ANDROMEDA Analysis Methods

Methodology	Size Range (µm)	Cost (high/medium/low)		Strengths / Weaknesses	Status at project start/gaps (what is state-of-the-art, which gaps/improvements are advised)	Andromeda reference persons	Links to Andromeda project tasks
		Equipment	Personnel				
Optical microscopy	>100 µm	Low	High	+ Cheap and relatively easy implementable method - High risk of mismatching plastics versus non-plastics due to matrix interferences - Need for strong matrix removal - No polymer identification	**Status**: Well studied method **Gaps/Improvements**: No further optimization planned within Andromeda	Bavo De Witte, Kati Lind, Natalja Buhhalko	WP2
Hyperspectral imaging	(to be evaluated, ~ >100µm)	Low	Med	+ Potential of some chemical signature + Potentially rapid + Could be stand alone or integrated in microscopes - not yet validated	**Status**: Method still being optimized. Has good potential when linked in combination with other techniques. **Gaps/Improvements**: Method development and validation needed.	Martin Hassellöv (Josef Brandt)	WP2
GC- and LC-MS analysis of chemical markers	ALL	Med-High	Med	+ In combination, LC-MS and GC-MS techniques can identify and quantify most organic chemicals. They are not suitable for elemental analysis + Chemical Markers can be used to identify specific types of plastic such as tyre & road wear particles. E.g. by analysis of benzothiazoles or 6-PPD + Mass based technique instead of counting particles	**Status**: Instrumentation is widely available across different laboratories in the consortium. **Gaps/Improvements**: Approaches need to be developed to non-target and target screening of plastic associated chemicals in environmental matrices and bulk plastic materials.	Andy Booth	WP2, WP4

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Fluorochromes	>50 µm	Low-Med	Med	+ Clear visualisation of microplastics + Approach is time-efficient and identification is fast - Matrix interference when coloring dye or pigment lacks specificity - Difficult to categorize type of plastics if polymer types are not known before hand	**Status**: Applications for water and sediment exist. Polymer identification has been proposed, but is still limited and currently lacks accuracy. **Gaps/Improvements**: There is currently limited automatization, but recently improved with automated image analysis techniques. Limited applications for biota matrices due to matrix interferences.	Bavo De Witte, Arun Mishra, Natalja Buhhalko	WP2
µFTIR	10-1000 µm	Med	High	+ Combines particle imaging, counting, size analysis and identification + Recognised as one of the most useful instruments in MP research - Analysis costs and time increase significantly when trying to work near the lower limit of detection - Requires very good sample processing before analysis - Difficulties in analysing long fibres, (not fully attached to the filter)	**Status**: Method considered to be the state of the art for MP analysis (down to 10 µm). Limited by costs and time of analyses, especially when targeting the smallest particles. Currently a lack of standardisation/harmonisation is an issue. Instrumentation is widely available across different laboratories in the consortium. **Gaps/Improvements**: Method validation needed, especially through 'round robin' exercises.	Stephan Kubowicz, Natalja Buhhalko	WP2,WP3, WP4
µRaman	1-1000 µm	Med	High	+ Combines particle imaging, counting, size analysis and identification + Recognised as one of the most useful instruments in MP research	**Status**: Method considered to be the state of the art for MP analysis (down to 1 µm). Not as widely used or developed as µFTIR. Currently a lack of standardisation/harmonisation is an issue. Limited availability across laboratories in the consortium.	Martin Hassellöv (Karin Mattsson)	WP3

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				- Analysis costs and time increase significantly when trying to work near the lower limit of detection - Requires very good sample processing before analysis	**Gaps/Improvements**: Lower limits to analysis and detection could be investigated in more detail. Method validation needed, especially through 'round robin' exercises.		
SEM-EDX	1-1000µm	High	med	+ particle identification plus elemental signatures, automated analysis applications + applicable e.g. for paint particles, TWRP	**Status**: Method still being optimized. Has good potential when linked in combination with other techniques. Limited availability across laboratories in the consortium. **Gaps/Improvements**: elemental signatures need to be calibrated, automation procedures still needed.	Martin Hassellöv (Juliana Aristeia De Lima)	WP3
LDIR	20-1000 µm	med	med	+ polymer identification + relative abundance determination + MP can be measured automatically + Report for ten characteristics of particles + Applicable for aquatic environmental matrix (water, sediment, biota, air) + smallest MP (environment sample) identified in automated mode was PET (11 x 14 µm) - Analysis without filter: time consuming for preparation, recovery not yet reported	**Status**: New technology that will likely replace µFTIR in the longer term. Methods still being optimized and is not widely recognised by the research community at present. Limited availability across laboratories in the consortium. **Gaps/Improvements**: Method validation is required, but one MIO methodological article is in preparation (submission July 2021).	Richard Sempere/Natascha Schmidt	WP3

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				- Analysis on filter: study in progress at MIO using five polymers: 1. PE (44 µm to 1039 µm) 2. PET (54 µm to 1028 µm) 3. PP (66 µm to 1213 µm) 4. PVC (59 µm to 1937 µm) 5. PS (62 µm to 1525 µm) - LDIR Library need to developed - method in progress			
TD-GC-MS/Pyr-GC-MS	All	Med	Med	The technique is suitable for quantifying the total mass of different polymer types in a sample. The technique does not permit direct analysis of particle number or particle size (pre-fractionation can help the latter to some degree). Significant challenges in quantitatively transferring extracted samples from filters to sample holders.	**Status**: Mass based analysis method. Relatively well developed and increasingly accepted, especially as it addresses policy needs more closely than other techniques (e.g. mass metrics). Method still needs development, optimization and harmonisation. Has good potential when linked in combination with other techniques (e.g. FTIR/Raman). Good availability across laboratories in the consortium. **Gaps/Improvements**: Challenges with matrix effects, certain polymer types, sample preparation and transfer to analysis vessels.	Andy Booth	WP3
Flow through micro-litter sampling from water	>50 µm	Low	Med	+ Relatively cheap to produce + Commercially available sieves + Easy to implement (to Ferrybox system)	**Status**: Devices are ready to use, with travel case	Villu Kikas, TalTech	WP2

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				+/- Option to use as standalone system, but then needs positioning device + Flowmeter already attached + Stand for easy use - Could be clogged (high bloom areas)			

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