

PlasticFreeDanube

SORTING PROTOCOL

for the assessment of macro-plastic waste
in and along fluvial systems

DOCUMENT INFORMATION

Work Package		4 Sampling and Sorting of Plastic Waste in and along of river systems	
Activity		4.1 Methodology for standardised sampling of plastic waste	
Detail Output		4.1.1 Sorting protocol	
Version	Date	Author	Organisation
v.2.0	26/10/2018	J. Mayerhofer, S. Lenz, G. Obersteiner	ABF-BOKU
v.3.0	20/03/2019	J. Mayerhofer, S. Lenz, G. Obersteiner	ABF-BOKU
v.4.0	18/10/2019	J. Mayerhofer, S. Lenz, G. Obersteiner	ABF-BOKU

1. PROCEDURE OF SORTING ANALYSIS

Sorting analyses represent an essential tool to identify and assess the composition of solid waste. In the course of the "PlasticFreeDanube" (PFD) project, this method is ideally suited to get information about possible sources of riverine plastic pollution as well as the assessment of the quantities. The following points briefly outline the procedure of sorting analysis and what should be considered in the planning. Subsequent a list of useful equipment is also given (Chapter 2).

In addition to a developed sampling protocol, which serves as a basis for the collection of plastic waste along rivers, the PFD-handbook contains a detailed description for handling with the sampling and sorting protocol.

SORTING ANALYSIS PROCEDURE

- Choose a weatherproof location for sorting** (protection against sudden rain, strong wind, etc.)

- Select suitable containers** (e.g. mortar trough for larger fractions like food packaging or housewares; barrels for beverage bottles and foils; buckets for smaller fractions like sanitary waste; additional containers for sludge, dirt, water, etc. as well as reserve)

- Label the containers** (and determine their tare weights)

- Arrange the fraction containers around the sorting table** (good accessibility for stuff, arrange similar categories next to each other)

- Weigh and document the total weight of each sample** (do not forget to subtract the weight of the collection containers, e.g. garbage bags)

- Assign the plastic waste to the correct fraction according the PFD-Masterlist**
(depending on the research question, other non-plastic materials such as wood, glass, paper, metal, etc. can also be recorded and evaluated; remove items from dirt, algae, mud/sand, organic substances, etc. as far as possible and put them in the "organic/non-plastic" fraction; bottles and containers may be emptied, provided they are filled with water/drink {→ also "organic/non-plastic" fraction}; separate unknown substances {e.g. oily mixture} and dispose them correctly)

- Document all categories / containers with a photo**

- Weigh each single fraction and enter them in the provided table (see appendix)**
(also non-plastics waste and other recorded fractions or materials; do not forget to subtract the tare weight of the containers)

- Count the items of each category and assign them to the defined size classes**
(according Chapter 4; enter the numbers again in the table)

- Describe each analysed plastic waste fraction and note "outliers" in the table**
(items, that are heavier than the average)

- Control the sum of all weighted categories with the initial weight** (Permissible weight deviations between the initial determined total weight and the sum of all sorted categories should not exceed 3%).

2. LIST OF EQUIPMENT

The following list contains some useful equipment, which contributes to a successful sorting.

General equipment	Sorting equipment
<input checked="" type="checkbox"/> PFD Sorting Protocol (electronic + some printed)	<input checked="" type="checkbox"/> Sorting table (+ film)
<input checked="" type="checkbox"/> Pens, clipboards for protocols	<input checked="" type="checkbox"/> Balance* + cable + spare batteries
<input checked="" type="checkbox"/> Work clothing and warning vests (if necessary)	<input checked="" type="checkbox"/> Containers incl. labelling (fraction, tare)
<input checked="" type="checkbox"/> Cut resistant gloves (protection against e.g. syringes)	<input checked="" type="checkbox"/> Reserve containers + labels
<input checked="" type="checkbox"/> First-aid-box (plaster, disinfection, bandage)	
<input checked="" type="checkbox"/> Roll scale or folding rule	
<input checked="" type="checkbox"/> Scissors, knife	
<input checked="" type="checkbox"/> Broom and dustpan	
<input checked="" type="checkbox"/> Camera (memory chip), batteries, charger	
<input checked="" type="checkbox"/> Laptop	
<input checked="" type="checkbox"/> Extension cable, distributor plug	
<input checked="" type="checkbox"/> Portable outdoor spotlight	
<input checked="" type="checkbox"/> Personal goods (food and drinks, spare clothes)	

* Balance with a recommend measuring accuracy of 0.01 kg



Figure: Sorting table and sorting containers for various categories

3. CLASSIFICATION OF MACRO-PLASTIC

3.1. Categorisation of macro plastic waste

The following table gives an overview of the classification of macro-plastic waste, defined in the framework of the “PlasticFreeDanube” project. This functional categorisation aims at allocating plastic waste to its origin or input sources. Another important aspect of this classification is that even laypersons without special prior knowledge can manage the allocation of plastic waste within the scope of sorting analyses. Corresponding data and information on plastic waste are essential to derive appropriate prevention measures.

