could be present as contaminant. Out of the participants; 9 laboratories used μFTIR as the final detection system, 6 LDIR, and 5 μRAMAN .

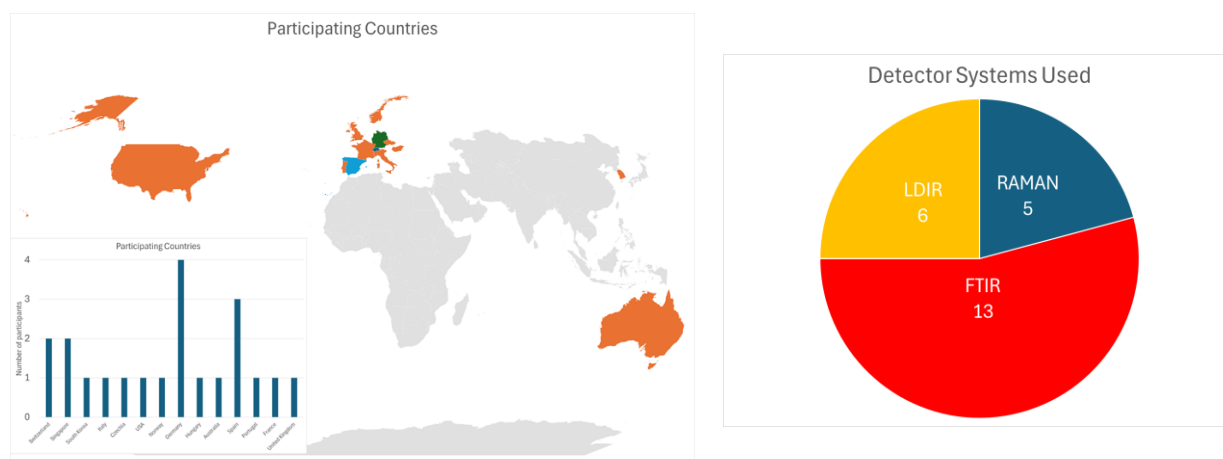


Figure 2. Participating countries and polymer identification instrument used.

3.1 Results Sample A

The results of the three identical tablets, A1, A2 and A3 and are given in **Error! Reference source not found.** where the mean, the standard variation (SD) and the relative standard deviation (RSD) between the laboratories are provided, in addition to the minimum, maximum and the average of the within laboratory variation. The RSD between the laboratories for the 3 individual tablets for PE varied from 52% to 68%, for PET from 54% to 67% and PS from 50% to 87%. For the total of the three polymers the variation ranged from 43% to 56%. The mean value reported by the participants for the three tablets A1, A2 and A3 varied from 63-67% for the individual polymers, and 58% for the total. Repeatability within the laboratories for the individual polymers varied from 0% to 173%, with an average of 43% for PE, 46% for PET and 43% for PS. For the total of three polymers the laboratory variation ranged from two to 100%, with an average of 29%.

Figure 4 displays the results of the average for the total of the three polymers (PE, PET, PS) for the three samples (A1, A2, A3) showing the variation between the laboratories in relation to the within laboratory variation. In the same figure the different detection techniques are μFTIR , LIDIR and RAMAN which are marked with different colours. Figure 4, Figure 5, and Figure 6 shows the results of the individual polymers PE, PET and PS.

Table 3. The between laboratory variation for the tablets A1, A2, A3 for PE, PET, PS and the total and the within laboratory variation of the three identical tablets.

Variation between the laboratories					
Polymer			Mean	SD	RSD
A1 50-500 µm	Polyethylene	PE	15	10	65%
	Polyethylene Terephthalate	PET	12	8	65%
	Polystyrene	PS	19	16	87%
Total 3 polymers			46	26	56%
A2 50-500 µm	Polyethylene	PE	16	11	68%
	Polyethylene Terephthalate	PET	11	8	67%
	Polystyrene	PS	14	9	66%
Total 3 polymers			42	23	55%
A3 50-500 µm	Polyethylene	PE	18	9	52%
	Polyethylene Terephthalate	PET	12	7	54%
	Polystyrene	PS	17	8	50%
Total 3 polymers			47	20	43%
Mean A1, A2, A3 50-500 µm	Polyethylene	PE	18	12	65%
	Polyethylene Terephthalate	PET	13	9	67%
	Polystyrene	PS	18	11	63%
Total 3 polymers			48	28	58%
Repeatability within the laboratory			Min	Max	Average
RSD A1, A2, A3 50-500 µm	Polyethylene	PE	3%	173%	43%
	Polyethylene Terephthalate	PET	0%	173%	46%
	Polystyrene	PS	3%	173%	43%
Sample A RSD A1, A2, A3	Total 3 polymers	RSD Total %RSD	2%	100%	29%

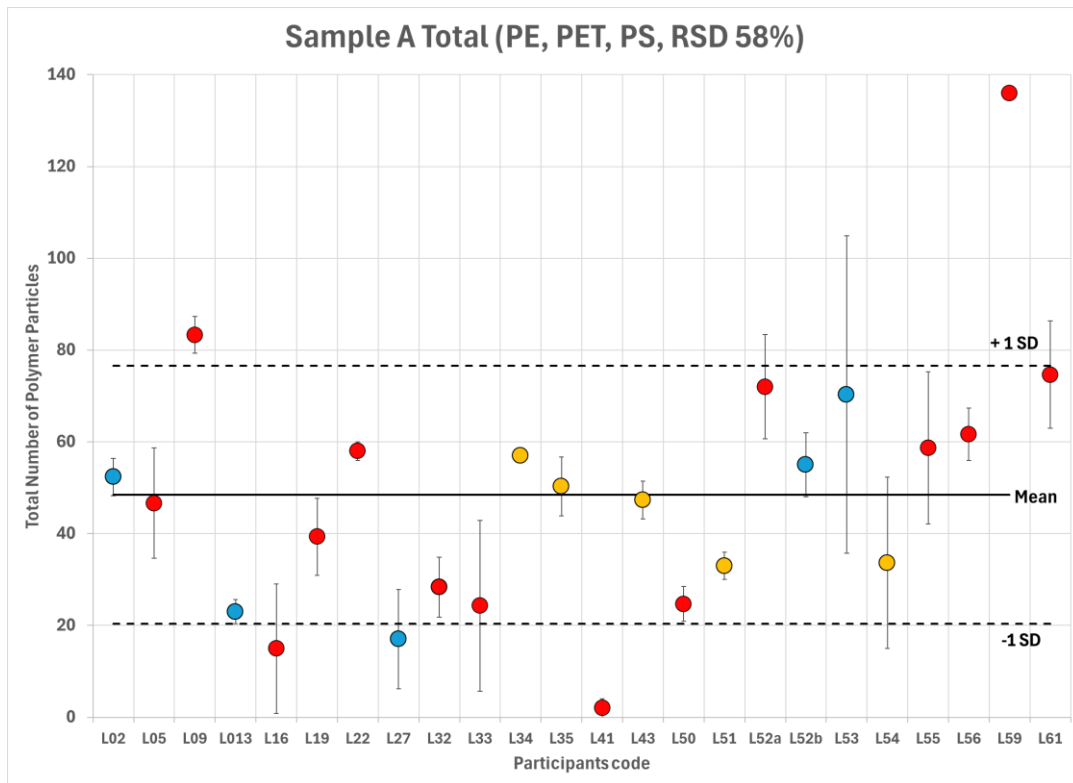


Figure 3. Graphical representation for Sample A, the average of the total number of polymer particles (PE, PET, PS) of the three samples (A1,A2,A3), the within laboratory SD, and the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

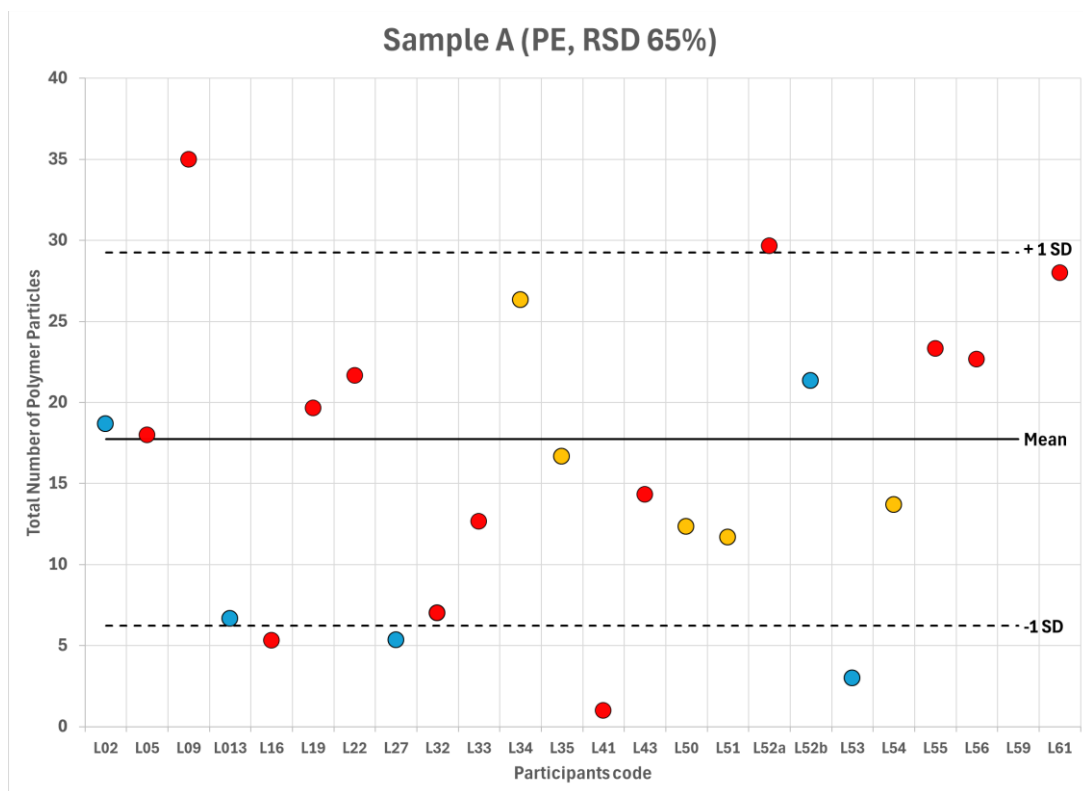


Figure 4. Graphical representation for Sample A, the average PE in the three samples (A1,A2,A3), the within laboratory SD, the mean, +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

