OSPAR REGIONAL ACTION PLAN ON MARINE LITTER

ACTION BRIEFING NOTE: ACTION 42

Summary of progress to investigate and promote best practices, techniques and technologies relating to preventing and reducing sewage and storm water related waste, including micro particles entering the marine environment.

Regional Action Plan for Marine Litter (RAP ML)

OSPAR's marine litter objective is "to substantially reduce marine litter in the OSPAR Maritime Area to levels where properties and quantities do not cause harm to the marine environment". OSPAR 2014 agreed a Regional Action Plan for Marine Litter for 2014-2021; this will be reviewed at the end of this period until spring 2021 after which OSPAR will work on the development of a new or updated RAP.

The RAP ML (2014-2021) defines the four key areas (themes) of actions to be implemented:

A. Reduction of litter from sea-based sources
B. Reduction from land-based sources
C. Removal of existing litter
D. Education and outreach

The full Regional Action Plan and its outputs can be accessed via https://www.ospar.org/work-areas/eiha/marine-litter/regional-action-plan

This Action Briefing Note focuses on Action 42. It sets out the issue, its relevance for OSPAR and the North-East Atlantic Ocean, the work that has been completed by regional action under OSPAR and finally highlights possible next steps which could be taken forward to the revision of the OSPAR regional action plan on marine litter.

The Action

Action 42 was to Investigate and promote with appropriate industries the use of Best Available Techniques (BAT) and Best Environmental Practice (BEP) to develop sustainable and cost-effective solutions to reducing and preventing sewage and storm water related waste entering the marine environment, including micro particles.

This action is a component of Theme B of the RAP ML to combat land-based sources of marine litter to address the reduction of sewage and stormwater related waste. The action was co-led by Ireland, Norway and Sweden.

Geographic scope: Relevant to all OSPAR Contracting Parties

The issue

Why is the release of plastic waste, including micro litter particles, from wastewater and storm water an issue for marine litter?

Marine litter means any persistent, manufactured or processed solid material (regardless of size), discarded, disposed of, or abandoned in the environment, including all materials discarded into the sea, on the shore, or brought indirectly to the sea by rivers, sewage, storm water, waves, winds, or by any other means.

The adverse impacts of plastic litter in the marine environment are well established with plastic products responsible for entanglement of animals, causing injuries to the alimentary tract, preventing digestion or blocking the intake of food to the point that the animal starves if ingested. For microplastics specifically, once in the marine environment they are almost impossible to clean up. Furthermore, laboratory studies have shown that very small ingested microplastics may cross the gut lining and accumulate in tissues. Other studies have highlighted the risk of micro plastics acting as vectors for toxic chemicals and pathogenic agents.

From studies in the open sea of the North East Atlantic, the concentration of microplastics[1] is above 2 particles/m^3, while in coastal waters of the Skagerrak it could be tens or hundreds per litre[2]. In beach and sediment surveys in the North Sea area, concentrations of several hundred microscopic plastic particles per kg sand have been recorded.

Wastewater and stormwater as a pathway for marine litter

Wastewater from industries and households can contain substantial amounts of microplastics. Microplastics are classified as either primary or secondary. Primary microplastics are intentionally engineered and added to products or used in production processes, whilst secondary microplastics are created intentionally or unintentionally during the production, use or waste phase of plastic items (specifically the degradation of plastic items over time). Microplastics in wastewater and stormwater can originate from industrial processes, cleaning products, textiles etc. Current studies indicate that the greatest contribution, however, may come from roads and paved surfaces in urban areas.

Wastewater is generally fed to Waste Water Treatment Plants (WWTPs) where most of the solid material, including microlitter, is retained in sewage sludge and hence does not get released in treated water outflows. Nevertheless, a certain amount of litter particles may pass through the plant and enter the environment via WWTP outflows / effluent water. However, WWTPs are designed to reduce the amount of particles, nutrients and organic matter inputs into the environment from wastewater.

