Analysis and valorisation of plastic debris in India

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Abstract

This report is an overview of floating plastic debris and the potential of valorisation collected plastic waste by pyrolysis.

Floating debris were collected from the Mithi river in India and delivered for material and chemical analyses to VTT, Finland. The plastic fractions were separated and its use as sole feedstock in fast pyrolysis assessed.

Debris sample analysis indicated that most of the debris originated from unauthorised commercial and residential settlements, which, by large, are not served by organized waste collection. High and low density polyethene, synthetic textile (polyester), PET, polystyrene and various foams dominated. Some fractions contained elevated concentrations of halogens, which could originate either from the environment or (salty water) or from plastics additives.

The quality of the oil obtained from pyrolysis of plastics mainly depend on the feedstock composition. Preferably polyolefin (PE, PP) feedstock is considered to be the best to obtain premium product. This feedstock mainly consisted of a mix of polymers, also major fractions of such that are not optimal for pyrolysis processes (PET, polyester) PET and polyester induce unwanted acid compounds. The major fraction generated in the fast pyrolysis trials on plastic debris was wax, and minor fractions of oil.

While oil is the desired product, the produced wax can also find industrial use. Wax can be utilized in petrochemical industry to produce different chemicals Industrial use also normally presumes that the impurity content (halogens, metals) stays below the recommended (low) limits.

Co-treatment with plastic waste collected from households and/or the industry and separated can be seen feasible. However further trials on the general composition of such combined waste are needed and analysis of the elemental composition of such waste. The yield and selectivity of the desired pyrolysis products can be achieved by optimising pyrolysis conditions.

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Figure 1. Collected plastic debris (Photo: Earth5R, Saurabh Gupta)

Recent Publications

1. Weiland, F., Qureshi, M. S., Wennebro, J., Lindfors, C., Ohra-aho, T., Shafaghat, H. & Johansson, A (2021) Entrained Flow Gasification of Polypropylene Pyrolysis Oil In: Molecules. 26, 23, 7317.
2. Qureshi, M. S., Oasmaa, A., Pihkola, H., Deviatkin, I., Tenhunen, A., Mannila, J., Minkkinen, H., Pohjakallio, M. & Laine-Ylijoki, J., (2020) Pyrolysis of plastic waste: Opportunities and challenges. Journal of Analytical and Applied Pyrolysis. 152, 104804.
3. Arnold, M. (2019) Plastic free oceans, lakes and rivers. Presentation in ASEM High-Level Meeting on Marine Sustainability 6 -8 Mar 2019, Bangkok, Thailand.
4. Wikberg, H., Bluemink, G., Arnold M. (2015) Hydrothermal carbonization (HTC) as a recovery technology for urban wastewater treatment. Annual World Conference on Carbon: Innovation with Carbon Materials, CARBON 2015 15-17.7.2015 Dresden, Germany.
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Biography

Mona Arnold has her expertise in circular economy processes and technologies and interest in developing circular and sustainable business models and value chains. She has a wide experience in the valorisation of different waste material and end of life products, such as municipal sludge and end of life vehicles. lately she has been involved in several projects relating to the management and evaluation of plastic waste and waste prevention. She is also involved in water management and its digitalization and active member of the European technology platform Water Europe (co-lead the Water Nexus working group).

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