



Comparison of Recycling Technologies for E-Wastes and Automobile Shredder Residues (ASR)

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Background

Existing technology of material recycling include mechanical separation, pyrolysis, help recover materials of vehicles and electronics.

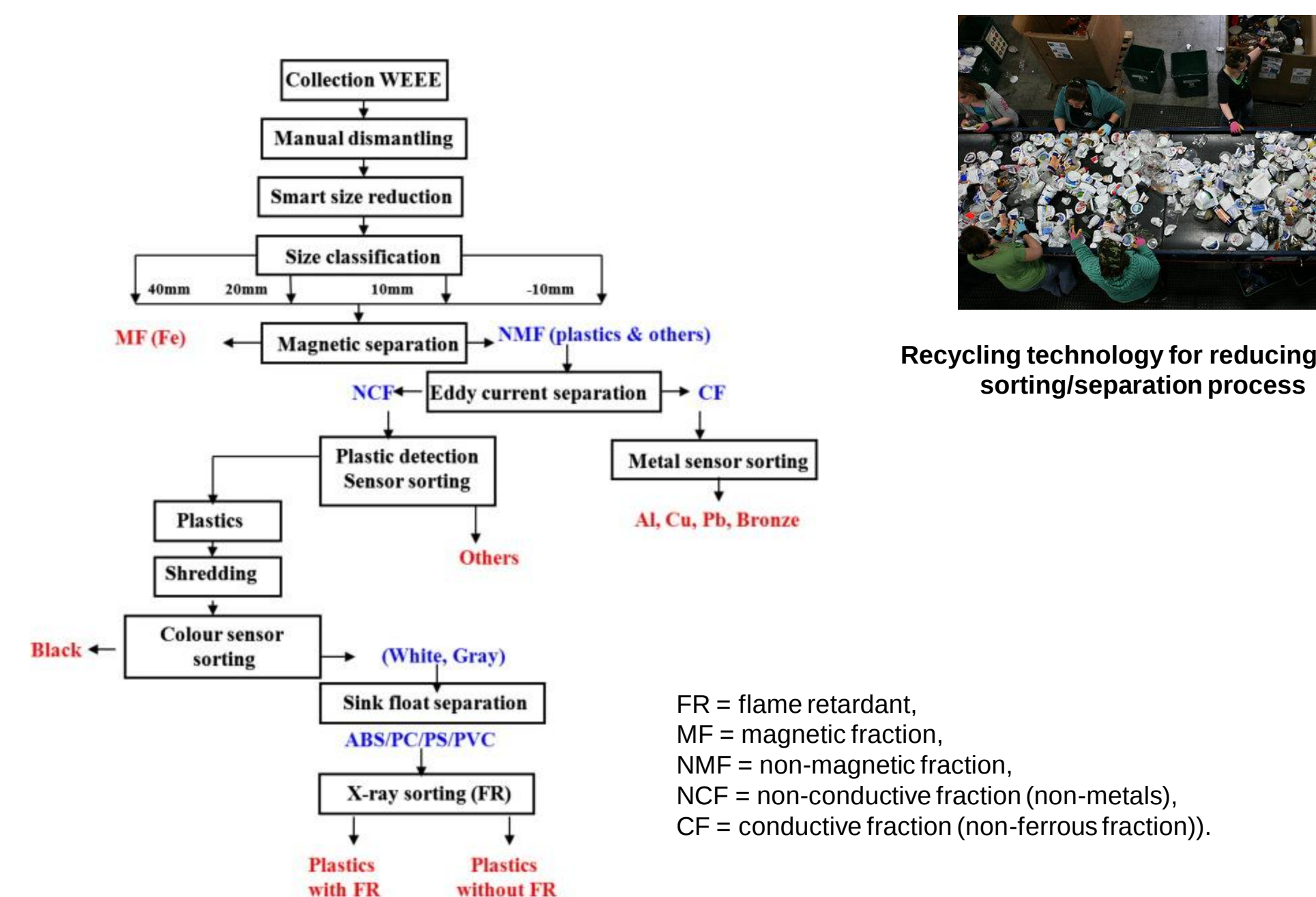
- The various existing recycling technologies varies depending on the materials. Materials recovery of electronics (e-waste) and vehicles (ASR: Automobile Shredder Residues) are can be recovered using the different techniques.
- Recycling technologies have been developed in order to recover materials that have been used to help preserve our planet. Material streams in the society have to be evaluated when new technologies are applied to recycling processes.

Various types of recycling technologies for automobiles and e-waste.

- Mechanical separation
- Magnetic Separation
- Eddy Current

Recycling Technologies

- Recycling technology is the advanced form of using various methods to recover as much materials as possible from product that have reached their end of life span. This technology uses different methods and machineries if necessary.



Example: Flow sheet representing a process of metals and plastics recovery from e-waste (WEEE)
(Source: N. Menada, S. Guignota, J.A. van Houwelingenb, "New Characterization Method of Electrical and Electoroni Equipment Waste (WEEE)," Waste Management in press (2012)



Recycling technology for reducing hand sorting/separation process

Objectives

Developing a new recycling technology to maximize material recovery and energy efficiency while reducing costs.

