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Subject Area	Waste processing and recycling

Optimised eddy current separator using particle spin

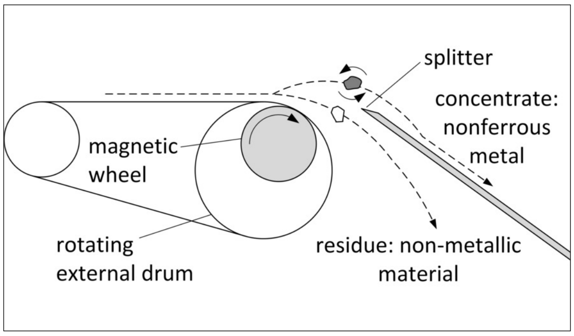

Figure 1: Function of an eddy current separator (ECS).

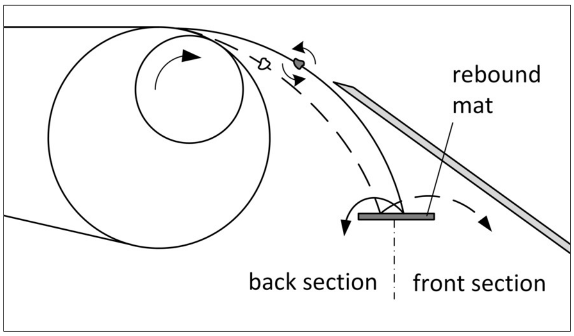

Figure 2: The horizontal rebound mat generates an accumulation of backward rotating particles in the back section.

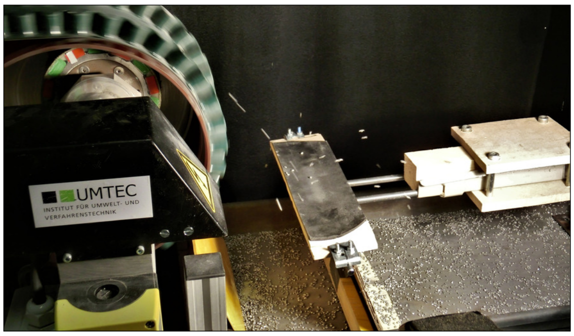

Figure 3: Experiment with aluminium particles and a horizontal rubber rebound mat.

Introduction: Eddy current separators (ECS) are used for the separation of conductive non-ferrous metals from non-conductive materials. A fast rotating magnetic wheel induces an eddy current in conductive particles passing overhead, which leads to a repulsive force. This is used to separate the conductive particles from the rest of the material by using a splitter (Figure 1). In practice, a perfect separation is not obtained as some of the conductive particles report to the residue, e.g. after colliding with the edge of the splitter. Experiments on a laboratory ECS were made to investigate how the previously lost valuable particles can potentially be recovered. It is well known that conductive particles not only experience a repulsive force when passing a ECS but also a spin is induced by the magnetic field. In this thesis it was investigated whether the spin of the conductive particles can be exploited for improving the separation results.

Procedure / Result: First it was attemted to deflect spinning particles by applying a Lorentz force, which is induced in conductive particles by a alternating magnetic field. Permanent magnets are one way of generating a magnetic field. In experiments, strong neodymium magnets were used to investigate how the magnetic field influences the particles in flight. The sample materials used were aluminium particles with grain sizes from 1 to 5 mm as well as gravel and glass as the inert component. The locally strong magnetic flux density of 390 mT did, however, not result in a deflection of the particle trajectories. Although particle spin was slowed down during passage throught the magnetic field, this effect could not be used for improving the separation result. A magnetic field can also be generated electrically with a coil or even just with a wire that carries an electric current. Thus, a number of experiments were carried out with direct and alternating current, however, without achieving an effect. Apparently, the magnetic flux density of maximum 30 mT was too low for any visible effect.
Then followed a series of experiments in which the spinning particles were directed onto an impact surface. Good results were achieved with an impact surface, which converts the rotational energy of the particle into a translational deflection. With a horizontal rebound mat (Figure 2 and 3) the probability of spinning (conductive) particles ending up in the "back section" was significantly higher than for non-spinning (non-conductive) particles. However, the accumulation of material on the rebound mat and the complex setup probably prevent a marketable implementation.

Result: Our experiments have not directly lead to an improved separation efficiency of the ECS under test. However, they have provided some valuable insight into the behaviour of spinning particles when passing magnetic fields or when impacting on a surface.