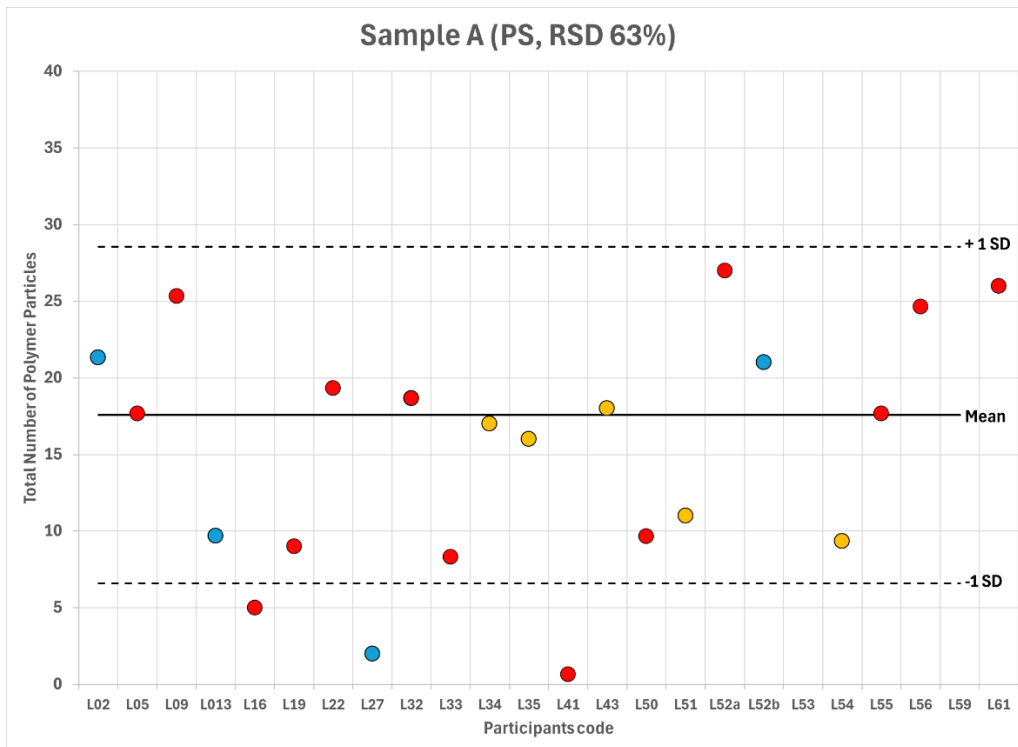


Figure 5. Graphical representation for Sample A, the average of PS in the three samples (A1,A2,A3), the within laboratory SD, the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

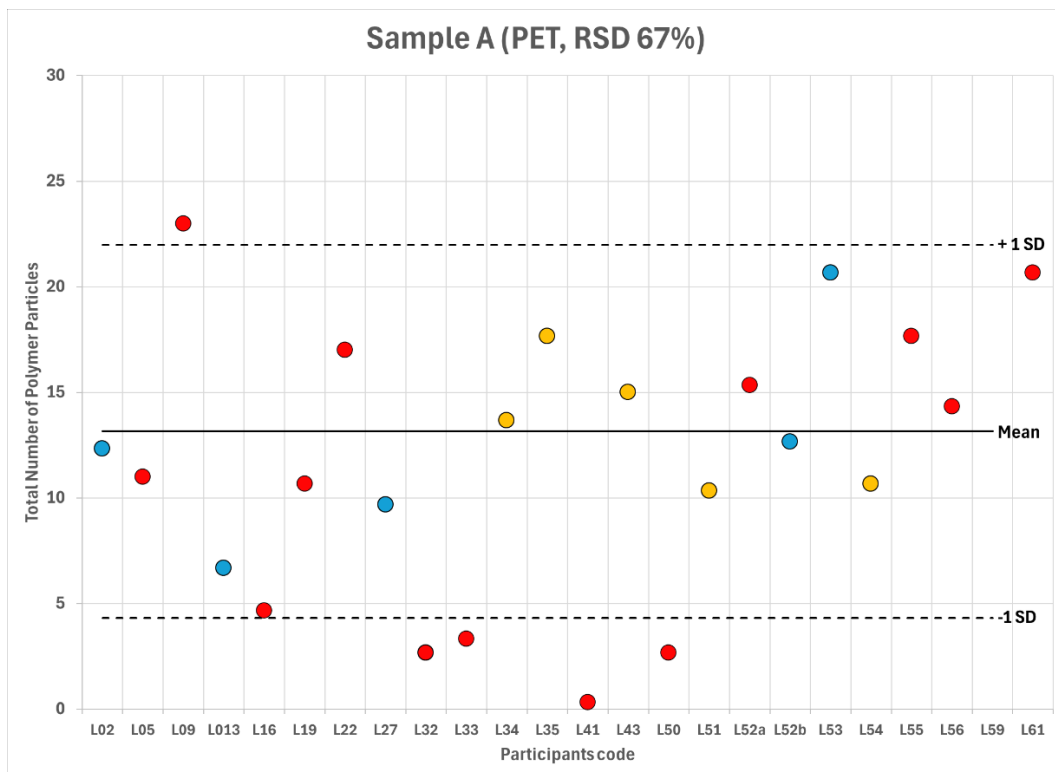


Figure 6. Graphical representation for Sample A, the average of PET in the three samples (A1,A2,A3), the within laboratory SD, the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

3.1 Results Sample B

The results for Sample B are summarised in Table 4. The between laboratory variation for the tablets A1, A2, A3 for PE, PET, PS and the total and the within laboratory variation of the three identical tablets. The RSD between the laboratories for the 3 individual tablets for PP varied from 54% to 91%, for PC from 57% to 80% and PVC from 56% to 61%. The total of the three polymers showed a variance between 43% and 59% of the interlaboratory variance of the three individual tablets. The mean value of the polymers reported by the participants for the three tablets B1, B2 and B3 and of the total varied from 57-83% for the individual polymers, and 64% for the total of the three polymers. Repeatability within the laboratories for the individual polymers varied from 0% to 173%, with averages of 45%, 57% and 48% for PP, PC and PVC respectively. For the total of three polymers the laboratory variation ranged from 4% to 117%, with an average of 27%.

Figure 7 displays the results of the average for the total of the three polymers (PP, PC and PVC) for the three samples (B1, B2, B3) showing the variation between the laboratories in relation to the within laboratory variation. In the same figure the different detection techniques are μ FTIR, LIDIR and RAMAN are marked with different colours. Figure 8, Figure 9, and Figure 10, show the results of the individual polymers PE, PET and PS.

Table 4. The between laboratory variation for the tablets A1, A2, A3 for PE, PET, PS and the total and the within laboratory variation of the three identical tablets.

Variation between the laboratories					
	Polymer		Mean	SD	RSD
B1 50-500 μ m	Polypropylene	PP	16	14	91%
	Polycarbonate	PC	12	9	80%
	Polyvinyl Chloride	PVC	14	9	61%
Total 3 polymers			42	29	69%
B2 50-500 μ m	Polypropylene	PP	20	11	57%
	Polycarbonate	PC	14	8	57%
	Polyvinyl Chloride	PVC	15	8	56%
Total 3 polymers			48	21	43%
B3 50-500 μ m	Polypropylene	PP	21	11	54%
	Polycarbonate	PC	13	10	75%
	Polyvinyl Chloride	PVC	17	10	61%
Total 3 polymers			51	28	54%
Mean B1, B2, B3 50-500 μ m	Polypropylene	PP	20	11	57%
	Polycarbonate	PC	15	12	83%
	Polyvinyl Chloride	PVC	17	13	74%
Total 3 polymers			52	33	64%
Repeatability within the laboratory			Min	Max	Average
RSD B1, B2, B3 50-500 μ m	Polypropylene	PP	2%	103%	45%
	Polycarbonate	PC	0%	173%	57%
	Polyvinyl Chloride	PVC	3%	173%	48%
Sample B RSD B1, B2, B3	Total 3 polymers	RSD Total %RSD	4%	117%	27%