Table 1: Classification of plastic waste in and along the Danube

Main-group	Sub-group	No.	Category	No.	Sub-Category	
Packaging	Drink bottles	1	PET drink bottles + caps			
	Food packaging	2	Food packaging	2a	Flexible packaging	
				2b	Hard plastic containers	
				2c	Liquid packaging boards	
				2d	Foamed food containers	
	Non-food packaging		3-9		3	Single-use tableware
					4	Shopping bags
					5	Cosmetic bottles & containers
					6	Cleaner bottles & containers
7					Building & construction packaging	
8					Packaging films and sheets	
9					Other plastic packaging	
Foamed	Foamed plastic	10	Foamed plastic (packaging / insulation / foamed fillers / undefinable foamed plastic items)	10a	Expanded Polystyrene (EPS) Packaging*	
				10b	Expanded or Extruded Polystyrene (EPS/XPS) for insulation*	
				10c	Other foamed plastic*	
Non-Packaging	Household / toys / sport / leisure	11-16		11	Housewares / household like items	
				12	Clothes, shoes and accessories	
				13	Toys, sport & leisure article	
				14	Fishing gear	
				15	Cigarette items	
				16	Lighters	
	Sanitary & medical article		17	Sanitary waste	17a	Feminine hygiene articles
					17b	Wet wipe/cleaning tissue
					17c	Cotton buds
					17d	Other sanitary waste
	Other non-packaging items		18-23		18	Medical & pharmaceutical waste
					19	Plastic ropes and strings
					20	Tapes
21					Shipping items	
22					Car parts	
23					Building & construction waste	
24					Unidentifiable plastic items	
Others	Other plastic items	24	Unidentifiable plastic items			

*currently there is only one “foamed plastic” fraction, a description for differentiation is in progress

3.2. SIZE CLASSES OF MACRO PLASTIC

In order to get information of the size distribution of macro-plastic waste, it is necessary to assign the collected items to a size class. The resulting data can serve as a basis for the abrasion and degradation condition of plastic objects. Following size classes have been defined:

- ▶ Mesoplastics | < 5 cm
- ▶ Macroplastics | 5 – 50 cm
- ▶ Megaplastics | > 50 cm

It is advisable to do the allocation to the size classes during the count. Thereby, it is helpful to stick a 5cm or 50cm long strip on the table (or draw it on the foil) as a rough indication. The longest edge length of the plastic items must be measured (see photo beside).

Cat.10: Foamed plastic; Size class > 50cm

Cat.24: Unidentifiable plastic items; Size class 5-50cm

Cat.15: Cigarette items; Size class < 5cm



MASTERLIST - Sorting Protocol for Plastic Waste



ID 1 PET DRINK BOTTLES



PET Getränkeflaschen



PET nápojové fľaše

Description All sizes (0.5l, 0.75l, 1l, 1.5l, 2l), incl. bottle caps (PP); also single bottle caps, which can be assigned as part of a PET bottle

Note Empty liquids; count also single caps



ID 2a FOOD PACKAGING

flexible pack/foils



Flexible Lebensmittelverpackungen



Flexibilné balenie potravín

Description Crisps packets, sweets wrappers, salad foil pack., nets for lemons/oranges, bubble wraps for fruits, external pack. for PET-bottles, etc.

Note May contain a thin aluminium layer, if the heavier part is the plastic (e.g. Chips Packaging)



ID 2b FOOD PACKAGING

hard plastic container



Lebensmittel-Vpkg. - Hartplastikbehälter



Balenie potravín - plastové kontajnery tvrdé

Description Food containers for meat, fruits, vegetables, yoghurt, (curd) cheese, cream, spread, etc.

Note Top film on a meat packaging (e.g. MAP) remains on, so that no falsifications occur during the counts; without foam pack;



ID 2c FOOD PACKAGING

liquid packaging boards



Lebensmittel-Vpkg. Getränkeverbundkartons



Balenie potravín - Nápoj zložený kartón

Description TetraPak, bonded drinks cartons for e.g. milk, orange juice, cream, etc.