- Evaluating new recycling technologies through literature review of existing recycling processes and experimental work.
- Showing mathematical modeling of the upcoming research on system design for recycling processes

Comparisons

Mechanical Separation

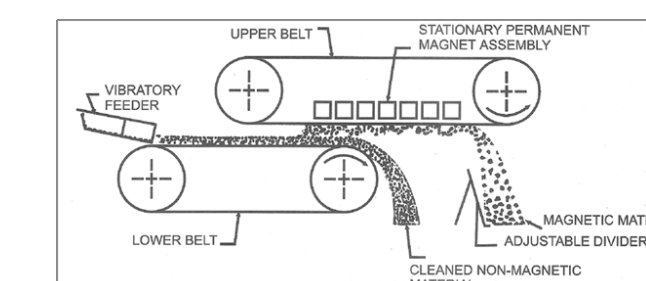
- Sink-float test. Materials such as various types of minerals are separated according to their densities using heavy liquid which has been proven to be the most precise one. Also, the sink-float analysis can be done using dry processes as well. It provides different characteristics (densities) of waste particles.



Sink/Float Tank for HDPE plastic recovery
(Source: Summit Systems Ltd)

Magnetic Separation

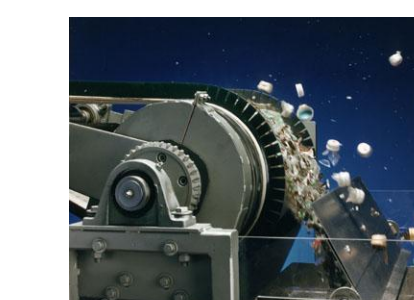
- This form of material separation will help distinguish between the metal and non-metal components. This system has a magnet at a specific point on a conveyor belt. The magnet pulls the ferrous materials to another belt and leaves the non-ferrous scrap.
- The downside of this form of technology is that it cannot distinguish between the various minerals which can contain contaminating scraps such as glass, zinc, and magnesium.



Magnetic Separation
(source from www.crusherportal.com)

Eddy Current Separation

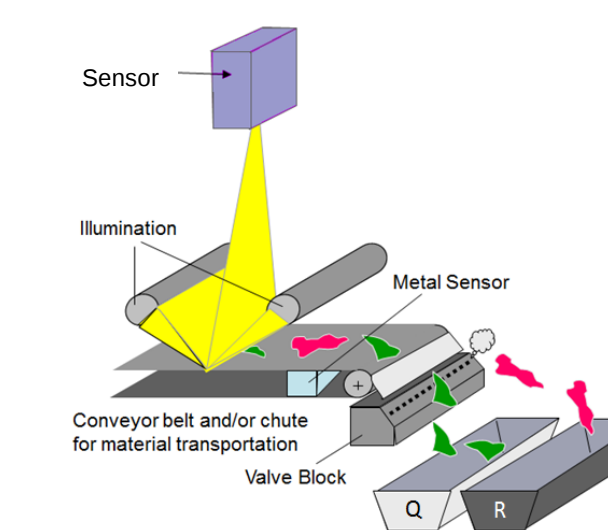
- Similar to magnetic separation. Uses rotors lined with magnets which alternate north and south. There is an external magnetic field which the rotor produces and thus repelling nonmagnetic metals and is thrown out of the stream of scrap. Only the non-metallic scrap is left.



Eddy Current Separation
(Source: brochure of Eriez Manufacturing Co.)

Color Sorting

- This separates the scrap by looking at the color differences. Each mineral scrap has its distinct color that separates them from the other. These are going through a stream. This can be done by human eye and sorted by hand.
- Automated processes for color sorting also exist.
- This process lacks efficiency from the other separating technology. Size and shape is not part of this. However, color sorting is done in conjunction with chemical etching which helps when sorting the colors.



Color Sorting for Plastics [1]

Future Advancement

Prospects

- Implementing current recycling technologies and combining them as a more efficient method.
- Studying various technologies that exist and acknowledging the flaws and improve recovery at a higher percent than current ones.

Summary

The study resulted in the following conclusions:

- Although there are numerous technologies currently existing, the rapidly growing market makes it difficult to continue using such technologies and advancement is needed. There is room for finding new ways to recover higher percentages of material or scrap than current ones.
- The different types of technologies that exist today include mechanical separation through sink-flow processes. In this case their densities play a key part to separate the scrap efficiently. Magnetic process separates the ferrous with the non-ferrous materials as well as the eddy current that uses rotors to function properly and to separate the metallic form non-metallic.
- Color sorting used in conjunction the other forms of technology separates the many types of metals that exist. This can be done by hand sorting or using the automated processes.

Future Work

- Continuing literature review:** literature review is a key to find the higher efficient processes. Through this one can learn new ways to develop technology which will increase material recovery percentages.
- Characteristics of wastes:** physical, mechanical, chemical properties of E-wastes and automobile shredder residues (ASR) will be sampled and analyzed. They include metals, glass, fiber, rubber plastics and dirt.
- System design for recovery processes:** a new system with Near Infrared (NIR) imaging will be applied in the recycling process for e-wastes and ASR

[1] M. Burgstaller, M. Pail "Novel Possibilities for Industrial Solutions through Chemical Colour Imaging" 15th International Conference of Near Infrared Spectroscopy Cape Town S. Africa (2011)