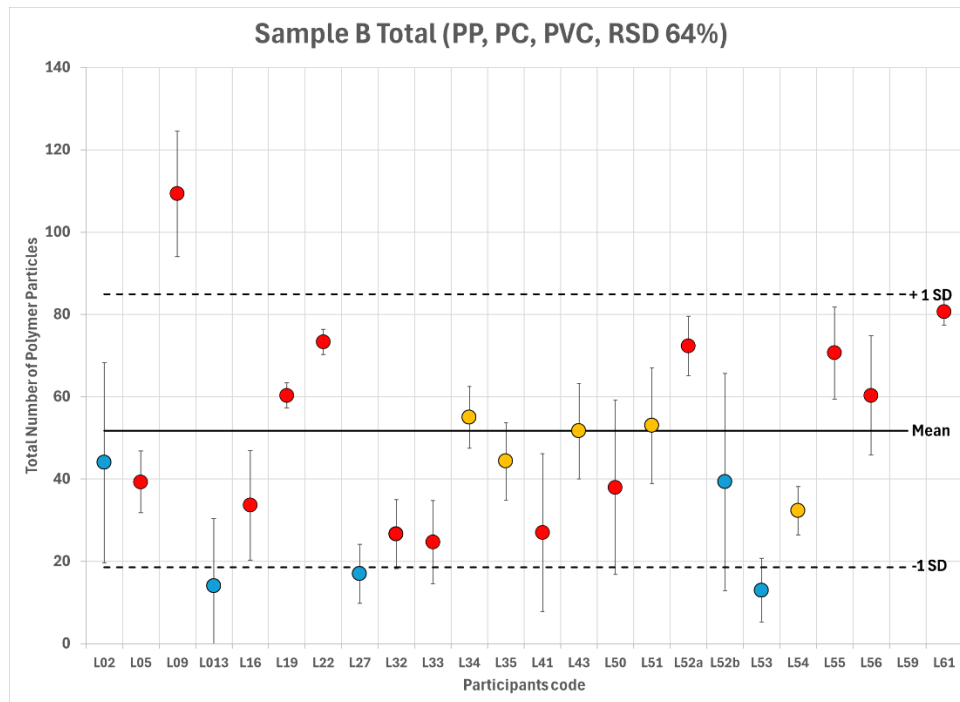


Figure 7. Graphical representation for Sample B, the average of the total number of polymer particles (PP, PC, PVC) of the three samples (B1,B2,B3), the within laboratory SD, and the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

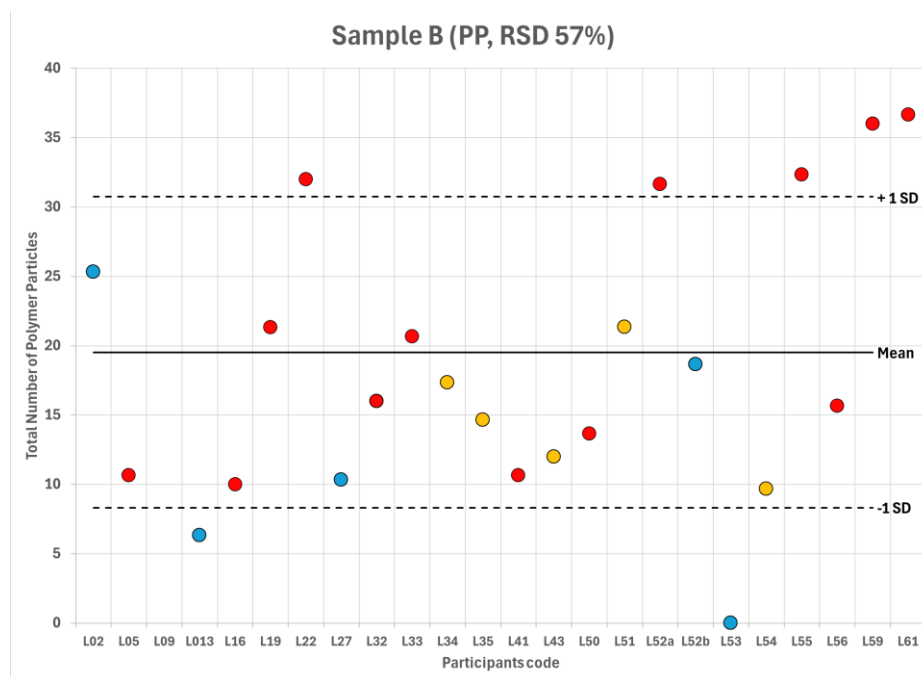


Figure 8. Graphical representation for Sample B, the average of PP in the three samples (B1,B2,B3), the within laboratory SD, the mean, +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● RAMAN).

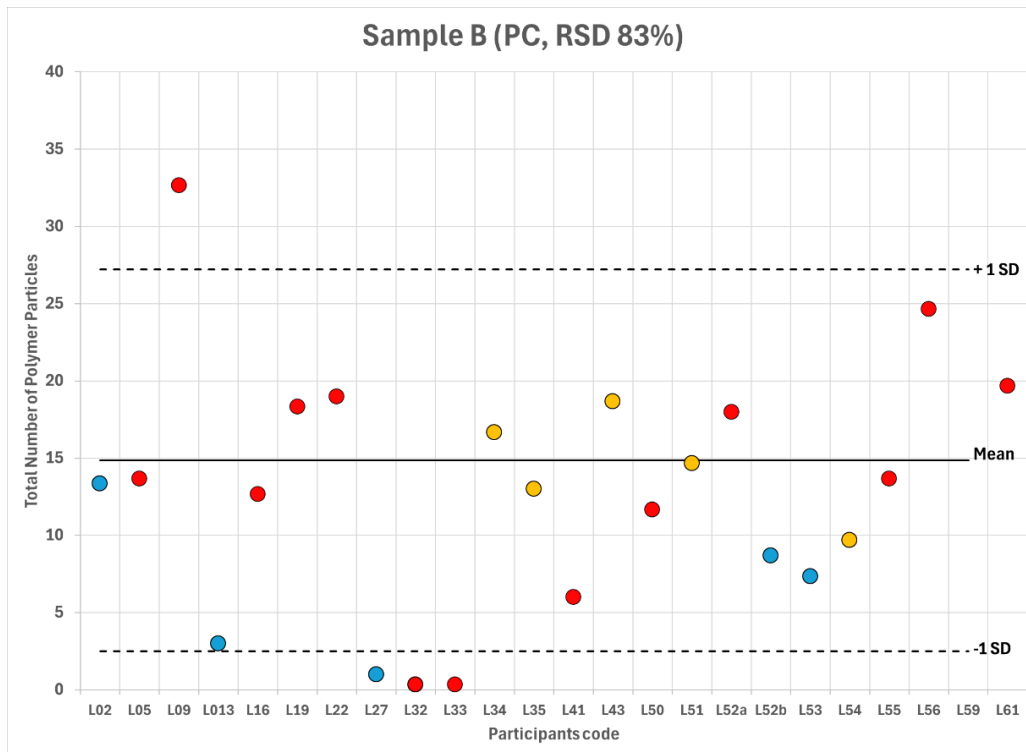


Figure 9. Graphical representation for Sample B, the average of PC in the three samples (B1,B2,B3), the within laboratory SD, the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

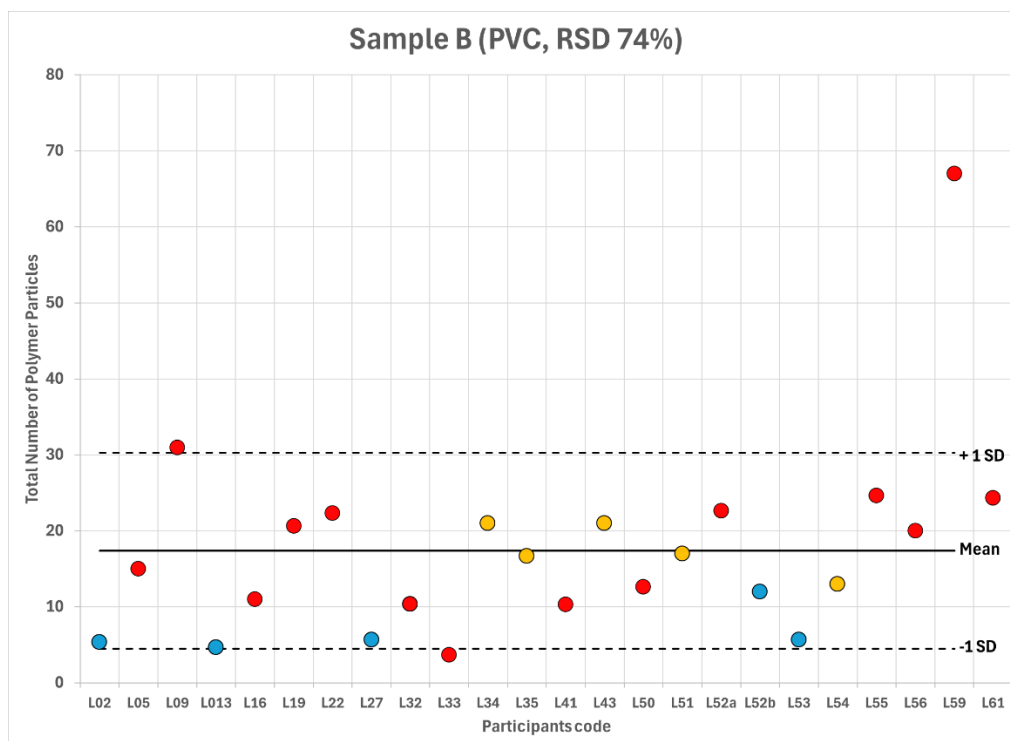


Figure 10. Graphical representation for Sample B, the average of PVC of the three samples (B1,B2,B3), the within laboratory SD, the mean and +1 SD or -SD of the variance between the laboratories. (● μFTIR, ● LDIR, ● μRAMAN).

3.3 Results Sample C

The results for the blank, Sample C are given for the 50 – 500 µm size range in Table 5 and for the size range below 50 µm in Table 6. In general, the blanks levels are low with a mean value of 5 total particles of the three samples, which is mostly determined by a few outliers, the median of all participants is 2 particles in the size range 50-500 µm which is the size range for which the tablets were designed.

However, looking at the results for the smaller size range (< 50 µm) a clear difference between the 3 most used detection technologies can be seen. For µFTIR only 1 PE and 1 PET particle was found, participant using LDIR found on average 4 PE, 2 PET, 2PP, 1PC, and 4 PVC particle. The large difference were the results using µRAMN as the final detection technology, here over 2000 PE, over 100 PVC, nearly 100 PP, and around 20 PS and PET particles were detected.

