



Electrostatics sorts and saves

Tom Shelley reports on a novel way of sorting materials, crucial for recycling, with many other applications

Design Pointers

Plastics and many other materials can be effectively and economically separated by electrostatic methods

Suitable charging techniques are: rubbing together (triboelectric), corona discharge and induction

It may be necessary to use combinations of different electrostatic techniques in complex separation flow sheets, especially those required to handle mixed domestic waste, to acquire a more negative charge

Different papers and plastics can be sorted efficiently using a combination of electrostatic techniques such as corona discharge charging, charging by induction and rubbing things together – all have their place in different stages of the process. Similar techniques can also be applied to a variety of materials, including agricultural seeds and products, medical feedstock and diamonds.

With the growing drive to recycle as much as possible, it is clear that low-cost machine methods offer the only practicable means of achieving the goals that EU member states have set themselves. To this end, the EU set up a Brite-EuRam III project called ELREC, short for ELectrostatic RECOvery of paper and plastic packaging wastes. The project was completed in December 2000.

Project leader was ERA Technology (www.era.co.uk), with seven other participants: Hamos in Germany, Centro Tecnológico Gaiker in Spain, HLC Henley Burrowes in Malvern, KTH Polymerteknologi and Ragn-Sells in Sweden, Komotini Paper in Greece, and the University of Southampton. The objective was to develop and demonstrate a practicable household-waste recycling plant. Removal of metal and glass is relatively straightforward, but paper and plastics present problems, hence the move to electrostatics.

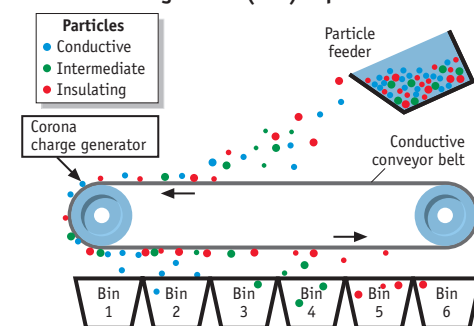
Jeremy Smallwood, a consultant with Electrostatic Solutions, originally became involved when he was with ERA Technology. He says that the paper-separation side of the project was less than 100% successful, but that plastic separation was “most successful”, and that one of the industrial participants has brought out a new range of commercial products with a wide range of applications as a result.

The problem with the paper separation was not so much the technology but the circumstances of the challenge. The method chosen was to apply a 0 to 30kV corona discharge from an array of needle electrodes to materials on a conductive conveyor belt. The materials with the highest conductivity are the first to discharge and fall off as the belt runs round the end roller, while more insulating particles take longer to discharge and are retained,

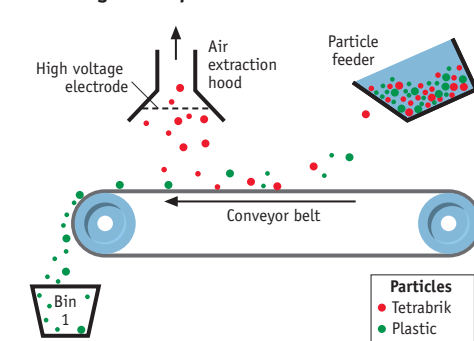
falling off later. The problem with applying this method to sort paper is that electrical properties vary by orders or magnitude according to humidity, which means that, unless the feedstock is very carefully dried, or the climate is fairly dry, the process is very weather dependent.

Tests at Malvern in the UK during a period of wet weather were discouraging, but a pilot-scale paper-separating plant is planned for the

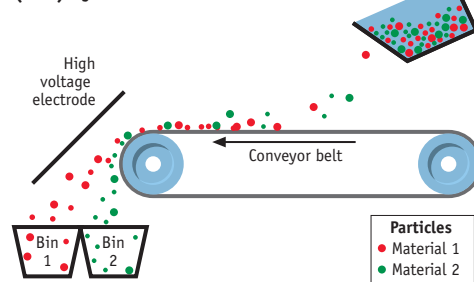
The Corona charged belt (CBS) separator



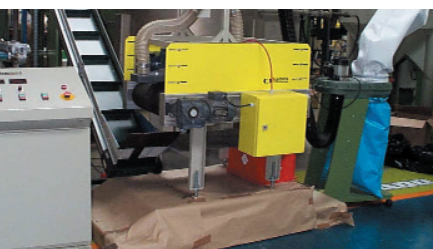
Levitating belt separator



Tribocharged belt separator (CBS) system



Electrostatic techniques are proving useful for sorting a range of materials





Low-cost machine methods of recycling offer the only practicable means of achieving the goals of EU members

Komotini site in Greece.

