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Application of Electrostatic Separator in a Waste Cable Recycling System

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1. Introduction

In Japan, a number of laws have been consolidated in order to help build a resource recycling society. In April 2000, the "Packaging Waste Recycling Law" came into full effect, and starting in April 2001, the "Home Electric Appliance Recycling Law" and "Architectural Material Recycling Law" also came into effect. Here, we are concerned with plastic that a material for which there are many recycling issues.

There are two types of plastic recycling, material recycling and thermal recycling, but high-purity type separation is necessary for the former, and with the latter, polyvinyl chloride (PVC) must be rejected due to problems like dioxin generation and incinerator corrosion. In either case, high-purity type separation is necessary for recycling. Although a number of sorting technologies have been developed and commercialized, there has not been practical device of dry process enabling high-volume separation of plastics with similar specific gravity.

In response to this problem, Hitachi Zosen has developed and commercialized the electrostatic separators (ES-F Series) enabling high-purity type separation of plastics <1>. This technology employs the frictional charged characteristics which is obtained when different types of plastic are rubbed together. By passing the charged plastic in an electrostatic field formed by a rotating drum electrode and a flat plate electrode, a drop path according as the charged characteristics is produced, and this enables high-purity type separation by dividing plates.

On the other hand, wire and cable sheath materials often use PVC or polyethylene(PE)based plastics due to their outstanding electrical insulation performance, flexibility and economy, but due to environmental problems, various manufacturers are selling incombustible PE (Eco-PE) instead of PVC, and the dissemination of this material is remarkable. However, the specific gravity separation method cannot be used because the specific gravity of Eco-PE is almost the same as PVC. And, the material also contains PE and crosslinked PE(XL-PE), so type separation of plastics utilized its method becomes much more difficult. <2>. The electrostatic separation method can separate irrespective of the specific gravity due to utilizing the charged characteristics of plastic.

This report describes the results of applying the electrostatic separator for these cable sheath material samples, and the electrostatic metal rejector for pulverized waste cable.

2. Electrostatic separation performance for waste cable plastic

2.1 Separation of PVC/PE/Eco-PE mixed plastic

For the separation test, we assumed cable shield material which has been disposed, and

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we used a blend of PVC, PE and Eco-PE pellets in a 1:1:1 ratio by weight(1kg each). Fig.1 shows the results of this test with the electrostatic separator that is comprised of a friction electrifier, a separating section (made up of a rotating drum electrode and opposing electrode)and a collection tank which uses two dividing plates to form 3 tanks. The equipment separates and collects PVC in the drum lower recovery tank (Tank Ⅰ), PE in the middle tank (Tank Ⅱ)and Eco-PE in the opposing electrode side recovery tank(Tank Ⅲ).

The results of recovering PVC,PE and Eco-PE were as follows:

[Tank Ⅰ] PVC : Purity 98.6% Recovery rate 98.7%
[Tank Ⅱ] PE : Purity 85.2% Recovery rate 95.2%
[Tank Ⅲ] Eco-PE : Purity 95.7% Recovery rate 84.5%

When each of these was further reseparated and increased in purity, the results were:

PVC : Purity 99.3% Recovery rate 94.2%
PE : Purity 99.0% Recovery rate 89.0%
Eco-PE : Purity 99.9% Recovery rate 84.5%