Table 5. The results for the three blank tablets, Sample C1, C2 and C3, size range 50-500 µm.

Polymer		Mean	Median	Min	Max
Polyethylene	PE	1	0	0	5
Polyethylene Terephthalate	PET	1	0	0	3
Polystyrene	PS	0	0	0	2
Polypropylene	PP	1	0	0	10
Polycarbonate	PC	0	0	0	2
Polyvinyl Chloride	PVC	1	0	0	4
Polyethylene	PE	1	0	0	4
Polyethylene Terephthalate	PET	2	0	0	29
Polystyrene	PS	0	0	0	1
Polypropylene	PP	0	0	0	2
Polycarbonate	PC	0	0	0	1
Polyvinyl Chloride	PVC	1	0	0	10
Polyethylene	PE	1	0	0	8
Polyethylene Terephthalate	PET	2	0	0	22
Polystyrene	PS	0	0	0	1
Polypropylene	PP	1	0	0	17
Polycarbonate	PC	0	0	0	1
Polyvinyl Chloride	PVC	1	0	0	2
Polyethylene	PE	1	0	0	12
Polyethylene Terephthalate	PET	1	0	0	18
Polystyrene	PS	0	0	0	1
Polypropylene	PP	1	0	0	6
Polycarbonate	PC	0	0	0	1
Polyvinyl Chloride	PVC	1	0	0	15
Total		5	2	0	21

Table 6. The results for the three blank tablets, Sample C1, C2 and C3, size range < 50 μm.

Sample	Polymer		RAMAN	LDIR	FTIR		
			Mean			Min	Max
Sample C1 < 50μm	Polyethylene	PE	4	7	1	0	18
	Terephthalate	PET	27	3	0	0	102
	Polystyrene	PS	22	1	0	0	102
	Polypropylene	PP	47	3	0	0	205
	Polycarbonate	PC	0	0	0	0	2
	Polyvinyl Chloride	PVC	65	4	0	0	204
Sample C2 < 50μm	Polyethylene	PE	1126	3	1	0	5605
	Terephthalate	PET	39	2	1	0	130
	Polystyrene	PS	29	0	0	0	130
	Polypropylene	PP	57	1	0	0	261
	Polycarbonate	PC	0	1	0	0	6
	Polyvinyl Chloride	PVC	46	4	1	0	130
Sample C3 < 50μm	Polyethylene	PE	5615	4	0	0	28049
	Terephthalate	PET	13	2	2	0	60
	Polystyrene	PS	2	1	1	0	9
	Polypropylene	PP	183	2	0	0	877
	Polycarbonate	PC	0	1	0	0	3
	Polyvinyl Chloride	PVC	198	5	0	0	877
Sample C < 50μm Mean C1, C2, C3	Polyethylene	PE	2252	4	1	0	11218
	Terephthalate	PET	29	2	1	0	77
	Polystyrene	PS	19	0	0	0	77
	Polypropylene	PP	99	2	0	0	448
	Polycarbonate	PC	0	1	0	0	4
	Polyvinyl Chloride	PVC	144	4	0	0	404

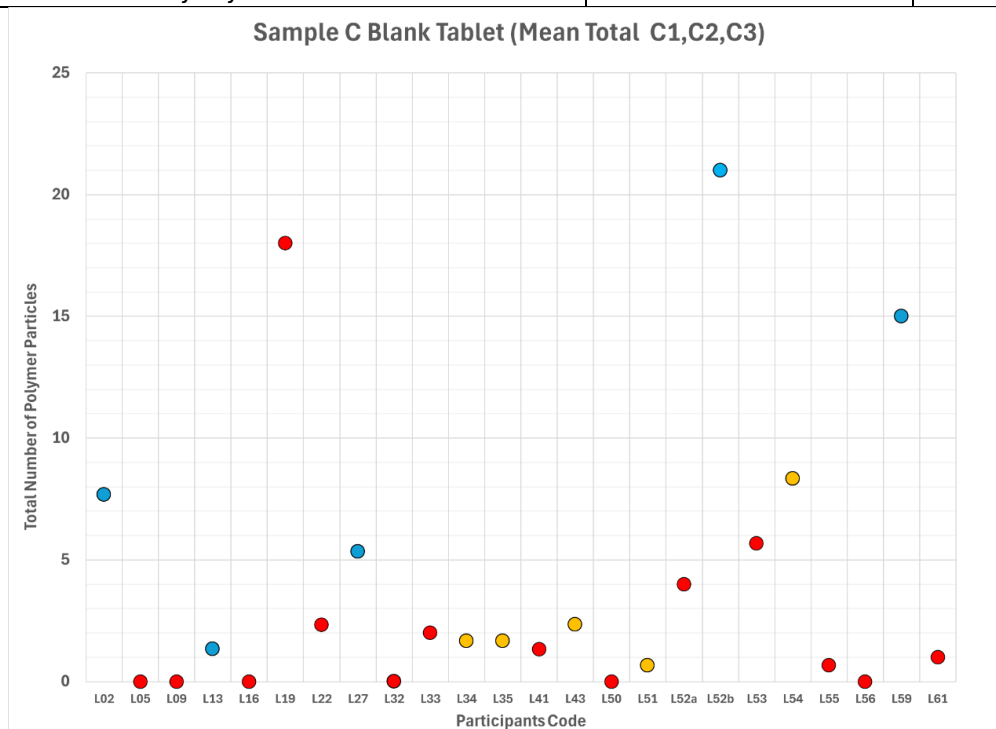


Figure 11. Sample C, the average of the total number of the six polymers in the three samples (C1,C2,C3), (● μFTIR, ● LDIR, ● μRAMAN).

3.4 Results general

The design value of the tablet is given for the total number of the polymers, the QA/QC procedure was only performed on the total of the three polymers in both Sample A and Sample B and is given in Table 7 and illustrated in Figure 12 and Figure 13.

While the variance within the samples is a little lower than 20%, the average within laboratory variation is just under 30% and the between laboratory around 60%. The within laboratory variation is higher than for example analysis of persistent organic pollutants such as PCDD/DF, BDEs or PFAS. The between laboratory variation expressed as %RSD are similar compared to other studies using similar tablets as a substitute for water samples. The number of laboratories not using the ISO method was too small (4) to draw any conclusion on the difference between using laboratories using the ISO method or an in-house method.

Table 7. The design value of the total of the added polymers in Sample A and Sample B and the variance within the tablets, within the laboratories, and between the laboratories.

	Polymers	Number particles	Variance Tablets	Within Laboratory	Between laboratory
Sample A1, A2, A3	PE, PET, PS	82	17%	29%	58%
Sample B1, B2, B3	PP, PVC, PC	88	18%	27%	64%

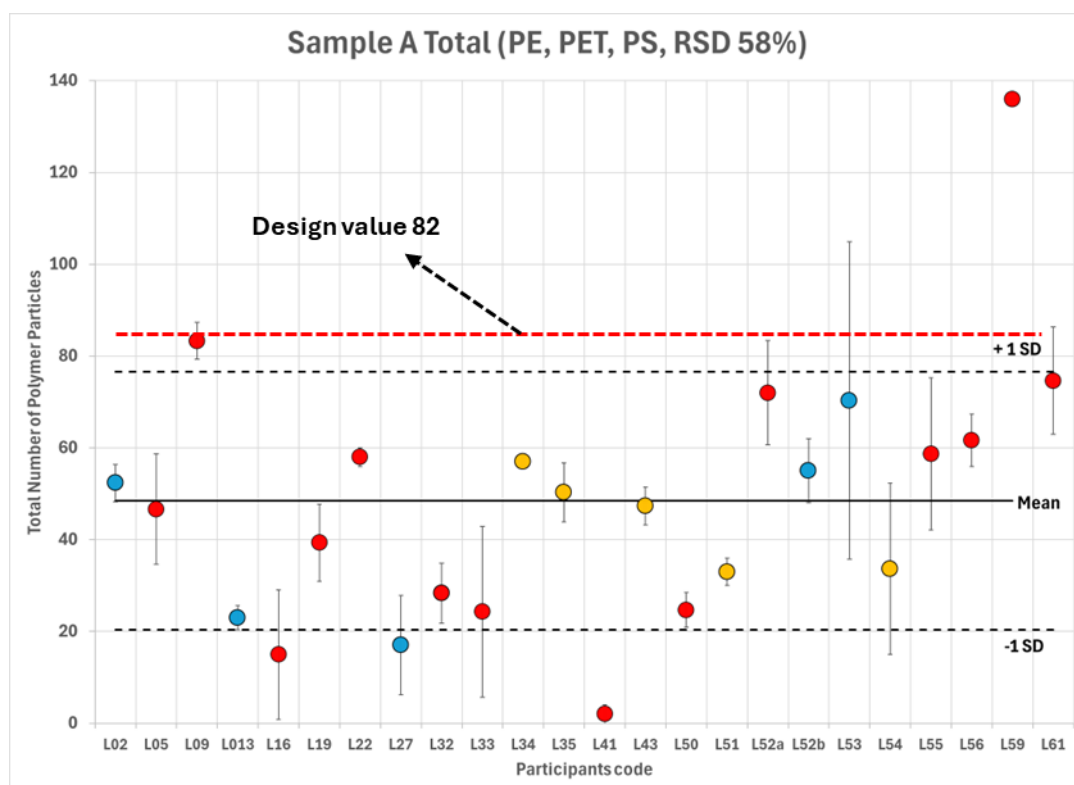


Figure 12. Results for Sample A, the design value is indicated by the dashed red line (● μFTIR, ● LDIR, ● μRAMAN).

