

with each other, as the size range does not exceed 3 mm. An important work involving the separation of small particles using the ECS method was carried out by Rem and co-workers (Rem *et al.*, 2000; Rem *et al.*, 1999; Zhang *et al.*, 1999; Rem and Zhang, 1999; Rem *et al.*, 1997; Rem *et al.*, 1998). A model was developed for small and medium-sized particles in both symmetric and asymmetric fields by treating the particles as magnetic dipoles. The theory was expanded in Rem's paper (Rem, 1999) for a rotary drum separator, sliding ramp, and vertical Eddy current separator.

Based on the analysis of separation mechanisms, proposals were made to improve the separation selectivity of small particles. A number of novel design concepts of ECS were highlighted by Rem *et al.* (2000). The redesigned Delft vertical ECS, the prototype and a laboratory wet ECS (WECS) were used in their investigation. The new vertical ECS was redesigned based on the one developed by van der Valk *et al.* (1998). In this new process, the magnets were more powerful than the ones used earlier.

A vertical Eddy current rotating separator, designed to increase the separation efficiency and to reduce the cost of the separation equipment, was proposed by Schlett *et al.* (Wang *et al.*, 2005). In the separator, the magnetic drum with NeFeB permanent magnets was driven by a dc electric motor that was placed under the magnetic drum. A mixture of copper wire and plastic particles with the average diameter of 4mm and length of 5mm was used to simulate electronic wastes in a laboratory-scale experiment.

4. 4. 2. Corona electrostatic separation

Corona electrostatic separation is an important technique suitable for fine particles with the size range of 0.1–5mm (Owada *et al.*, 1997; Meier-Staude and Koehnlechner, 2000; Schubert and Warlitz, 1994). The utilization of corona electrostatic separators in material recovery from waste electric and electronic equipment for a recycling purpose is only in its infancy. Both fundamental and practical aspects concerning the design of new electrode system have been investigated and developed by Iuga *et al.* (1998; 1989; 1994; 1995).

One of the advantages of electrostatic separation in cable recycling is to obtain a metal-free product. However,

in some cases, the specific resistance of certain types of flexible PVC and rubber used to make cables falls below $4 \times 10^{10} \text{ } \Omega \cdot \text{m}$. Hence, corona electrostatic separation is difficult because the discharge time constant of the non-conductor may fall below 1 s (Meier and Koehnlechner, 2000).

4. 4. 3. Triboelectric separation

Triboelectric separation makes it is possible to sort plastics depending on the difference in their electric properties. For the processing of plastics waste, research has shown many obvious advantages of triboelectric electrostatic separation, such as independence of particle shape, low energy consumption, and high throughput (Stahl and Beier, 1997).

4. 5. Density-based separation

Several different methods are employed to separate heavier materials from lighter ones. The difference in density of the components is the basis of separation. It is indicated that density-based separation processes have found widespread application in non-metal/metal separation (Schubert, 1991). Gravity concentration separates materials of different specific gravity by their relative movement in response to the force of gravity and one or more other forces, the latter often being the resistance to motion offered by a fluid, such as water or air (Wills, 1998). The motion of a particle in a fluid is dependent not only on the particle's density, but also on its size and shape, large particles being affected more than smaller ones. In practice, close size control of feeds to gravity processes is required in order to reduce the size effect and make the relative motion of the particle specific gravity dependent.

5. Non-metal recovery from WEEE

The main components of non-metal in WEEE are pitch fibre, plastic and glass. The organic matter in PCB contains pitch fibre, which serves as fuel to produce energy to maintain the Kaldor furnace temperature. And then, the finally remained slag can act as road building material. The plastic are mostly from the shell of computer, TV, washing machine and so on, which can be served as either raw material of new product after melt or fuel. The glass is mostly from indicator of CRT. The glass is always