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MRAI's

MATERIAL RECYCLING

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THE VOICE OF INDIAN RECYCLING INDUSTRY

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THE BLACK PLASTIC

» Mixed plastics from electronics scrap after passing through a shredding line and separation of metal fractions

HOW CAN EFFICIENCY OF PLASTICS RECOVERY FROM ELECTRONICS WASTE BE RAISED AND HOW A HIGHER PROPORTION OF IT CAN BE MADE INTO VALUABLE, CLEAN PLASTIC FRACTIONS? **DEEPAK MEHTA** TAKES A LOOK AT THE PROBLEMS INVOLVED AND OFFERS VIABLE SOLUTION

DEEPAK MEHTA

Electrical and electronic equipment (EEE) is made up of many different materials. When recycling this equipment, it is sought above all, and as far as it is possible, to fully recover the metallic fraction (ferrous, non-ferrous and precious metals). The metal fractions are the "object of desire" and various techniques are available for almost complete metal recovery. But electronic waste also contains other recyclables such as ABS, PS and other materials. There could still be certain amounts of residual substances (like dust, glass, etc) which, in some cases have only low or no value at all. They nevertheless have to be separated from the recyclable materials.

Beside the "metals" resource, the "plastics" resource should also have to play a large role in recycling. This is however mostly not the case in practice, as recovery of clean plastic fractions from EEE waste is much

With the electrostatic separation technologies of the Bavaria-based hamos, it is possible to separate "black" plastics with great success into clean separate fractions.

— DEEPAK MEHTA

more laborious than recycling of the metals. This is because the presently available sorting possibilities can only exploit the entire plastics raw material potential to a limited extent. A large proportion of this material is therefore lost and is used, for example, to recover thermal energy.

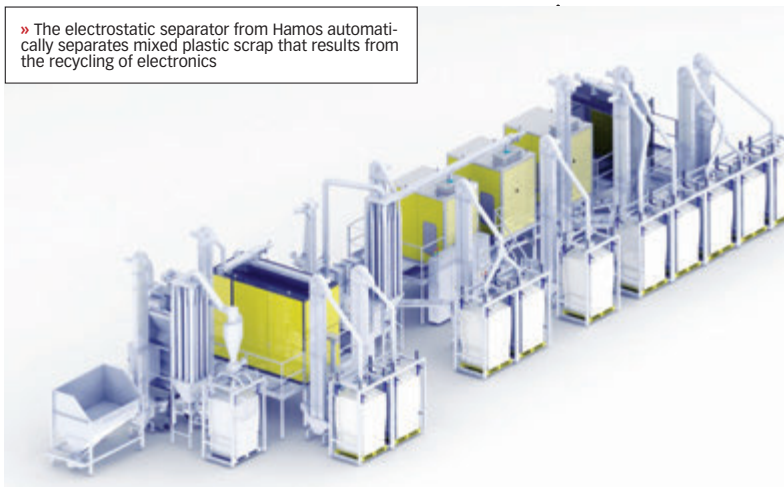
The granulate material purity achievable with electrostatic separation are very high and sometimes stretch beyond 99.50%. The recyclate is so clean that it can easily be used again to produce high-grade compounds and, in turn, can be processed into new technical products. In this way, valuable technical raw materials can be recovered from materials that cannot be processed further. Depending on the application, expensive virgin material can be entirely or at least partially replaced by more favourably priced recyclate. Many products can then be produced entirely from recycled plastics. This is an important economic aspect, especially against a background of rising oil and raw material prices. In addition, it also makes an important contribution towards environmental protection through avoidance of waste.

PLASTICS FROM ELECTRONIC WASTE

By definition, "electrical and electronics scrap" arises from a number of different types of equipment. As no material pre-separation into clear-cut pre-separation according to types of materials is made in recycling companies while processing, this mixture of materials ends up in shredding plants. This leads to mixed plastics waste after the metal fraction has been separated out. The residual material, consisting not only different plastics, but will be dust, wood, glass, residual metals, elastomers and many other such undesired contaminants.

The task of plastics recyclers then consists of production from this complex mixture of re-usable plastics fractions. As experience shows, particularly high demands are placed on purity of the recyclate, as they often compete with virgin materials. On the other hand, there is also a task here of recovering the highest possible proportion of clean plastics, so that as little as possible good material is lost. Plastics recycling is only economical if the highest possible proportion of material fractions is recovered.

