



Waste Planning

Thermal plasma technology supports precious metal recovery from WEEE

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Waste Electrical and Electronic Equipment (WEEE) consists of discarded electrical or electronic devices from domestic, commercial and industrial sources. Before the introduction of the WEEE Directive in January 2007, the disposal of electronics waste was largely unregulated. This led to a rather informal attitude to the processing of electronic waste, which can cause serious health and pollution problems, and allowed society to discard a major source of scarce and valuable metals.

The WEEE Directive was introduced to reduce the amount of electrical and electronic waste produced and to encourage its reuse, recycle and recovery in a managed and regulated manner.

Historically, some WEEE contained hazardous substances, such as mercury in some switches, lead in solder and cadmium in batteries. However, since 1 July 2006 these materials have been progressively phased out as a result of the RoHS Directive. The typical lifetime of most electrical and electronic is around 10 years, and therefore after 2016 WEEE treatment will focus increasingly on the recovery of valuable and Precious Metals (PM) including copper, gold, silver and palladium, rather than solely on the potential hazards of the waste. As awareness grows of the strategic nature of PM metals, so WEEE will be seen increasingly as a valuable source of these metals, and 'town mining' will become an ever more attractive option for material supply, owing to the increasing scarcity of natural resources.

The UK now throws away 1.2Mt of WEEE every year, equivalent to 20kg per person per year, and as the market for new electrical devices grows in line with consumer demand and electronic goods become obsolete ever more quickly, so the amount of WEEE produced every year will also continue to increase. In the EU as a whole only 33 per cent of WEEE is collected and treated, despite the high intrinsic value of the PM contained in the waste. For example, the average mobile phone and DVD player contain around £15 and £28 of PM respectively and overall WEEE contains PM worth around £1 for every kilogramme of discarded equipment (September 2011 values). In the face of a potentially untapped source of metals worth in the region of £1.2 trillion every year, it is not surprising there has been a strong growth of interest in the recycling of WEEE.

The majority of the high value metals are found on the Printed Circuit Boards (PCBs) in the key electronic components and the metals that connect them, for example:

Integrated Circuit (IC) Sweeps (Au 200-3500 ppm; Ag 0.2-3 per cent)
Multilayer Ceramic Capacitors (Ag 1-15 per cent; some contain Pd 0-17,000ppm)
Recovered IC Copper Powder (Au 50-500 ppm)

At present much of the WEEE waste is collected through municipal waste collection facilities and original equipment manufacturers, although as the environmental and economic value of WEEE becomes more widely appreciated it seems certain that more innovative methods of collection and processing will develop. For example, through the Distributor Take Back Scheme, supermarkets and other leading UK electrical retailers will provide funding to local councils to help them provide facilities for customers to deposit their old electrical products for recycling.

Using Tetronics' plasma smelting technology, WEEE is pre-segregated and crushed in order to concentrate the PM-containing fraction of the waste before being fed into a sealed furnace and heated using a plasma arc. The plasma arc provides an intense, controllable source of heat that melts, gasifies or vaporises the components in the WEEE and separates them into different streams. The precious metals are collected in a copper-alloy bullion at the bottom of the furnace, whilst the less valuable material is transformed into a glassy vitrified material called Plasmarok, that can be used in construction. For some WEEE with an especially high organic content, the crushed material is incinerated prior to the plasma smelting operation in order to prevent increased losses of PM. The PM-containing metal alloy is then sent to a final refiner who is able to separate the various precious metals so that they can replace their equivalents that would otherwise need to be extracted from underground in far-flung parts of the Globe.

Tetronics' patented technology has been successfully employed in a wide range of environmental applications. Its metal recovery plants have been operating for decades in North America, Europe and the Far East, including the start-up in Taiwan during 2012 of the first plasma system dedicated to the recovery of PM from WEEE. The key to this success lies in the combination of a proven technical solution with low operating costs and industry-leading technical recovery rates, typically 98 per cent or better for the PM content. Typical operating costs for a plasma treatment facility sized to process 1200 tonnes per year of WEEE concentrate (equivalent to around 36,000 tonnes per year of WEEE or 3 per cent of the UK market) are around £0.11 per kg of original WEEE (depending on local unit costs), giving capital payback times for a typical plant of under two years.

It is an exciting moment to be involved with WEEE recycling, with rapid changes occurring in attitudes to the recycling of WEEE around the World, including the recognition of the strong benefits of plasma technology. The UK and EU-governments are both actively encouraging research and development of WEEE recycling and organisations such as Tetronics are actively involved with industry bodies to promote the subject further.

At present Tetronics' plasma technology places the UK at the forefront of the development of WEEE recovery systems. The start of operations of the plant in Taiwan next year will further strengthen the case for the adoption of this technology in the UK and bring benefits to both industry and local communities.

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