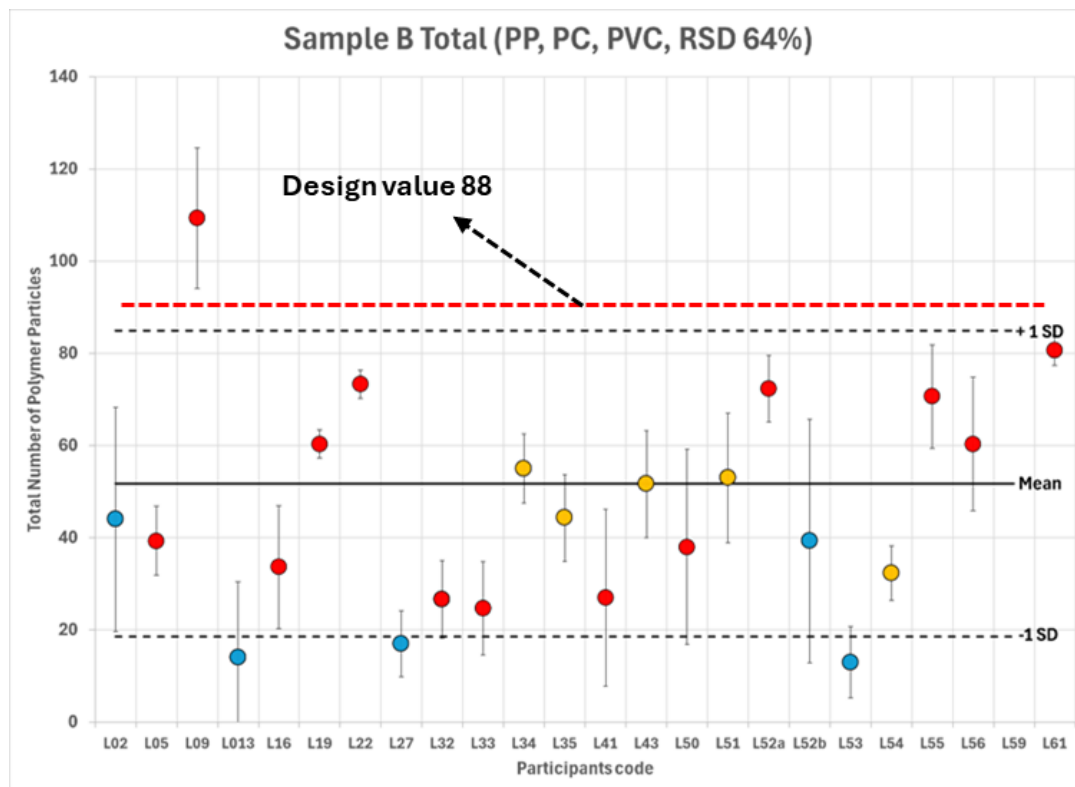


Figure 13. Results for Sample A, the design value is indicated by the dashed red line (● μ FTIR, ● LDIR, ● μ RAMAN).

The average of the result reported was significantly under the design value of 82 and 88 particles respectively for Sample A1, A2 and A3 and Sample B1, B2, B3 of the three added polymer mixtures 48 and 52 for Samples A and B respectively. This would indicate an average recovery of 59% and 63% which is relatively low and as result are not compensated for recovery this result in a significant systematic error for the analysis. This suggests that two critical steps may be leading to an underestimation of the results. The first is the dissolving of the tablet followed by filtration and the second is the identification software and its associated databases. Although the results are promising, continued focus on QA/QC – including participation in ILC studies - is necessary.

4. Conclusion

The ILC was successfully organised using soda tablets as substitutes for water samples, with a focus on implementing the new ISO standard for water samples. The results were promising, showing between-laboratory variations of 58% and 64%, which are in line with similar studies. For the first time, within-laboratory variation was also assessed, averaging 27% for Sample A and 29% for Sample B.

Regarding recovery, participants reported only 59% and 63% of the design values for the total polymer content in Sample A (PE, PET, and PS) and Sample B (PP, PC, and PVC), respectively. This indicates a significant systematic error, as the results are not compensated for recovery. Two analytical steps - filtration and polymer identification (including software and polymer databases) - are crucial for obtaining accurate results and should be examined in more detail. These findings highlight the need for continued QA/QC efforts, including future ILC studies, to further advance the state of the art in microplastic analysis.

5. Appendix

5.1 Participating laboratory results

Full name	Institute	Country
Svetlana Pakhomova	Norwegian Institute for Water Research	Norway
Laura Cherta	IMDEA Agua	Spain
Gbotemi Adediran	UK Centre for Ecology and Hydrology	United Kingdom
Gabor Bordos	Eurofins Analytical Services Hungary Kft	Hungary
Robert (Bob) Symons	Eurofins Environment Testing Australia	Australia
Carla Palma	Instituto Hidrografico	Portugal
Eva Bejarano	AIMPLAS, Plastics Technology Centre	Spain
Danence Lee	PUB Singapore's National Water Agency	Singapore
Paul-Tiberiu Miclea	Franhofer CSp	Germany
Marie-Sophie Stawinoga	WESSLING GmbH	Germany
Loddo Riccardo	Regional Agency for Enviromental Protection Liguria	Italy
Mo Huajuan	SGS Testing & Control Services Singapore Pte Ltd	Singapore
Lei Lei	Nestlé Research	Switzerland
Mathias Peters	Hohenstein Laboratories GmbH & Co. KG	Germany
Roman Jurnečka	T.G.Masaryk Water Research Institute, pri	Czechia
Maximilian Ries	Thermo Fisher Scientific	Germany
Jaehak JUNG	KIAST Korea Institute of Analytical Science and Technology	South. Korea
Katherine Shaw	National Institute of Standards and Technology	USA
Soledad Muniategui Lorenzo	Universidade da Coruña UDC University Institute of Environment IUMA)	Spain
Dr. Dina Gabriel	Currenta GmbH & Co. OHG	Germany
Wesam Alwan	Agilent Technologies	Australia
Arina Eremina	NQAC Vittel	France
Ralf Kägi	EAWAG	Switzerland

5.2 Detailed results

5.2.1 Sample A

5.2.2 Sample B

5.2.3 Sample C

5.2.1 Results Sample A

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32
Sample A1 50-500 µm	Polyethylene	PE	21	17	37	4	9	13	22	4	6
	Polyethylene Terephthalate	PET	12	4	23	9	8	18	18	18	0
	Polystyrene	PS	20	25	24	7	11	4	20	4	22
Total 3 polymers			53	46	84	20	28	35	60	26	28
Sample A2 50-500 µm	Polyethylene	PE	16	16	38	7	0	26	21	0	3
	Polyethylene Terephthalate	PET	10	11	23	9	0	0	16	3	4
	Polystyrene	PS	22	8	26	8	0	8	19	2	15
Total 3 polymers			48	35	87	24	0	34	56	5	22
Sample A3 50-500 µm	Polyethylene	PE	19	21	30	9	7	20	22	12	12
	Polyethylene Terephthalate	PET	15	18	23	2	6	14	17	8	4
	Polystyrene	PS	22	20	26	14	4	15	19	0	19
Total 3 polymers			56	59	79	25	17	49	58	20	35
Sample A 50-500 µm	Polyethylene	PE	19	18	35	7	5	20	22	5	7
	Polyethylene Terephthalate	PET	12	11	23	7	5	11	17	10	3
	Polystyrene	PS	21	18	25	10	5	9	19	2	19
Total 3 polymers			52	47	83	23	15	39	58	17	28
Repeatability											
Sample A 50-500 µm	Polyethylene	PE	13%	15%	12%	38%	89%	33%	3%	115%	65%
	Polyethylene Terephthalate	PET	20%	64%	0%	61%	89%	89%	6%	79%	87%
	Polystyrene	PS	5%	49%	5%	39%	111%	62%	3%	100%	19%
Sample A RSD A1, A2, A3	Total 3 polymers	RSD Total	4	12	4	3	14	8	2	11	7
		%RSD	8%	26%	5%	12%	94%	21%	3%	64%	23%

5.2.1 Results Sample A

Participant code			L33	L34	L35	L41	L43	L50	L51	L52a	L52b
Sample A1 50-500 µm	Polyethylene	PE	3	24	12	3	14	7	14	26	19
	Polyethylene Terephthalate	PET	2	16	20	1	13	2	6	15	12
	Polystyrene	PS	2	18	21	0	19	13	13	26	19
Total 3 polymers			7	58	53	4	46	22	33	67	50
Sample A2 50-500 µm	Polyethylene	PE	11	26	19	0	12	18	9	27	21
	Polyethylene Terephthalate	PET	3	14	12	0	18	2	18	13	11
	Polystyrene	PS	8	17	12	0	14	9	9	24	20
Total 3 polymers			22	57	43	0	44	29	36	64	52
Sample A3 50-500 µm	Polyethylene	PE	24	29	19	0	17	12	12	36	24
	Polyethylene Terephthalate	PET	5	11	21	0	14	4	7	18	15
	Polystyrene	PS	15	16	15	2	21	7	11	31	24
Total 3 polymers			44	56	55	2	52	23	30	85	63
Sample A 50-500 µm	Polyethylene	PE	13	26	17	1	14	12	12	30	21
	Polyethylene Terephthalate	PET	3	14	18	0	15	3	10	15	13
	Polystyrene	PS	8	17	16	1	18	10	11	27	21
Total 3 polymers			24	57	50	2	47	25	33	72	55
Repeatability											
Sample A 50-500 µm	Polyethylene	PE	84%	10%	24%	173%	18%	45%	22%	19%	12%
	Polyethylene Terephthalate	PET	46%	18%	28%	173%	18%	43%	64%	16%	16%
	Polystyrene	PS	78%	6%	29%	173%	20%	32%	18%	13%	13%
Sample A RSD A1, A2, A3	Total 3 polymers	RSD Total	19	1	6	2	4	4	3	11	7
		%RSD	76%	2%	13%	100%	9%	15%	9%	16%	13%