Storm water runoff has been found to contain both large litter items and microlitter. In OSPAR countries, storm water runoff is either combined with wastewater flows to WWTPs, or treated separately. Both methods have the potential to release litter into the natural environment. For combined systems, there is a risk that stormwater overflows will lead to untreated discharges of wastewater, as well as deterioration of the sludge quality. Where storm water is treated separately, it is drained into a dedicated storm water system from where it is transported to the receiving water with or without storm water treatment, thus transporting any litter items straight to the sea by rivers and other water ways.

A further possible route for microplastics to reach the marine environment from wastewater, is via the use of sewage sludge as fertilizer. As microplastics are retained in sewage sludge, when applied to agricultural land, the soil can become polluted, resulting in the potential for microplastics in crops[3] and also in surface run-off into rivers (which will eventually end up in the marine environment).

What has been done by OSPAR to address the issue?

Action 42 addresses both macro- and micro litter related to wastewater and stormwater management, but the work completed to date has mainly focused on micro litter, and especially on micro plastics. Due to the broad scope of this action, the task leads initially focused on microlitter, as macrolitter would be, in part, addressed by many other actions of the OSPAR RAP ML.

In order to gather a better understanding of the issue, OSPAR Contracting Parties have developed four documents that comprise the outputs for this collective action:

1. A report on techniques to reduce litter in wastewater and stormwater in 2016;
2. A technical synthesis report on technologies for litter reduction from waste- and storm water and supply in 2017;

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[1] For the study in question microplastics were understood to be between 250 micrometres to 5 mm in size

[2] H.A. Leslie et.al. Microplastics en route: Field measurements in the Dutch river delta and Amsterdam canals, wastewater treatment plants, North Sea sediments and biota. Elsevier int (2017).

[3] Jing-JieGuo et al. Source, migration and toxicology of microplastics in soil. Elsevier int (2020). Available at: https://www.sciencedirect.com/science/article/pii/S0160412019325097

3. An OSPAR Background document on BAT/BEP in urban wastewater treatment systems, with a focus on stormwater related litter in particular microplastics was published in 2019; and

4. A short summary of responses received from a specific questionnaire on stormwater systems which was circulated in 2019, with responses provided in 2019 and early 2020. The questionnaire synthesis provides a snapshot of the current situation at the time of the questionnaire.

A summary of the key points and conclusions from each output is presented in the sections below.

Techniques to reduce litter in wastewater and stormwater

A first report concerning techniques to reduce litter in wastewater and storm water was finalized in 2016. This aimed to articulate the best available technology (BAT) to reduce litter in wastewater and storm water. This report found that discharge from storm water drains and untreated municipal sewerage is depicted as the major land-based pathways of marine litter. The report presents a series of treatment techniques for the removal of debris from wastewater and storm water, ranked by cost-effectiveness and utility.

The report concluded that WWTPs, with mechanical, biological and chemical treatment of the wastewater have a high efficiency since they can retain >97% of microlitter ≥300 µm and generally >80% of litter particles ≥20 µm in the sewage sludge. Therefore, efforts made within the OSPAR member states to reduce the discharge of untreated wastewater and to include conventional primary and secondary treatment of the municipal wastewater would have a substantial effect in reduction of the marine litter. However, despite high retention rates, large amounts of particles are still released into the marine environment.

The report also concluded that most storm water in the OSPAR region is not treated at all and therefore recommended installation of storm water treatment facilities in exposed areas. Conventional treatment systems like grids followed by wet-ponds would reduce the litter load from storm water to sea substantially. To improve the reduction of microlitter in storm water additional filtration and/or chemical precipitation is needed. Investment and maintenance cost for storm water treatment facilities differs substantially between different technologies and locations, but all facilities need proper maintenance to avoid clogging and malfunctioning. Also, low impact development mimicking the natural hydrology in urban area has a good potential to reduce the load of litter to the sea.

