Integrated technologies to recover metal and plastic from electronic waste

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VTT Technical Research Centre of Finland has developed a new electronic waste recycling concept that combines a range of technologies and reduces waste. One of the technologies included in the concept is gasification, which is used to recover not only metals and rare-earth elements from the waste but also organic components that can be used to produce energy or products, such as plastic and chemicals. VTT has brought together a group of Finnish partners to promote material-efficient production.

Vast amounts of valuable raw materials are lost through recycling and processing: As much as half of all materials can end up in landfill. Products are becoming increasingly complex, which is why traditional mechanical recycling processes are no longer enough.

Traditional recycling focuses on recovering base metals and precious metals, such as gold, leaving other valuable resources, and especially hydrocarbon-containing organic matter, unutilised.

VTT has developed a recycling concept based on integrated technologies, which can be used to increase the efficiency of material recovery and reduce the use of virgin minerals and fossil resources. In addition to the mechanical sorting of waste, the range of techniques includes gasification, which is a thermal conversion process for separating not only metals but also organic materials that can then be used to produce energy or products, such as plastic and chemicals.

MINEWEE circular economy experiment to take place in the autumn of 2018

VTT's role in the MINEWEE project is to build an industrial ecosystem for recovering critical raw materials from metallic waste, such as residues from electronic waste processing. The project team is currently developing a process for handling electronic waste as well as circuit board and shredder residue, which consists of scrap pretreatment, mechanical separation of metals, gasification and hydrometallurgical unit processes.

VTT's tasks in the project include pretreating and characterising materials, thermal conversion and the associated chemical dissolution. Aalto University focuses on recovering rare-earth elements.

MINEWEE is one of Tekes's Challenge Finland projects, and the project consortium includes businesses from all levels of the value chain, such as metal waste processing companies and technology suppliers.

In addition to VTT and Aalto University, the consortium currently consists of Loimi-Hämeen Jätehuolto Oy, BMH Technology Oy, Kuusakoski Oy, Stena Recycling Oy, Technology Industries of Finland, Finnish Car Recycling Ltd and Global EcoSolutions Oy.

Building new value chains and piloting technologies will take place in VTT's BIORUUKKI pilot centre in Espoo during 2018. The goal is to prove the effectiveness of the techniques from the pretreatment of waste to the recovery of new raw materials in practice.

WEEE is an important source of critical raw materials

The manufacture of batteries and laser technology, for example, depends on materials whose global availability varies. Demand for these critical raw materials continues to increase, which is why their availability must be ensured and recycling increased. Waste electrical and electronic equipment (WEEE) is the second most important source of critical raw materials after the primary sector of the economy.

Electronic waste and the waste generated by WEEE processing are heterogeneous materials that are difficult to recycle. The organic matter contained in them, such as fibres and plastics, can be turned into energy and hydrocarbons, which can be used in products such as plastic. Metals that have until now been left unutilised can be separated from the ash generated by gasification.

Critical raw materials

Critical raw materials, such as gallium, germanium, platinum group metals and rare-earth elements, are used extensively in electronics and energy industry products, such as rechargeable batteries, displays and computers. The EU's list of critical raw materials includes materials that are of high importance to the EU economy and of high risk associated with their supply. Critical raw materials cannot generally be easily substituted by other materials. The electronics industry of European countries is almost completely dependent on the import of these materials.

Demand for most critical raw materials will grow to several dozen times the current level by 2030. WEEE, which Finland currently produces more than 20 kg per person per year, depending on the estimate, has been identified as a crucial secondary source of critical raw materials.

Provided by VTT Technical Research Centre of Finland