5.2.1 Results Sample A

Participant code			L53	L54	L55	L56	L59	L61	Mean	STDEV	RDS
Sample A1 50-500 µm	Polyethylene	PE	6	11	23	15	-	35	15	10	65%
	Polyethylene Terephthalate	PET	22	0	18	14	-	22	12	8	65%
	Polystyrene	PS	80	3	16	28	-	31	19	16	87%
Total 3 polymers			108	14	57	57	52	88	46	26	56%
Sample A2 50-500 µm	Polyethylene	PE	3	14	33	28	-	22	16	11	68%
	Polyethylene Terephthalate	PET	20	12	20	18	-	22	11	8	67%
	Polystyrene	PS	40	10	23	14	-	22	14	9	66%
Total 3 polymers			63	36	76	60	43	66	42	23	55%
Sample A3 50-500 µm	Polyethylene	PE	0	16	14	25	-	27	18	9	52%
	Polyethylene Terephthalate	PET	20	20	15	11	-	18	12	7	54%
	Polystyrene	PS	20	15	14	32	-	25	17	8	50%
Total 3 polymers			40	51	43	68	41	70	47	20	43%
Sample A 50-500 µm	Polyethylene	PE	3	14	23	23	52	28	18	12	65%
	Polyethylene Terephthalate	PET	21	11	18	14	43	21	13	9	67%
	Mean A1, A2, A3	Polystyrene	PS	47	9	18	25	41	26	18	11
Total 3 polymers			70	34	59	62	136	75	48	28	58%
Repeatability									Min	Max	Average
Sample A 50-500 µm	Polyethylene	PE	100%	18%	41%	30%	-	23%	3%	173%	43%
	Polyethylene Terephthalate	PET	6%	94%	14%	25%	-	11%	0%	173%	46%
	RSD A1, A2, A3	Polystyrene	PS	65%	65%	27%	38%	-	18%	3%	173%
Sample A RSD A1, A2, A3	Total 3 polymers	RSD Total	35	19	17	6	-	12			
		%RSD	49%	55%	28%	9%	-	16%	2%	100%	29%

5.2.1 Sample A

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32	L33
Sample A1 < 50µm	Polyethylene	PE	15	0	2	30	0	2	0	6	0	0
	Polyethylene Terephthalate	PET	208	0	0	22	0	1	22	0	0	0
	Polystyrene	PS	290	0	10	91	2	2	0	2	0	0
Sample A2 < 50µm	Polyethylene	PE	17	0	3	35	0	3	0	2	0	0
	Polyethylene Terephthalate	PET	151	0	0	26	0	1	0	1	0	0
	Polystyrene	PS	242	0	4	64	0	0	0	2	0	1
Sample A3 < 50µm	Polyethylene	PE	26	0	1	35	0	2	0	1	0	0
	Polyethylene Terephthalate	PET	205	0	0	25	0	5	0	3	0	0
	Polystyrene	PS	341	0	1	63	0	3	0	4	0	5
Sample A Mean < 50µm	Polyethylene	PE	19	0	2	33	0	2	0	3	0	0
	Polyethylene Terephthalate	PET	188	0	0	24	0	2	7	1	0	0
	Polystyrene	PS	291	0	5	73	1	2	0	3	0	2
Sample A RSD < 50µm	Polyethylene	PE	6	0	1	3	0	1	0	3	0	0
	Polyethylene Terephthalate	PET	32	0	0	2	0	2	13	2	0	0
	Polystyrene	PS	50	0	5	16	1	2	0	1	0	3

5.2.1 Sample A

Participant code			L34	L35	L41	L43	L50	L51	L52a	L52b	L53	L54
Sample A1	Polyethylene	PE	0	1	0	0	0	4	0	24	2857	41
< 50µm	Polyethylene Terephthalate	PET	0	1	0	0	0	0	5	35	816	21
	Polystyrene	PS	3	15	0	0	0	3	13	110	2857	68
Sample A2	Polyethylene	PE	0	3	0	0	0	2	1	19	3163	11
< 50µm	Polyethylene Terephthalate	PET	0	4	0	0	0	3	0	31	1116	9
	Polystyrene	PS	2	21	0	0	0	9	9	79	3163	43
Sample A3	Polyethylene	PE	1	0	0	0	0	0	3	13	1308	5
< 50µm	Polyethylene Terephthalate	PET	0	0	0	0	0	2	1	24	1570	21
	Polystyrene	PS	1	11	0	0	0	8	12	57	3663	44
Sample A	Polyethylene	PE	0	1	0	0	0	2	1	19	2443	19
Mean < 50µm	Polyethylene Terephthalate	PET	0	2	0	0	0	2	2	30	1167	17
	Polystyrene	PS	2	16	0	0	0	7	11	82	3228	52
Sample A	Polyethylene	PE	1	2	0	0	0	2	2	6	994	19
RSD < 50µm	Polyethylene Terephthalate	PET	0	2	0	0	0	2	3	6	380	7
	Polystyrene	PS	1	5	0	0	0	3	2	27	407	14

5.2.1 Sample A

Participant code			L55	L56	L59	L61
Sample A1	Polyethylene	PE	20	0	NA	2
< 50µm	Polyethylene Terephthalate	PET	23	0	NA	0
	Polystyrene	PS	60	0	NA	1
Sample A2	Polyethylene	PE	8	0	NA	0
< 50µm	Polyethylene Terephthalate	PET	6	0	NA	1
	Polystyrene	PS	54	0	NA	0
Sample A3	Polyethylene	PE	27	0	NA	0
< 50µm	Polyethylene Terephthalate	PET	23	0	NA	0
	Polystyrene	PS	84	0	NA	0
Sample A	Polyethylene	PE	18	0	NA	1
Mean < 50µm	Polyethylene Terephthalate	PET	17	0	NA	0
	Polystyrene	PS	66	0	NA	0
Sample A	Polyethylene	PE	10	0	NA	1
RSD < 50µm	Polyethylene Terephthalate	PET	10	0	NA	1
	Polystyrene	PS	16	0	NA	1

5.2.2 Results Sample B

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32	L33
Sample B1 < 50µm	Polypropylene	PP	75	0	9	0	6	4	0	0	0	1
	Polycarbonate	PC	58	0	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	8	0	1	0	0	1	0	0	0	0
Sample B2 < 50µm	Polypropylene	PP	93	0	5	26	0	1	0	1	0	0
	Polycarbonate	PC	106	0	0	10	1	1	0	2	0	0
	Polyvinyl Chloride	PVC	8	0	0	30	0	3	0	0	0	0
Sample B3 < 50µm	Polypropylene	PP	85	0	19	31	3	1	0	0	0	1
	Polycarbonate	PC	80	0	0	13	2	3	0	0	0	0
	Polyvinyl Chloride	PVC	6	0	1	38	0	1	0	0	0	0
Sample B Mean < 50µm	Polypropylene	PP	84	0	11	19	3	2	0	0	0	1
	Polycarbonate	PC	81	0	0	8	1	1	0	1	0	0
	Polyvinyl Chloride	PVC	7	0	1	23	0	2	0	0	0	0
Sample B RSD < 50µm	Polypropylene	PP	9	0	7	17	3	2	0	1	0	1
	Polycarbonate	PC	24	0	0	7	1	2	0	1	0	0
	Polyvinyl Chloride	PVC	1	0	1	20	0	1	0	0	0	0

5.2.2 Results Sample B

Participant code			L34	L35	L41	L43	L50	L51	L52a	L52b	L53	L54
Sample B1 < 50µm	Polypropylene	PP	0	2	0	0	0	5	3	72	398	23
	Polycarbonate	PC	0	0	0	0	0	0	1	21	0	5
	Polyvinyl Chloride	PVC	1	0	0	0	0	2	1	90	928	13
Sample B2 < 50µm	Polypropylene	PP	0	3	0	0	0	3	6	70	238	7
	Polycarbonate	PC	1	0	0	0	0	1	3	25	1904	4
	Polyvinyl Chloride	PVC	0	0	0	0	0	1	0	54	0	10
Sample B3 < 50µm	Polypropylene	PP	1	4	0	0	0	2	6	87	685	4
	Polycarbonate	PC	0	2	0	0	0	1	1	15	3426	0
	Polyvinyl Chloride	PVC	0	3	0	0	0	1	0	51	0	5
Sample B Mean < 50µm	Polypropylene	PP	0	3	0	0	0	3	5	76	440	11
	Polycarbonate	PC	0	1	0	0	0	1	2	20	1777	3
	Polyvinyl Chloride	PVC	0	1	0	0	0	1	0	65	309	9
Sample B RSD < 50µm	Polypropylene	PP	1	1	0	0	0	2	2	9	226	10
	Polycarbonate	PC	1	1	0	0	0	1	1	5	1717	3
	Polyvinyl Chloride	PVC	1	2	0	0	0	1	1	22	536	4

Sample B <50 µm

5.2.2 Results Sample B

Participant code			L55	L56	L59	L61
Sample B1	Polypropylene	PP	9	0	NA	2
< 50µm	Polycarbonate	PC	15	0	NA	0
	Polyvinyl Chloride	PVC	15	0	NA	0
Sample B2	Polypropylene	PP	25	0	NA	0
< 50µm	Polycarbonate	PC	11	0	NA	0
	Polyvinyl Chloride	PVC	26	0	NA	0
Sample B3	Polypropylene	PP	16	0	NA	0
< 50µm	Polycarbonate	PC	18	0	NA	1
	Polyvinyl Chloride	PVC	5	0	NA	0
Sample B	Polypropylene	PP	17	0	NA	1
Mean < 50µm	Polycarbonate	PC	15	0	NA	0
	Polyvinyl Chloride	PVC	15	0	NA	0
Sample B	Polypropylene	PP	8	0	NA	1
RSD < 50µm	Polycarbonate	PC	4	0	NA	1
	Polyvinyl Chloride	PVC	11	0	NA	0