Finally, the report also concluded that storm water should preferably not be treated in municipal wastewater treatment plants while high flow variability, low water temperature and pollutions will impair the treatment and deteriorate the sludge quality. However, pre-treatment grids/screens may be applicable in areas with combined sewer systems prone to overflow in order to reduce discharge of large litter (>5 mm).

The main message of the report is that better treatment is needed for untreated discharges of wastewater and places with simple mechanical treatment. The report also highlights the importance of addressing litter before it enters the storm water system by using cleaning techniques such as street cleaning and emptying waste bins. Dry vacuum cleaning is seen as the most efficient form of street cleaning since it also proved to reduce the particle content in air.

Since publication of the report, in order to comply with stricter regulations on phosphorus, ultrafiltration (UF) techniques are more widely applied in OSPAR Contracting Parties, which enhance the reduction of suspended solids and thus microlitter to nearly 100%. However, another issue of concern is that most of the removed microlitter ends up in the sewage sludge.

Technologies for litter reduction from waste- and storm water and supply

As a next step and with the aim to present the key messages and conclusions from the 2016 report in an easy to digest form (as well as taking into account updated information), a second technical synthesis report was compiled on technologies for litter reduction from waste- and storm water and supply. The 2017 report provided an overview of microlitter sources that ended up in, and / or are discharged from, wastewater and stormwater systems, and identified the most common existing measures that can be put in place to reduce discharges.

The synthesis report recommended that each country develop strategies and / or action plans to reduce the discharge of microlitter from stormwater and wastewater treatment plants to the sea. It is also recommended that treatment processes should be considered where appropriate and addressing microlitter sources directly should be given priority in order to reduce the possibility of microlitter discharges from wastewater and stormwater systems.

The synthesis report also stated that, for many countries, construction of treatment systems or secondary treatment is still pending. By enforcement of existing plans and implementing the Wastewater Directive many countries will reduce the discharge of microlitter significantly. As a result of the outcome of the report, a clarification was added to national action 64 of the RAP ML, to 'ensure effective implementation of Urban Waste Water Treatment Directive (91/271/EEC)'.

Review of BAT and BEP in Urban Wastewater Treatment Systems focusing on the reductions and prevention of stormwater related litter, including micro-plastics, entering the Marine Environment

The two previous reports did not contain any substantial information on how combined collection and treatment systems handle stormwater related litter and prevent it entering the marine environment. This topic was therefore picked up as a third report. The third output was published as an OSPAR Background Document[4] in 2019, a review of BAT and BEP focusing on combined storm water systems. The OSPAR Convention defines BAT as 'the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste' and BEP as 'the application of the most appropriate combination of environmental control measures and strategies'. The report reviewed current practice for WWTPs as well as stormwater systems that connect to WWTPs (combined systems), and was developed to provide information on existing storm water handling practices in the OSPAR region, specifically, how Combined Sewer Overflow (CSOs) performance standards, and best available processes, technologies and systems can be employed to minimise stormwater related litter, and particularly microplastics, entering the marine environment through CSOs.

The report addressed combined systems and therefore there is still a knowledge gap in regard to storm water management with separate sewer systems.

The treatment of storm water by 'separate storm water systems'

The final output of this action reviewed the treatment of storm water by separate storm water systems across OSPAR Contracting Parties, through the collection of information via a questionnaire. The majority of the responses received were from national and local environmental authorities. The report presents a summary of the responses received, and therefore a snapshot of the current situation at the time of the questionnaire, i.e., in 2019/2020.

In summary, the proportion of stormwater that underwent some form of treatment was not known for the majority of countries as no data was available or collected on this topic, however for those that had data, the percentages of stormwater that underwent treatment varied greatly, from approximately 10%, to approximately 75%. A number of different techniques were cited for dealing with storm water, including the use of ponds and basins, underground sedimentation, urban green structures, soil infiltration and storm water tanks. However, the techniques cited vary between the different OSPAR Contracting Parties, and indeed within countries (i.e. the type of treatment is based on the requirement for water quality in the receiving waters). Some, but not all Contracting Parties collect information on effectiveness of techniques for treating stormwater, and there are a number of new treatment technologies under development.