» The electrostatic separator from Hamos automatically separates mixed plastic scrap that results from the recycling of electronics



However, it has been observed in recycling that not all plastics can be brought back into circulation, on account of legal requirements. Among these, plastics like that containing brominated flame retardants may not be reused, and have to be separated into separate fraction. There are furthermore also many other plastics present, such as PC or PMMA, which are only present in low amounts of 1 - 2 % in the entire plastics fraction. On account of the low amounts of these plastics, recycling only pays off to a limited extent, as the effort required to recover these plastics is sometimes higher than the possible return from them. The largest proportion of plastics in mixed electronics waste consists of PS and ABS, as well as PP. Experience shows that these materials make up around 55% of the input material and that 40 to 50% of the input material consists of uneconomically recoverable plastic, flame retarded materials, impurities, etc. Work is however ongoing to minimise this fraction with new processes and thereby to raise the return.

It is not only the type of plastic that plays a large role in plastics recycling, but also the colour. Plastics in electronics scrap involves a particularly high proportion of black plastics, which can account for 60% to 75 % (in toner cartridges, it sometimes amounts to more than 90%). The reason for this is that not only the fact that black is "modern", but there is also a role played by the cost aspects. While, for example, colouring a plastic red makes it up to 30% more expensive, the extra costs for a black coloured plastic are minimal.

The separation technology used by hamos works irrespective of the colour, while other technologies like optical sorting systems are still very much in their infancy

PLASTICS SORTING

In sorting post-consumer packaging waste from the "yellow bags or bins" used in Germany, opto-electronic sorting equipment has become widely adopted. They use near infrared recognition (NIR) to automatically recognise plastic bottles in PET, PE, PP and other materials, and to clearly identify the plastics by their individual categories. By using downstream air-blast units with the NIR technique, it is possible to sort not only complete bottles, but also flakes and other granulated recyclate materials.

It has also tried to use NIR sorting of plastics from electronics scrap. However the big disadvantage for a long time was that it could recognise only light colour plastics, and not dark plastics. As only around 20 to 40% of plastics in electronic scrap has light colour, good material totals only around 55% of the entire amount used. According to the EU's WEEE waste electrical & electronic equipment directive, NIR technique was not economical for sorting plastics from electrical and electronics scrap. A large proportion of recyclable ABS and PS was not recognised, which ended up as non-recyclable waste. Despite further development of NIR sorting, experts still view its economic use with scepticism.

If we want to exploit the valuable "plastics" resource to its fullest potential, it is also absolutely essential to recover black plastics in as much as possible purity, according to the type of plastic. Electrostatic separation technology can be used with great success for separation of such mixed plastics from electronics scrap.

Completion of the separation process results in ABS or PS fractions with high purity of at times more than 99%. This method if separation takes place irrespective of the colour. Completely black coloured material mixtures can also be easily separated.

But electrostatic separation has a catch: Complex mixtures, as the case with electronics scrap, cannot be simply processed as such. There has to be a form of pre-concentration applied prior to the electrostatic process, so that undesired plastics such as those containing flame retardants, can be separated.

A combination of dry and wet processing technologies is recommended for the required plastics pre concentration from such complex material mixtures.

IF WE WANT TO EXPLOIT THE VALUABLE "PLASTICS" RESOURCE TO ITS FULLEST POTENTIAL, IT IS ALSO ABSOLUTELY ESSENTIAL TO RECOVER BLACK PLASTICS IN AS MUCH AS POSSIBLE PURITY, ACCORDING TO THE TYPE OF PLASTIC.

DRY AND WET SEPARATION PROCESSES

It is possible to separate all undesired foreign materials such as film, dust, fibres, etc in the particle size area of < 50 mm from pre-shredded WEEE plastics materials with dry separation processes.

A combination of air classifiers, settling tables or other processes are used for this purpose.

It is furthermore recommended to sieve the fine fraction as much as possible and to remove the metal parts that may possibly still be present. The material is then prepared for wet separation.