Note



ID 2d FOOD PACKAGING

Foamed food container



Geschäumte Lebensmittel-Vpkg.

Description Foamed take away boxes (e.g. for ice cream), foamed protective covers for e.g. fruits

Note



ID 3 Single use tableware



Einweggeschirr

riad na jedno použitie

Description Plastic cutlery (spoon, fork, knife), plates, trays, straws, plastic cups, etc.

Note Included foamed cups for tea



ID 4 Shopping Bags



Einkaufstragetaschen

nákupné tašky

Description Exclusively shopping bags, which are handed out by the trade (but also knot bag for fruits and vegetables)

Note No garbage bags, no bags for animal faeces



ID 5 COSMETIC BOTTLES & CONTAINERS



Kosmetikartikel

Kozmetické fľaše a nádoby

Description Sunblocks, shower gel, deodorant, etc.

Note



ID 6 CLEANER BOTTLES & CONTAINERS



Reinigungsmittel

Description Detergent, cleaner, etc.

Note



ID 7 BUILDING & CONSTRUCTION PACKAGING



Verpackungstuben und Behälter

Description Packaging of adhesives and sealants (e.g. silicone tube); packaging of building and construction materials, etc.

Note



ID 8 PACKAGING FILMS & SHEETS



Verpackungsfolien

Description Sheets, foils, films, (also film parts that can no longer be precisely identified)

Note



ID 9 OTHER PLASTIC PACKAGING



Sonstige Kunststoffverpackungen

Description Fuel can, engine oil bottles, undefinable bottles, strapping bands, plastic flower pots (one-way), big-bags, etc.

Note Includes composite packaging



ID 10 FOAMED PLASTIC



Geschäumte Kunststoffe

Description "Styropor", refrigerator trays and boxes, insulation panels and boards, spray foam, filling material for furniture

Note Without foamed food and fishing gear pack



ID 11 HOUSEWARES / HOUSEHOLD LIKE ITEMS



Haushaltswaren, haushaltsähnliche Artikel

Description Typical household appliances (keep-fresh package/container, pen, coffee machine, laundry basket), curtains, tablecloth, gardening equipment (planter), etc.

Note Exclude "streetwear" textile (→ ID 12)



ID 12 Clothes, shoes and accessories



Straßenkleidung inkl. Accessoires

Description Shoes/sandals (incl. flip-flops), clothes, handbags, backpacks, etc.

Note If the polymer content of the cloth can be determined for mixed fibres (e.g. polyester/cotton), use the percentage weight; If unknown, whether natural or synthetic fibre → fire test (*see below)



ID 13 TOYS & LEISURE ITEMS



Spielsachen sowie Sport und Freizeitartikel

Description Sport items (tennis racket, football, etc.) balls, dolls, plastic sandbox buckets, etc

Note



14 FISHING GEAR



Fischereizubehör

Description Nets, lines, fishing rod, foamed plastic packaging for fishing baits

Note



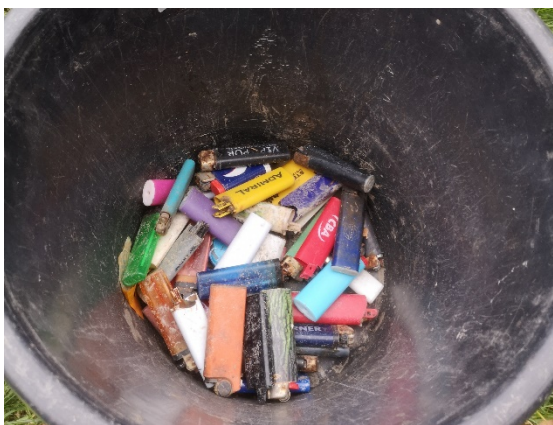
15 CIGARETTE ITEMS



Zigarettenartikel

Description Butts & filters, tobacco pouches / plastic packaging of cigarette box

Note No paper/no alu packaging



16 LIGHTERS



Feuerzeuge

Description

Note Lighters are weighed in total. Exact plastic weight is determined later by multiplication with the factor 0.8 to exclude metal content



17a FEMININE HYGIENE ARTICLES



Damenhygieneartikel

Description Sanitary towels, tampons (incl. packaging)

Note



ID 17b WET WIPE / CLEANING TISSUE



Feucht- und Reinigungstücher

Description

Note



ID 17c COTTON BUDS



Wattestäbchen

Description

Note



ID 17d OTHER SANITARY WASTE



Sonstige Sanitärabfälle

Description Toothbrush and other dental hygiene articles, Urinal deodorizer block holder, etc.