In terms of plans to tackle the issue of litter in stormwater, there were varying degrees of progress across OSPAR Contracting Parties. Although some countries are undertaking activities such as projects, assignments and awareness campaigns, or litter picking regime requirements, many have no dedicated plans in place. Stormwater management is generally considered at a catchment or regional level for OSPAR Contracting Parties, rather than managed nationally.

Barriers to progress

Although there has been a lot of work undertaken by OSPAR Contracting Parties to address Action 42 of the OSPAR RAP ML, there have also been a number of issues that have prevented progress from being made. These include questions regarding the mandate and competence of OSPAR, and specifically ICG-ML, in terms of addressing issues related to wastewater and stormwater, which although having a definite impact on the marine environment, occur upstream. It

[4] Review of best available techniques (BAT) and best environmental practices (BEP) in urban wastewater treatment systems in accordance with the URBAN Waste Water Treatment Directive (91/271/EEC) and other relevant standards, with a focus on reduction and prevention of stormwater related litter (including microparticles) entering the marine environment

is often the case that government agencies and bodies are divided by environmental compartment (i.e. focusing on terrestrial or marine environments) and so coordinating and collaborating across these divisions is challenging. Therefore, it has been difficult to ensure that appropriate terrestrial water colleagues are engaged in discussions. Furthermore, Contracting Parties (who are also EU Member States) are already committed to implementing EU Directives on Urban Wastewater Treatment and the Water Framework Directive, and so often energies are focused on those existing pieces of legislation, and the added value that OSPAR brings to these discussions is not always understood.

However, through the work that has been done to date, a number of knowledge gaps (in relation to the management of wastewater and stormwater) have been identified and would need to be answered in order to make any further progress on this issue. Therefore, any institute or body wishing to take this issue forward would need to consider the following:

- An understanding of the quantities of microlitter in sewage sludge is needed;
- An understanding of the quantities of sewage sludge used as fertilizer on agricultural soil is needed;
- An understanding of the extent to which microplastics are present in fertilizers generally, and the amount that are leached into water courses as a result;
- An understanding of the environmental impact of sewage sludge spread on agricultural soil, including run off to the marine environment is needed;
- Information on the relative importance of the different pathways for marine litter and microparticles is still very limited (storm water is expected to have very high litter content as it receives direct run-off from roads etc.);
- The harm of discharges from Urban WWTPs (i.e. microplastics that are not captured through the treatment systems). The smallest particles are to a much less degree "cleaned out" (by which we mean separated) by modern wastewater plants. There is a concern that these small micro- and nanoparticles have the largest potential for biological harm;
- The fate of these small microparticles in the marine environment is unknown. Is there a limit to fragmentation? Do they stay individual - or do they quickly interact with other particles etc. making uptake in small organisms less probable?
- There are few studies on the transport of litter by storm water, reduction of litter by storm-water treatment technologies and final load of litter on the marine environment from storm water;
- The amounts of microlitter in storm water etc. from construction and cleaning and maintenance of infrastructure;
- The amounts of microlitter in storm water etc. from cleaning and maintenance of transport media (such as boats, cars, planes etc.);
- Cost-effectiveness of wastewater and stormwater technology; and
- Data on spill frequency and spill duration of combined systems.
- The impact of storm water systems as vectors for macrolitter has not been addressed and needs separate assessment.

Potential options for future work (next steps)

One potential option would be to recommend that each country could develop strategies/action plans to reduce the discharge of microlitter from stormwater and wastewater treatment plants to the sea. It could also be recommended that treatment processes are considered (where appropriate) and addressing microlitter sources directly should be given priority in order to reduce the possibility of microlitter discharges from wastewater and stormwater systems.