5.2.2 Sample B

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32
Sample B1 50-500 µm	Polypropylene	PP	23	6	58	0	6	28	33	0	10
	Polycarbonate	PC	6	13	26	0	7	15	19	1	0
	Polyvinyl Chloride	PVC	2	16	31	0	6	20	22	14	7
Total	Total 3 polymers		31	35	115	0	19	63	74	15	17
Sample B2 50-500 µm	Polypropylene	PP	18	14	37	6	10	18	29	20	20
	Polycarbonate	PC	8	19	28	1	14	15	19	2	0
	Polyvinyl Chloride	PVC	3	15	27	3	13	24	22	3	11
Total	Total 3 polymers		29	48	92	10	37	57	70	25	31
Sample B3 50-500 µm	Polypropylene	PP	35	12	42	13	14	18	34	11	18
	Polycarbonate	PC	26	9	44	8	17	25	19	0	1
	Polyvinyl Chloride	PVC	11	14	35	11	14	18	23	0	13
Total	Total 3 polymers		72	35	121	32	45	61	76	11	32
Sample B 50-500 µm	Polypropylene	PP	25	11	46	6	10	21	32	10	16
	Polycarbonate	PC	13	14	33	3	13	18	19	1	0
	Polyvinyl Chloride	PVC	5	15	31	5	11	21	22	6	10
Total	Total 3 polymers		44	39	109	14	34	60	73	17	27
Repeatability											
Sample B 50-500 µm	Polypropylene	PP	34%	39%	24%	103%	40%	27%	8%	97%	33%
	Polycarbonate	PC	83%	37%	30%	145%	41%	31%	0%	100%	173%
	Polyvinyl Chloride	PVC	92%	7%	13%	122%	40%	15%	3%	130%	30%
Mean Total	Total 3 polymers	RSD Total	24	8	15	16	13	3	3	7	8
		%RSD	55%	19%	14%	117%	40%	5%	4%	42%	31%

5.2.2 Sample B

Participant code			L33	L34	L35	L41	L43	L50	L51	L52a	L52b
Sample B1	Polypropylene	PP	9	20	18	0	5	4	14	32	21
50-500 μm	Polycarbonate	PC	1	17	12	2	20	4	11	20	16
	Polyvinyl Chloride	PVC	3	17	7	3	19	6	18	24	20
Total	Total 3 polymers		13	54	37	5	44	14	43	76	57
Sample B2	Polypropylene	PP	26	20	13	14	21	19	14	31	27
50-500 μm	Polycarbonate	PC	0	18	14	8	18	18	20	16	10
	Polyvinyl Chloride	PVC	4	25	28	14	26	17	13	17	15
Total	Total 3 polymers		30	63	55	36	65	54	47	64	52
Sample B3	Polypropylene	PP	27	12	13	18	10	18	36	32	8
50-500 μm	Polycarbonate	PC	0	15	13	8	18	13	13	18	0
	Polyvinyl Chloride	PVC	4	21	15	14	18	15	20	27	1
Total	Total 3 polymers		31	48	41	40	46	46	69	77	9
Sample B	Polypropylene	PP	21	17	15	11	12	14	21	32	19
50-500 μm	Polycarbonate	PC	0	17	13	6	19	12	15	18	9
Mean B1, B2, B3	Polyvinyl Chloride	PVC	4	21	17	10	21	13	17	23	12
Total	Total 3 polymers		25	55	44	27	52	38	53	72	39
Repeatability											
Sample B	Polypropylene	PP	49%	27%	20%	89%	68%	61%	60%	2%	52%
50-500 μm	Polycarbonate	PC	173%	9%	8%	58%	6%	61%	32%	11%	93%
RSD B1, B2, B3	Polyvinyl Chloride	PVC	16%	19%	64%	61%	21%	46%	21%	23%	82%
Mean Total	Total 3 polymers	RSD Total	10	8	9	19	12	21	14	7	26
		%RSD	41%	14%	21%	71%	22%	56%	26%	10%	67%

5.2.2 Sample B

Participant code			L53	L54	L55	L56	L59	L61	Mean	STDEV	RDS
Sample B1	Polypropylene	PP	0	8	24	11	-	31	16	14	91%
50-500 µm	Polycarbonate	PC	0	9	16	35	-	22	12	9	80%
	Polyvinyl Chloride	PVC	17	13	21	14	-	30	14	9	61%
Total	Total 3 polymers		17	30	61	60	-	83	42	29	69%
Sample B2	Polypropylene	PP	0	7	40	7	-	44	20	11	57%
50-500 µm	Polycarbonate	PC	18	10	10	25	-	20	14	8	57%
	Polyvinyl Chloride	PVC	0	11	18	14	-	18	15	8	56%
Total	Total 3 polymers		18	28	68	46	-	82	48	21	43%
Sample B3	Polypropylene	PP	0	14	33	29	-	35	21	11	54%
50-500 µm	Polycarbonate	PC	4	10	15	14	-	17	13	10	75%
	Polyvinyl Chloride	PVC	0	15	35	32	-	25	17	10	61%
Total	Total 3 polymers		4	39	83	75	-	77	51	28	54%
Sample B	Polypropylene	PP	0	10	32	16	36	37	20	11	57%
50-500 µm	Polycarbonate	PC	7	10	14	25	60	20	15	12	83%
Mean B1, B2, B3	Polyvinyl Chloride	PVC	6	13	25	20	67	24	17	13	74%
Total	Total 3 polymers		13	32	71	60	163	81	52	33	64%
Repeatability									Min	Max	Average
Sample B	Polypropylene	PP	NA	39%	25%	75%	-	18%	2%	103%	45%
50-500 µm	Polycarbonate	PC	129%	6%	24%	43%	-	13%	0%	173%	57%
RSD B1, B2, B3	Polyvinyl Chloride	PVC	173%	15%	37%	52%	-	25%	3%	173%	48%
Mean Total	Total 3 polymers	RSD Total	8	6	11	15	-	3			
		%RSD	60%	18%	16%	24%	-	4%	4%	117%	34%

5.2.3 Sample C

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32
Sample C1 < 50µm	Polyethylene	PE	0	1	NA	0	0	0	2	3	ND
	Polyethylene Terephthalate	PET	0	3	NA	0	0	2	1	1	ND
	Polystyrene	PS	0	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	10	NA	NA	0	0	0	3	2	ND
	Polycarbonate	PC	2	NA	NA	0	0	0	0	0	ND
	Polyvinyl Chloride	PVC	0	NA	NA	4	0	0	0	0	ND
Sample C2 < 50µm	Polyethylene	PE	1	NA	NA	0	0	0	1	1	ND
	Polyethylene Terephthalate	PET	0	NA	NA	0	0	29	0	1	ND
	Polystyrene	PS	0	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	2	NA	NA	0	0	0	0	1	ND
	Polycarbonate	PC	1	NA	NA	0	0	0	0	1	ND
	Polyvinyl Chloride	PVC	0	NA	NA	0	0	0	0	0	ND
Sample C3 < 50µm	Polyethylene	PE	1	NA	NA	0	0	1	0	2	ND
	Polyethylene Terephthalate	PET	0	NA	NA	0	0	22	0	2	ND
	Polystyrene	PS	1	NA	NA	0	0	0	0	1	ND
	Polypropylene	PP	2	NA	NA	0	0	0	0	0	ND
	Polycarbonate	PC	1	NA	NA	0	0	0	0	1	ND
	Polyvinyl Chloride	PVC	2	NA	NA	0	0	0	0	0	ND
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	1	NA	NA	0	0	0	1	2	ND
	Polyethylene Terephthalate	PET	0	NA	NA	0	0	18	0	1	ND
	Polystyrene	PS	0	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	5	NA	NA	0	0	0	1	1	ND
	Polycarbonate	PC	1	NA	NA	0	0	0	0	1	ND
	Polyvinyl Chloride	PVC	1	NA	NA	1	0	0	0	0	ND
Total			8	NA	NA	1	0	18	2	5	ND

5.2.3 Sample C

Participant code			L33	L34	L35	L41	L43	L50	L51	L52a	L52b
Sample C1 < 50µm	Polyethylene	PE	2	0	0	2	0	0	0	0	0
	Polyethylene Terephthalate	PET	0	1	1	0	0	0	0	1	1
	Polystyrene	PS	2	0	0	1	0	0	0	0	0
	Polypropylene	PP	0	0	1	0	4	0	0	0	0
	Polycarbonate	PC	0	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	0	1	0	0	0	0	0	0	3
Sample C2 < 50µm	Polyethylene	PE	0	1	0	0	0	0	0	0	1
	Polyethylene Terephthalate	PET	0	0	1	0	0	0	0	2	2
	Polystyrene	PS	0	0	0	0	0	0	0	0	0
	Polypropylene	PP	0	0	0	1	2	0	0	0	0
	Polycarbonate	PC	1	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	0	0	0	0	0	0	0	5	10
Sample C3 < 50µm	Polyethylene	PE	0	0	0	0	0	0	0	1	1
	Polyethylene Terephthalate	PET	0	0	1	0	0	0	2	1	1
	Polystyrene	PS	0	0	0	0	0	0	0	0	0
	Polypropylene	PP	0	0	1	0	1	0	0	0	0
	Polycarbonate	PC	0	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	1	2	0	0	0	0	0	2	2
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	1	0	0	1	0	0	0	0	2
	Polyethylene Terephthalate	PET	0	0	1	0	0	0	1	1	4
	Polystyrene	PS	1	0	0	0	0	0	0	0	0
	Polypropylene	PP	0	0	1	0	2	0	0	0	0
	Polycarbonate	PC	0	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	0	1	0	0	0	0	0	2	15
Total			2	2	2	1	2	0	1	4	21

