SOLIDS
Metal waste treatment and recycling
About the EPOS Technology Focus

Within the scope of the EPOS project, extensive literature and market research reviews were performed in order to identify different technological, organisational, service and management solutions that could be applied to different industrial sites and clusters. The collected information will aid in establishing on-site and/or cross-sectorial industrial symbiosis opportunities; additionally, to enhance overall sustainability, performance and resource efficiency of different process industry sectors. Through the cooperation of project partners, a longlist of different technological options was created. Resource material for this list included: scientific articles, project reports, manufacturer’s documentation and datasheets.

SOLIDS

In addition to liquids and gases, solid waste and other by-products can be utilised in many ways in order to achieve RE and IS. Two of the most common options for utilisation of solid wastes are re-use and recycling, and is often used in waste streams of plastics and metals. General techniques for pre-treatment and the recycling of plastics, metal and other wastes are addressed.

Re-use and recycling of the solid waste is in some cases not feasible, e.g. due to highly contaminated waste. In such cases, the solid waste can be used for energy production through incineration, producing heat, steam or electricity. Energy valorisation of the solid wastes is especially practical, as it can have caloric content. In addition to basic waste incineration, other options for energy valorisation of solids are considered, namely pyrolysis and gasification. Using these two approaches, new resources can be obtained from the waste (gas and liquid fuels, etc.).

In addition to the energy valorisation, some emergent approaches for the recovery of minerals, metals and rare earths from cement kiln dust and fly ash are added, together with options for combustion improvement.

METAL WASTE TREATMENT AND RECYCLING

- Metal waste treatment and recycling
- Pyrometallurgy
- Hydrometallurgy
- Electrometallurgy
Metal waste treatment and recycling include a set of technological procedures, which are implemented in order to reduce and/or reuse metal waste streams. Various metal waste streams can be treated, for example used cars, railway tracks, cans, metal packaging material, electrical wires and cables, etc. E-waste represents a significant source of precious metals.

The process includes different stages, beginning with the collection and transport of the metal waste. Afterwards, the metal waste is separated from the other waste; different types of metal must also be separated, which can be done using several techniques (magnetic separation, separation of the metals while they are in liquid form).

After the metals are sorted and separated, the obtained metal scraps must be treated to remove impurities, which is usually done by melting the metal waste and refining it in a similar way as removing of the impurities from virgin ore.

Usually the waste metal recycling process involves the reduction of the waste size via shredding, compression or other technique. In the process of metal recycling, various techniques can be combined, depending on the type of metal waste and desired results of the process.

**Figure 1** Combination of different metal recycling processes

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**Technology 1: Metal waste treatment and recycling (general)**

Metal waste treatment and recycling include a set of technological procedures, which are implemented in order to reduce and/or reuse metal waste streams. Relevant technology processes can be implemented for the treatment of metal waste from communities and industry sectors where there is a significant amount of waste metals.

**Applicability**

The reduction and re-use of waste metal streams. Relevant technology processes can be implemented for the treatment of metal waste from communities and industry sectors where there is a significant amount of waste metals.

**Maturity**

Varied
Pyrometallurgy is the process of metal extraction and purification involving the application of heat. It is used to extract and purify metals from either virgin ore or a mixture. In order to separate different metals from the mixed metal waste, the metal mixture is melted and separated in the molten state, taking advantage of the different melting points of different metals.

Applicability
To separate mixed metal waste and for recovery of metal from e-waste.

Maturity
Commercial.

Project/product reference
Tenova’s solutions.
Hydrometallurgy involves various chemicals, usually in a water solution, that are applied into mixed metal waste. The various controlled reactions between the metals remove different metals individually.

**Technology 3: Hydrometallurgy**

**Applicability**
To separate mixed metal waste and for the recovery of metal from e-waste.

**Maturity**
Commercial.

**Project/product reference**
Outotec’s hydrometallurgical solutions.
Electrometallurgy is a set of processes related to metal electrodeposition. There are categories of electrometallurgical processes, namely electrowinning, electrorefining, electroplating, electroforming. Electrowinning is the extraction of metals from aqueous solutions or melts of their salts. Electrorefining is the purification of metals by means of electrolysis. Electroplating is the deposition of one layer of the metal on another. Electroforming is the manufacturing of the thin metal parts.

Technique 4: Electrometallurgy

Applicability
Techniques such as electrowinning and electrorefining are used to extract and purify waste metals for further processing. Electrometallurgy can also be used for the recovery of metal from e-waste.

Maturity
Commercial.

Project/product reference
Axine Water’s solution.

2. “Metal sensing, metal separation and metal sorting,” MSS, [Online].