For wastewater treatment, water borne litter, including items of risk to the environment and public health (such as bottles and sanitary products), could be considered for inclusion within the definitions of ‘good status’ used by the EU’s Water Framework Directive. Continued investment in wastewater infrastructure is needed to remove sanitary items, to reduce the exchange between wastewater and drainage systems, and to allow storage of water following storms. This would reduce the risk of items such as sanitary products and light street debris such as crisp packets, bottles, caps and food cartons entering rivers.

Further research on microplastics in sludge, specifically around the need for a threshold for treated sludge used in agriculture could also be considered.

Wastewater and storm water act as transport media for a number of upstream point sources. Therefore, when considering interventions to reduce litter from sewage and stormwater, they should focus at (or as close to as possible) the source of the pollution, i,e, focussing on stopping microplastics entering the waste systems to begin with. Some of these sources are explicitly covered by RAP-ML Action 46[5], especially sources of primary microplastics like cosmetics and plastic pellets. Furthermore, in the recent review of the UWWTD it was stated that microplastics should be considered for a future threshold for wastewater discharges as well as linking this to the need for spill limit for Combined Sewer Overflows.

Other microlitter sources like microfibres from washing, microplastics from roads and tyres, microplastics from sport pitches, microplastics from construction work, microplastics from cleaning and maintenance of infrastructure and transport media etc. are not explicitly covered in the RAP-ML (2014-2021). Such themes have to a small degree been mentioned in the output reports of Action 42, especially road microplastics. Most of them, however, have not been adequately addressed in any of the collective actions but some countries have done national work on them. These upstream sources could be included in the discussions of a new RAP-ML for OSPAR.

Other actions that are of relevance for Action 42 is Action 39 and 40 which are about understanding loopholes and best practices in waste management that contribute to marine litter, as well as Action 43 which is about possibilities to reduce the use of single-use and other items. Measures addressing upstream sources for marine litter will also have a positive effect in reducing macro litter items which risk ending up in storm water.

Potential themes for consideration in the next RAP

Potential themes that could be included in the development of the next OSPAR RAP ML are as follows:

- Measures to reduce plastic micro-fibre inputs from washing machines in industries and private homes such as the installation of filters or improved fabric technologies reducing wear;
- Better design and run-off protection from rubber sport facilities etc.;
- Improved procedures for cleaning/sweeping of roads to catch tyre wear/road paint/dust particles – this is believed to be the biggest source of marine microlitter;
- Improved collection systems for all kinds of construction works, maintenance etc.;
- Infiltration or other treatment of storm water run-off, especially from roads with heavy traffic and urban areas;
- Improved understanding of how best to tackle road run-off, and in particular how it should be treated/in what circumstances;
- Improved understanding of how best to avoid microplastics getting into the sewage system in the first place; and
- Improved understanding of how best to treat water to separate microplastics.

It should be noted that any possible future OSPAR work in relation to wastewater, storm water and sewage sludge, should be considered in the context of other ongoing work in other fora, with the aim to add value and focus on themes not being picked up elsewhere (for example by ongoing EU work).

Cooperation with other international organisations

Wastewater and storm water related wastes seem to be a theme well suited for cooperation with other regional seas organisations, other international organisations and especially with the European Commission (EC).

There are a number of workstreams being undertaken at the EU level relating to upstream measures for microplastics. These include the possible revision of the Urban Wastewater Treatment Directive with respect to micropollutants, expected to be finalised by the end of 2021. The scope is broader than microplastics, but these pollutants are

[5] Evaluate all products and processes that include primary micro plastics and act, if appropriate, to reduce their impact on the marine environment.

nevertheless an important part of the work and sewage sludge will also be part of the discussion. OSPAR's further work in relation to wastewater, storm water and sewage sludge should therefore take this ongoing work into account, and wherever possible seek to build on this and add value, by particularly focussing on those themes not being picked up by ongoing EU work, for example plastics/microplastics in storm water.