5.2.3 Sample C

Participant code			L53	L54	L55	L56	L59	L61	Mean	Median	Min	Max
Sample C1 < 50µm	Polyethylene	PE	0	5	0	NA	0	0	1	0	0	5
	Polyethylene Terephthalate	PET	0	1	0	NA	0	0	1	0	0	3
	Polystyrene	PS	0	0	0	NA	0	0	0	0	0	2
	Polypropylene	PP	0	0	0	NA	2	0	1	0	0	10
	Polycarbonate	PC	0	0	0	NA	0	0	0	0	0	2
	Polyvinyl Chloride	PVC	0	1	0	NA	1	0	1	0	0	4
Sample C2 < 50µm	Polyethylene	PE	0	4	0	NA	2	0	1	0	0	4
	Polyethylene Terephthalate	PET	0	2	0	NA	0	0	2	0	0	29
	Polystyrene	PS	0	0	0	NA	1	0	0	0	0	1
	Polypropylene	PP	0	0	0	NA	0	0	0	0	0	2
	Polycarbonate	PC	0	0	0	NA	0	0	0	0	0	1
	Polyvinyl Chloride	PVC	0	1	0	NA	1	2	1	0	0	10
Sample C3 < 50µm	Polyethylene	PE	0	8	1	NA	0	1	1	0	0	8
	Polyethylene Terephthalate	PET	0	2	1	NA	0	0	2	0	0	22
	Polystyrene	PS	0	0	0	NA	1	0	0	0	0	1
	Polypropylene	PP	17	0	0	NA	0	0	1	0	0	17
	Polycarbonate	PC	0	0	0	NA	0	0	0	0	0	1
	Polyvinyl Chloride	PVC	0	1	0	NA	0	0	1	0	0	2
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	0	6	0	NA	12	0	1	0	0	12
	Polyethylene Terephthalate	PET	0	2	0	NA	0	0	1	0	0	18
	Polystyrene	PS	0	0	0	NA	0	0	0	0	0	1
	Polypropylene	PP	6	0	0	NA	1	0	1	0	0	6
	Polycarbonate	PC	0	0	0	NA	0	0	0	0	0	1
	Polyvinyl Chloride	PVC	0	1	0	NA	2	1	1	0	0	15
Total			6	8	1	NA	15	1	5	2	0	21

5.2.3 Sample C

Participant code			L02	L05	L09	L013	L16	L19	L22	L27	L32
Sample C1 < 50µm	Polyethylene	PE	1	0	NA	12	0	0	0	0	ND
	Polyethylene Terephthalate	PET	26	0	NA	1	0	1	0	0	ND
	Polystyrene	PS	3	NA	NA	1	0	0	0	0	ND
	Polypropylene	PP	19	NA	NA	5	0	0	0	0	ND
	Polycarbonate	PC	0	NA	NA	0	0	0	0	0	ND
	Polyvinyl Chloride	PVC	2	0	NA	20	0	0	0	0	ND
Sample C2 < 50µm	Polyethylene	PE	15	0	NA	0	0	0	0	0	ND
	Polyethylene Terephthalate	PET	54	0	NA	0	0	10	0	0	ND
	Polystyrene	PS	10	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	17	0	NA	0	0	0	0	0	ND
	Polycarbonate	PC	0	NA	NA	0	0	0	0	0	ND
	Polyvinyl Chloride	PVC	0	NA	NA	0	0	0	0	0	ND
Sample C3 < 50µm	Polyethylene	PE	14	NA	NA	0	0	0	0	0	ND
	Polyethylene Terephthalate	PET	60	0	NA	0	0	22	0	0	ND
	Polystyrene	PS	9	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	28	NA	NA	0	0	1	0	0	ND
	Polycarbonate	PC	0	NA	NA	0	0	0	0	0	ND
	Polyvinyl Chloride	PVC	2	NA	NA	0	0	0	0	0	ND
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	10	0	NA	4	0	0	0	0	ND
	Polyethylene Terephthalate	PET	47	0	NA	0	0	11	0	0	ND
	Polystyrene	PS	7	NA	NA	0	0	0	0	0	ND
	Polypropylene	PP	21	0	NA	2	0	0	0	0	ND
	Polycarbonate	PC	0	NA	NA	0	0	0	0	0	ND
	Polyvinyl Chloride	PVC	1	0	NA	7	0	0	0	0	ND

Sample C <50 µm

5.2.3 Sample C

Participant code			L33	L34	L35	L41	L43	L50	L51	L52a	L52b
Sample C1 < 50µm	Polyethylene	PE	2	0	4	0	0	0	3	0	7
	Polyethylene Terephthalate	PET	0	0	2	0	0	0	0	0	8
	Polystyrene	PS	0	0	1	0	0	0	0	0	2
	Polypropylene	PP	1	0	4	0	0	0	2	1	6
	Polycarbonate	PC	0	0	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	0	1	3	0	0	0	0	0	98
Sample C2 < 50µm	Polyethylene	PE	5	4	0	0	0	0	0	0	8
	Polyethylene Terephthalate	PET	0	2	0	0	0	0	0	0	9
	Polystyrene	PS	0	0	0	0	0	0	0	0	4
	Polypropylene	PP	0	0	4	0	0	0	0	0	7
	Polycarbonate	PC	0	1	1	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	1	1	3	0	0	0	1	0	99
Sample C3 < 50µm	Polyethylene	PE	0	0	1	0	0	0	0	0	11
	Polyethylene Terephthalate	PET	0	0	1	0	0	0	4	0	3
	Polystyrene	PS	0	0	0	0	0	0	0	0	3
	Polypropylene	PP	1	0	1	0	0	0	0	0	9
	Polycarbonate	PC	0	1	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	1	0	6	0	0	0	0	0	111
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	2	1	2	0	0	0	1	0	26
	Polyethylene Terephthalate	PET	0	1	1	0	0	0	1	0	20
	Polystyrene	PS	0	0	0	0	0	0	0	0	9
	Polypropylene	PP	1	0	3	0	0	0	1	0	22
	Polycarbonate	PC	0	1	0	0	0	0	0	0	0
	Polyvinyl Chloride	PVC	1	1	4	0	0	0	0	0	308

5.2.3 Sample C

Participant code			L53	L54	L55	L56	L59	L61
Sample C1 < 50µm	Polyethylene	PE	0	16	18	NA	12	0
	Polyethylene Terephthalate	PET	102	3	12	NA	0	0
	Polystyrene	PS	102	2	0	NA	0	0
	Polypropylene	PP	205	6	4	NA	1	0
	Polycarbonate	PC	0	0	2	NA	0	0
	Polyvinyl Chloride	PVC	204	8	10	NA	2	0
Sample C2 < 50µm	Polyethylene	PE	5605	5	6	NA	1	0
	Polyethylene Terephthalate	PET	130	3	6	NA	0	0
	Polystyrene	PS	130	1	1	NA	2	0
	Polypropylene	PP	261	3	1	NA	0	0
	Polycarbonate	PC	0	0	6	NA	0	0
	Polyvinyl Chloride	PVC	130	6	11	NA	7	0
Sample C3 < 50µm	Polyethylene	PE	28049	8	14	NA	0	0
	Polyethylene Terephthalate	PET	0	3	6	NA	0	0
	Polystyrene	PS	0	3	0	NA	7	0
	Polypropylene	PP	877	4	4	NA	0	0
	Polycarbonate	PC	0	1	3	NA	0	0
	Polyvinyl Chloride	PVC	877	7	16	NA	1	0
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	11218	10	13	NA	12	0
	Polyethylene Terephthalate	PET	77	3	8	NA	0	0
	Polystyrene	PS	77	2	0	NA	0	0
	Polypropylene	PP	448	4	3	NA	1	0
	Polycarbonate	PC	0	0	4	NA	0	0
	Polyvinyl Chloride	PVC	404	7	12	NA	2	0

Sample C <50 µm

5.2.3 Sample C

Participant code			Min	Max	RAMAN	LDIR	FTIR
Sample C1 < 50µm	Polyethylene	PE	0	18	4	7	1
	Polyethylene Terephthalate	PET	0	102	27	3	0
	Polystyrene	PS	0	102	22	1	0
	Polypropylene	PP	0	205	47	3	0
	Polycarbonate	PC	0	2	0	0	0
	Polyvinyl Chloride	PVC	0	204	65	4	0
Sample C2 < 50µm	Polyethylene	PE	0	5605	1126	3	1
	Polyethylene Terephthalate	PET	0	130	39	2	1
	Polystyrene	PS	0	130	29	0	0
	Polypropylene	PP	0	261	57	1	0
	Polycarbonate	PC	0	6	0	1	0
	Polyvinyl Chloride	PVC	0	130	46	4	1
Sample C3 < 50µm	Polyethylene	PE	0	28049	5615	4	0
	Polyethylene Terephthalate	PET	0	60	13	2	2
	Polystyrene	PS	0	9	2	1	1
	Polypropylene	PP	0	877	183	2	0
	Polycarbonate	PC	0	3	0	1	0
	Polyvinyl Chloride	PVC	0	877	198	5	0
Sample C < 50µm Mean C1, C2, C3	Polyethylene	PE	0	11218	2252	4	1
	Polyethylene Terephthalate	PET	0	77	29	2	1
	Polystyrene	PS	0	77	19	0	0
	Polypropylene	PP	0	448	99	2	0
	Polycarbonate	PC	0	4	0	1	0
	Polyvinyl Chloride	PVC	0	404	144	4	0