Note



ID 18 MEDICAL & PHARMACEUTICAL WASTE



Medizinische und pharmazeutische Abfälle

Description Syringes, medical strip/plaster, pill blister, etc.

Note



ID 19 PLASTIC ROPES & STRINGS



Kunststoffseile und -schnüre

Description All sizes

Note If unknown, whether natural or synthetic fibre
→ fire test (*see below)



ID 20 TAPES



Klebebänder

Description adhesive strips, fabric tapes (e.g. Gaffa tape)

Note



ID 21 SHIPPING ITEMS



Schiffsgegenstände

Description buoys, life jacket, fender etc.

Note specify larger items



ID 22 CAR PARTS



Fahrzeugteile

Description fenders, hubcaps, tyres, licence tag holder,
fluid container/tanks, etc

Note specify larger items (e.g. tyres)



ID 23 BUILDING & CONSTRUCTION WASTE



Baustellenabfälle

Description Pipes, cable sheath, frames, tools, tubes, etc.

Note If the metallic part clearly predominates in cables (copper), then to the category of non-plastics



ID 24 UNIDENTIFIABLE PLASTIC ITEMS



Nicht identifizierbare Kunststoffgegenstände

Description unidentifiable plastic items or other plastic articles which cannot be clearly assigned to any of the other categories with respect of their origin

Note specify larger items

ID 25 ORGANIC & OTHER NON-PLASTIC ITEMS



Organik und andere Nicht-Kunststoffabfälle

Description Water, sludge, other organic components (like leaves, grass, smaller twigs, etc.); also other non-plastic waste (“residual waste”);

Note Collect organic and residual waste separately in order to dispose of them correctly;

*Fire Test:

Plastic/Fibre	Combustibility
Cotton	<i>burns quickly, glows after, embers can be inflamed by careful blasting</i>
PP,PE, Polyester	<i>melting, then burning</i>

OPTIONAL CATEGORIES (OTHER MATERIALS)

27a RESIDUAL WASTE



Restmüll

Description

27b GLAS



Glas

Description

27c ALUMINIUM & METAL



Aluminium und Metall

Description

27d PAPER & CARDBOARD



Papier und Kartonagen

Description

27e WOOD



Holz

Description

EVALUATION TABLE

Code of sample:			
Date of Sampling:		Initial weight (brutto):	kg
Date of Sorting:		Tara (collection cont.):	kg
Time / Duration:		Sample weight (netto):	kg

No.	CATEGORY	TARE WEIGHT Container	NET WEIGHT Fraction	COUNT / SIZE CLASS			COMMENT
				< 5cm	5–50cm	>50cm	
1	PET drink bottles + caps						
2a	Flexible packaging						
2b	Hard plastic containers						
2c	Liquid packaging boards						
2d	Foamed food containers						
3	Single-use tableware						
4	Shopping bags						
5	Cosmetic bottles & containers						
6	Cleaner bottles & containers						
7	Building & construction packaging						
8	Packaging films and sheets						
9	Other plastic packaging						
10	Foamed plastic						
11	Housewares / household like items						
12	Streetwear						
13	Toys, sport & leisure article						

No.	CATEGORY	TARE WEIGHT Container	NET WEIGHT Fraction	COUNT / SIZE CLASS			COMMENT
				< 5cm	5-50cm	> 50cm	
14	Fishing gear						
15	Cigarette items						
16	Lighters						
17a	Feminine hygiene articles						
17b	Wet wipe/cleaning tissue						
17c	Cotton buds						
17d	Other sanitary waste						
18	Medical & pharmaceutical waste						
19	Plastic ropes & strings						
20	Tapes						
21	Shipping items						
22	Car parts						
23	Building & construction waste						
24	Unidentifiable plastic items						
25a	<i>Non-Plastic Fraction</i>						
25b	<i>Organic</i>						
SUMMARY							
S	SUM [kg]		kg				
C	TOTAL (Counts)						
TW	Total weight [kg] (before sorting)		kg				
WD	Weight deviation (in kg and %)	= TW before[kg] – Sum [kg]	kg	$= \frac{WD [kg]}{TW \text{ before } [kg]}$		%	Deviation should be less than 3%, otherwise check the weights again!