Products from Waste Water
- Fibres, polymers and other organics -

Need for EU End of Waste (EoW) status

Waste water has a huge potential for resource recovery. This factsheet, which is one of three on this subject, presents **fibres, polymers and other organic** materials that can be recovered from **municipal waste water*** and their possible non-fertiliser applications**. The technologies used for the recovery of these materials are at least at the industrial demonstration stage.

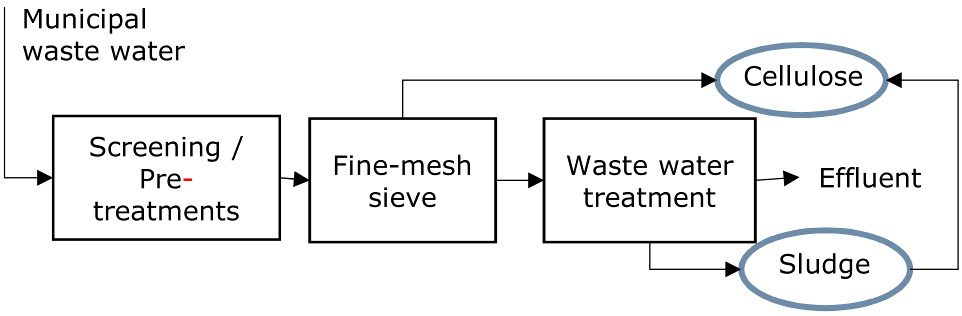
A lack of EU End of Waste (EoW) status inhibits the marketability of these materials. Creating EoW criteria will increase the amount of reused waste in the EU. This can increase the self-sufficiency of the EU and decrease the need for waste disposal.

- Over **100 stakeholders** were consulted for this factsheet
- There are proven technologies (pilot scale and above) for the recovery of **a number of polymers** from municipal waste water
- There are over **50 recent EU projects** on waste water resource recovery (Horizon 2020, Horizon Europe, LIFE, InterReg), with **hundreds of partner organisations**
- The estimated chemical recovery potential in the EU for both cellulose and bioplastic is more than **100 ktonne/year**

Waste water is a resource.

* Similar products can be recovered from other waste water sources such as from the food and dairy industries.
** Fertilising product applications are excluded, because the EU EoW procedure for these is covered by the new EU Fertilising Products Regulation (EU)2019/2009.

Waste water treatment and streams for recovery



An overview of the general waste water treatment process scheme. Streams used for resource recovery are indicated with blue circles.

Reuse in action: the asphalt contains cellulose recovered from waste water.
Wetterskip Fryslân 2016.

Materials

Product	Possible applications (excl. fertiliser)	Existing market*
Bioplastic (PHA, PHBV and PLA)**	Biodegradable plastics - Coatings - Input for composite material – Self-healing concrete	Yes
Cellulose	Asphalt binder - Insulation material - Construction material - Input for composite material - Paper and cardboard - Bio-polymers	Yes
Extracellular Polymeric Substance (EPS)	Glue - Coating material - Thickening agent - Flame retardants - Membrane fabrication - Input for composite material	-
Char (Hydrochar, Biochar, Activated carbon)	Source for activated carbon Construction material (additive for concrete, asphalt, lime plaster, gypsum and clay) - Input for composite material - Anaerobic digestion additive - Source for activated carbon Filtration - Purification	- - Yes
Bio crude oil	In an oil refinery for e.g.: Biodiesel - Jet fuel - Asphalt - Plastics - Textiles	Yes

• For a similar product not recovered from waste water

** PHA: polyhydroxyalkanoate; PHBV: Poly-hydroxy-butyrate-co-valerate; PLA: Polylactic Acid

Examples

The table above presents materials that have proven technologies (industrial demonstration stage) for the recovery of reusable materials from municipal waste water.

You will find more information on the recovery of cellulose and bioplastic (PHA and PLA) in this factsheet. These materials show great potential for resource recovery.

PHBV sample derived from organic residues
AquaMinerals/Paques Biomaterials, 2021

Cellulose

Municipal waste water enters the treatment plant and flows through a coarse screen that removes large particles. The cellulose can then be recovered with a fine-mesh sieve. It is further treated (e.g. washed, sanitised, dried) before reaching the end-product quality (e.g., crude, fluff or pellets).

Bioplastic

PHA and PHBV can be produced by the fermentation of sludge and other organic materials into fatty acids that are then converted to bioplastic which is extracted from the biomass as a pure natural polymer. PHA is biodegradable in soil and marine environments and in home and industrial composting.

PLA can be produced by fermenting sugars, for instance from cellulose from waste water. PLA is biodegradable in industrial composting.

Market potential

		Cellulose	Bioplastic
€	Price	75-3.500* €/tonne	3.000 – 10.000 €/tonne
	Full scale	Yes	**
	Recovery potential	375-750 ktonne/year	150-300 ktonne/year
		4-8% of EU demand	***

*The price of cellulose is highly dependent on its quality. For pulp and paper applications it was around 450-650 €/tonne in 2020.

** PHA production will be further demonstrated from Q1-2022.

*** Due to rapid developments in bioplastic demand, it is hard to say to which degree bioplastics produced from waste water could cover the EU demand. It is expected that the bioplastic demand will increase to 133 ktonne/year in 2025. Therefore, recovered bioplastic could play a significant role in the market.

Environmental aspects

Resource recovery from waste water can have environmental benefits. It will decrease the amount of waste being landfilled and it can replace the use of fossil resources, which are limited. Furthermore, resource recovery can in some cases be more energy efficient than using virgin materials.

- Removing cellulose early in the waste water treatment process results in less solids going to the main waste water treatment. This can decrease energy consumption of waste water treatment by up to 15% and reduce CO_2 production by up to 20%.
- Recovered bioplastics can replace fossil fuel-based alternatives.

Quality aspects

The purity of PHA can be >99% and the prioritised applications will be in agriculture, horticulture and self-healing concrete. The material could meet safety standards for children's toys and possibly for food-grade contact.

Cellulose recovery is applied at multiple full-scale sites and commercial products are being developed. In one project, recovered cellulose was used as an asphalt additive for bicycle paths. This shows that recovered cellulose can meet the quality expected by end-users.

Additional comments

- Exporting to other Member States is relevant for both examples
- There are no existing national EoW criteria

"We need to focus on processes instead of origin; processes can determine product quality"
- Jan Arends, Program Manager Water at Capture -

"There is a lot of potential and support base for the recovered materials from waste water"
- Leon Korving, Scientific project manager at Wetsus -

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This factsheet is reviewed and updated periodically, to present the most recent information. This is version 1 (October 2021).

Over one hundred stakeholders were consulted, see here.

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