The plastic/plastic separation technology involves charging shredded plastics by tumbling them together. This results in some items becoming positively charged and others negatively charged. A suitably charged, high-voltage electrode will then attract particles of one type and repel others. Which charge materials acquire when rubbed together is determined by the triboelectric series. However, unlike the electrochemical series, the exact order of materials given by different sources seems to vary, as charging properties are strongly influenced by the nature of the material surface.

An ELREC plant, run by Gaiker in Spain, has been used to separate plastics and Tetrabrik (milk-carton material) output streams from its existing domestic waste separator. PVC and PET, which have similar densities, appear as a mixed heavy fraction from a flotation process and are readily separated, as are PE and PP, which appear as a light fraction. Gaiker has also been able to demonstrate separation of ABS from electronic scrap.

A mixed Tetrabrik and polymer output fraction can be separated by an entirely new ELREC technology. This technique, the Levitating Belt Separator, passes particles under a positively charged electrode on an earthed conveyor, charging them by induction.

An earthed particle in an electric field redistributes charge to become an equipotential surface, and thus acquires a charge opposite to that of the high-voltage electrode generating the electric field. This opposing charge leads to attraction towards the electrode. A dielectric particle remains polarised because of its inability to redistribute electrons. Non-conducting particles (polymers, in this case) have no net charge and so are neither attracted nor repelled. The Tetrabrik particles, however, retain a net charge and lift off.

Ragn-Sells, one of the other project participants, has demonstrated a 250kg/hour plant for separating polyethylene and polypropylene

from pre-sorted Swedish domestic waste. Initial results show output purities in the range: 95 to 99.7%, with good recovery rates.

The biggest beneficiary of the whole programme, however, seems to be Hamos, which has brought out a new EKS range of production triboelectric charged separators based on ELREC designs, capable of throughputs of up to 1,500kg/hour. According to Hamos, Chitosan, a Chitin derivative with growing use in food and medical industries, may be electrostatically separated from contaminants such as plastic foil packaging, and plastic fibres from the fishing nets used to catch them.

During 2000, Hamos says it has sold four EKS machines for separating rubber sealing from shredded PVC window profiles. A clean PVC fraction with a purity of more than 99.9% may be reached from an input fraction containing 5 to 7% rubber. The few rubber particles remaining can be separated by an opto-electronic colour sorter, to reach near 100% pure PVC.

A leading recycler in Southern Germany has installed an EKS system to sort plastics from recycling bottle caps. In the first step, a PE fraction of more than 99.5% purity is dry separated from a mixture of expanded PVC and PE. In a second step, a clean PVC product is produced with a purity of more than 99%.

A leading maker of automotive plastics is said to be using an EKS separator to separate mixed ABS and PMMA production wastes resulting from making tail lights. An ABS fraction with a purity of 99.8% can be achieved after shredding. A second separation step results in a clean PMMA fraction of 99.7% purity.

Solvay is apparently going to commission a Hamos electrostatic separator to remove foreign matter prior to chemical recycling PVC in a plant to be commissioned in Northern Italy in autumn this year. Similarly Butler-MacDonald has ordered Hamos EKS equipment to electrostatically separate different plastics in its computer recycling plant in Indianapolis, Indiana. More information can be found on the web (www.hamos.com).

An Israeli company, TechnoSeed, has announced an effective electrostatic process for separating plant seeds from themselves and other matter. This idea has proved difficult to establish commercially, and the originally enthusiastic announcements have suddenly gone quiet and links on the web have been disconnected, but this does not mean that the idea has been given up. TechnoSeed says that its equipment, details of which it will not divulge, can separate seeds and grains, separate stalk and leaf portions from cut grass and herbs, and clean and sort tea, coffee kernels and cocoa beans.

ERA Technology	Enter 450
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