ELV RECYCLING STEPS UP A GEAR

Development of improved sorting technologies for the non-ferrous fraction of auto-shredders

Although the number of end of life vehicles (ELVs) needing recycling is growing, due to processing limitations aluminium recycling rates are being hindered. A European-funded project – ShredderSort – aims to contribute to new solutions to the aluminium recycling industry.

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More than 10 million tons of automotive waste from end of life vehicles (ELV) are generated yearly in the EU and the values are continuously increasing. ELV wastes are managed by the auto-shredder plants which process ELVs through a series of mechanical and physical operations in order to separate the materials into different streams: ferrous, non-ferrous, heavy non-metal and fluff. Ferrous materials, constituting more than 60wt% (percentage by weight), are sent to steel-making plants, while the non-ferrous (NF) fraction, rich in aluminium and representing slightly less than 10wt%, is processed to separate some alloys.

Copper alloy fragments are usually obtained by hand sorting, heavy media separation and even by color sorting devices. The aluminium rich fraction obtained contains a wide range of Al alloys with different chemical compositions due to the presence of different alloying elements (e.g. Si, Mg, Mn, Cu, Zn). The different concentrations of such metals confer specific properties to each alloy, which are arranged within a standard series classification.

Several Al alloys are difficult to separate due to their similar physical-chemical properties. Some technologies have been proposed to separate them using vision/colour sorting systems, but requiring firstly a surface cleaning and a chemical treatment by etching in baths in order to modify the surface colour of some alloys. However this kind of technology becomes expensive since is highly intensive regarding water, chemicals and energy consumptions and subsequently has not been successfully applied.

As a result, aluminium fragments containing several alloys are still downgraded to produce some types of cast alloys, hindering the recycling rates of aluminium, mainly in what respects to the manufacture of wrought alloys from secondary materials. Moreover since the separation processes being used, like hand picking, are labour-intensive, aluminium scrap continues to be exported from the EU to foreign countries, increasing the European dependence on raw-materials. The improvement of recycling of the NF fraction can have important implications in the recycling efficiency, with subsequent advantages from the economic, environmental, and resources conservation point of view.
of vehicles are still exported through dubious channels, despite a ban. Comparing the normal return quotas (approximately 1.78 million in Germany alone) means that For example, a sudden increase of end-of-life vehicles is connected to an actuator (commonly pneumatic ejectors) that removes from the circuit some pieces and leaving others to proceed in the belt.

Today, some technologies of this kind already exist such as those based on vision analysis, X-rays, electromagnetic, colour detection, among others. Nevertheless, all of them still have limitations. Concerning aluminium alloys, there is no proved technology that can systematically sort fragments with different concentration of alloying elements.

The ShredderSort project aims at further improving existing scrap sorting technologies based on combined electromagnetic and spectroscopic principles, in order to achieve a successful recovery of some different alloy groups in the NF shredder fraction. To start, the process separates heavy metals (copper alloys, including brass and bronze) by means of advanced multi-frequency electromagnetic sensing principles - Electromagnetic Tensor Spectroscopy (EMTS) combined with Vision Image Analysis (VIA).

In this system, a high speed vision system enables to determine the position, size and orientation of the fragments, followed by detecting the characteristic conductivity tensor of the fragment through modelling the response of electromagnetic sensors. The process allows separating Cu-based fragments from light metal fragments. In sequence, the LBS technique allows discrimination between different light alloys based on their chemical composition, which, when assembled with a sorting device (sensor/detector/actuator), can provide separation of alloy groups.

The technique consists of a shot of a high power laser beam focused on the surface of the particle/fragment, inducing a plasma which when cooled emits the atomic spectra of the constituting elements. By means of spectra treatment and an adequate definition of regions of interest in the spectra, different alloys can be distinguished and subsequently separated. Both EMTS-VIA and LBS methods avoid any complex pre-treatment or any kind of sample manipulation, and provides an easy and speedy analysis. It is therefore appropriate to be applied in a sensor/detection sorting device.

The technology is still in development but the results achieved so far are promising. The EMTS-VIA and LBS sorting techniques are currently being developed at the lab scale. Laser deep level spectrometer construction (for LBS) is also running. Integration of the several systems is an important task to proceed. The project will also involve the design, construction and operation of pilot sorting lines where the technologies will be assessed and demonstrated.

Concerning aluminium alloys, Figure 1 shows the typical distribution of the alloys that can be found in the NF fraction of a shredder plant. These values are based on the experience gathered in the activities of the ShredderSort project, although varying from plant to plant and from time to time in each plant, depending on many factors namely from the type of scrap processed in each batch and the market profiles of consumers.

Currently most shredders receive and treat many other scraps than ELVs, namely electric waste, aircraft and ship waste, metal residues from demolishing and other general waste materials. However, the most important Al alloys used in automotive applications are present in the waste. That is the case of wrought alloys of series 3xx used in many vehicle components such as engine blocks, pistons and heads, as well as in subframes and wheels. Axles and subframes can also be constructed using stampings and extrusions from wrought series 5xxx and 6xxx.

Figure 1 – Typical distribution of main aluminium alloy series of NF fractions of shredders

Aluminium Alloys in NF

In the NF fraction, Al alloys can constitute more than 75% of the flow, while Cu alloys account for nearly 15-20%. Regarding aluminium, Figure 1 shows the typical distribution of the alloys that can be found in the NF fraction of a shredder plant. These values are based on the experience gathered in the activities of the ShredderSort project, although varying from plant to plant and from time to time in each plant, depending on many factors namely from the type of scrap processed in each batch and the market profiles of consumers.

These two alloy types have also common applications in other car components, such as in inner and outer panels, and space frames. Forgings made of 6xxx alloys have also applications in car construction namely in suspension parts.

Wrought alloys from series 1xxx and 3xxx have usually other applications than cars, the former being mainly applied in electric wires and foil, while the latter are commonly used in utensils and beverage cans.

ShredderSort Project

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Promotion: SEDA All-in-One solution

There are currently over one billion vehicles on the planet. This number is increasing by a further 83 million annually. Thanks to the EU Directive on End-of-Life Vehicles, Europe provides a positive example, and environmental protection plays a major role in this. Nonetheless, we continue to notice that, even beyond Eastern Europe and the BRICS nations, where development and awareness in this area are still in their early stages, loopholes and the absence of inspections are being exploited. This even affects exemplary recycling nations in Europe such as Germany to a certain degree.

For example, a sudden increase of end-of-life vehicles (approximately 1.78 million in Germany alone) means that recyclers, to some extent, no longer operate compliant businesses and yet they are still trading. In addition, a number of vehicles are still exported through dubious channels, despite a ban. Comparing the normal return quotas (approx. 400,000 units in the years before and after) highlights a still excessively high number of end-of-life vehicles which simply disappear from the market.
As the global market leader in the end-of-life vehicle drainage sector, SEDA is also a driving force in the industry, working closely together with the major automotive manufacturers. The advances made with mature technology and high quality levels are convincing but not only with car drainage. Current trends indicate an increasing focus on the removal of the most valuable vehicle components. This is where SEDA is now setting new standards. With its All-in-One solution, SEDA has now developed a system that allows you to not only fully drain a vehicle but also to remove its components. The SEDA Tilling Lift eliminates the need for a second process of transporting the vehicle to another workstation. This saves time, space and money, and makes the All-in-One solution a very cost-effective turnkey solution for drainage and rational dismantling of end-of-life vehicles on the market. www.seda.at

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