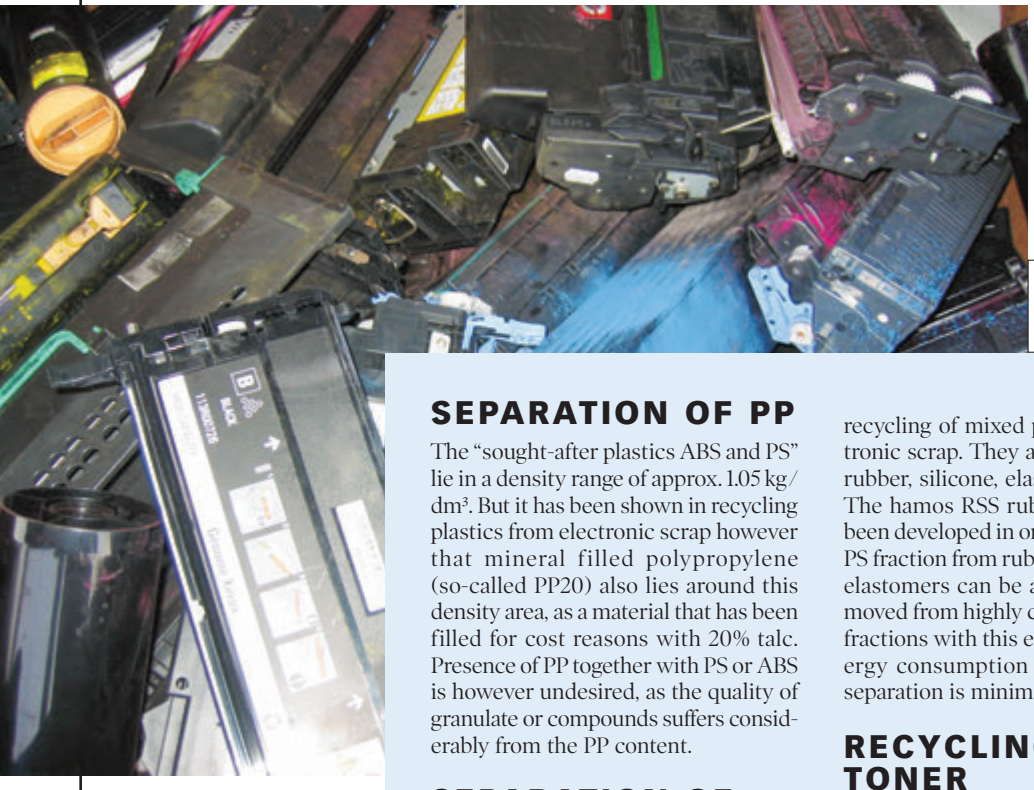
A number of float-or-sink basins containing fluids of different densities, following one after the other, are used in the wet separation process. With a density of approx. 1.08 kg/dm³ used in the first stage, all product groups (PS, ABS, PP etc) float, due to their lower density, while undesired foreign materials, including flame retarded plastics sink, which can be disposed of.

A subsequent separation stage with water (density 1.0 kg/dm³) not only rinses away the residual separation fluid from the first separation stage, but also enables separation of PP and PE as the floating fraction and PS and ABS as the sinking fraction. It is in this way that sought-after concentrated PS and ABS and concentrated PP and PE fractions are be produced from WEEE plastics.

UNDESIRED FOREIGN MATERIALS

The PS and ABS mixtures could be contaminated significantly by high amounts of foreign materials like wood. Corona-roll type electrostatic separators are proven for separation of wood fractions. Different electrical conductivity between moist wood and dry plastic is used here for separation. The plastic is practically free of wood after this stage. Conductive rubber is also simultaneously separated at this stage.

WEEE RECYCLING



» There has been no suitable recycling process in place for this type of mixed product

SEPARATION OF PP

The "sought-after plastics ABS and PS" lie in a density range of approx. 1.05 kg/dm³. But it has been shown in recycling plastics from electronic scrap however that mineral filled polypropylene (so-called PP20) also lies around this density area, as a material that has been filled for cost reasons with 20% talc. Presence of PP together with PS or ABS is however undesired, as the quality of granulate or compounds suffers considerably from the PP content.

SEPARATION OF ABS AND PS

It is easy to separate ABS and PS from each other with the electrostatic separation technology. A double-stage separation process is used for this purpose!

A separation line for plastics from electronics waste therefore consists of two hamos EKS separators working on electrostatic principles in the first stage. These two pieces of equipment work parallel to each other, separating together at a rate of approx. 1.500 kg/h. Approx 1,500 kg PS and ABS per hour can be separated with use of the hamos KRS line equipped with three electrostatic separators, whereby the PP20 fraction is separated off in its own separation process.

SEPARATION OF ELASTOMERS

Elastomers present a large problem in recycling of mixed plastics from electronic scrap. They arise in the form of rubber, silicone, elastomer foams, etc. The hamos RSS rubber separator has been developed in order to also free the PS fraction from rubber. The undesired elastomers can be almost entirely removed from highly concentrated waste fractions with this equipment. The energy consumption required here for separation is minimal.

RECYCLING OF TONER CARTRIDGES

Recycling of toner cartridges is a particular challenge. But electrostatic separation is also ideal for recycling plastics from toner cartridges.

After running through the recycling line, the granulated ABS and PS materials become so clean that they can be used again in production of new toner cassettes.

A large part of the valuable resources contained in a toner cassette are recovered in this way. It is therefore possible to utilise almost the entire recyclable material potential in toner cassettes.

» **Mr Mehta** is MD of Leevams Incorporated, the leading solution provider for recycling industry, including plastics, textiles, e-waste, cables, MSW, metals.)