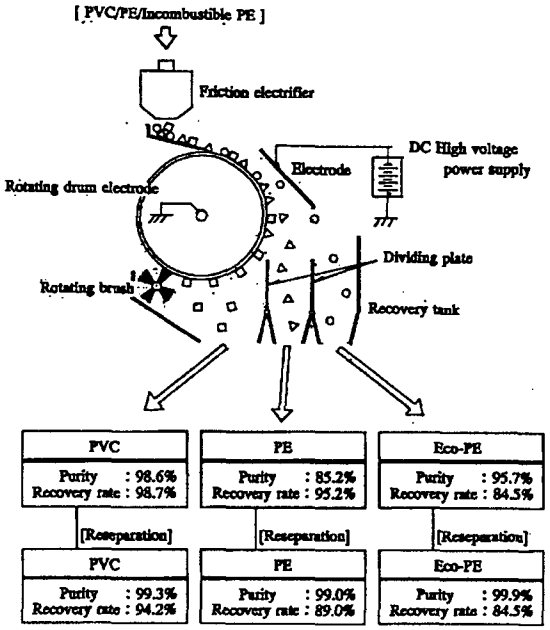

Fig.1 PVC／PE／Eco-PE separation results

2.2 Separation of XL-PE

XL-PE is a thermosetting material, so it is hard to recycle and use it in extrusion molding. Therefore, material recycling is difficult with plastic mixed with XL-PE, and in almost all cases it

is handled by landfill or incineration. So we investigated for separating XL-PE from a plastic mixture XL-PE, Eco-PE and PE. For the separation sample, each type was formed into flat pieces with a thickness of about 2mm, and these were then pulverized to 10mm or less, and mixed in a ratio of 1:1:1 by weight. Fig.2 shows the results of separation.

In the first separation, we separated and recovered PE and Eco-PE, and then the remaining plastic was reseparated to recover PE and Eco-PE. In the recovered PE and Eco-PE from the second separation (recovery rate: 70%), the remaining amount of XL-PE was 1.5%, so the obtained results are adequate for material recycling.

In the results of separating a plastic mixture of XL-PE and Eco-PE, the residual ratio of XL-PE in the recovered Eco-PE (recovery rate: 65%) was 2.7%.

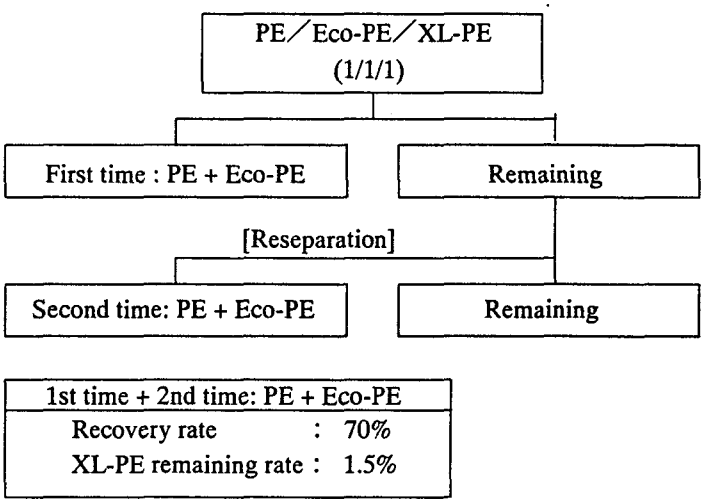

Fig.2 XL-PE separation results

3. Electrostatic metal rejection performance

Here we describe the metal rejection performance of the electrostatic metal rejector (ESP-C Series) commercialized by Hitachi Zosen<3>, for pulverized mixture of waste cable plastics and metals.

Fig.3 shows separation results for cable pulverized pieces. In this results, the plastic (shield material) recovery rate was 93.6%, and the residual ratio of metal in this was 0.9%. When reseparation was done in order to lower the residual ratio of metal, there was no effect on the plastic recovery rate, and it was possible to reduce the residual ratio of metal by 0.1%.

In waste cable recycling there is separation which aims to achieve high-purity recovery valuable metals like copper and aluminum. So the position of the dividing plate in the electrostatic metal rejector were adjusted from the plastic high recovery position to the metal high recovery position, and separation performance was investigated. As a result, in the second separation we obtained a metal purity of 99.99% and a recovery rate of 98.41%.

Due to the above results, we confirmed that the electrostatic metal rejector can be applied to high-purity recovery of plastics and metals from pulverized waste cable material.

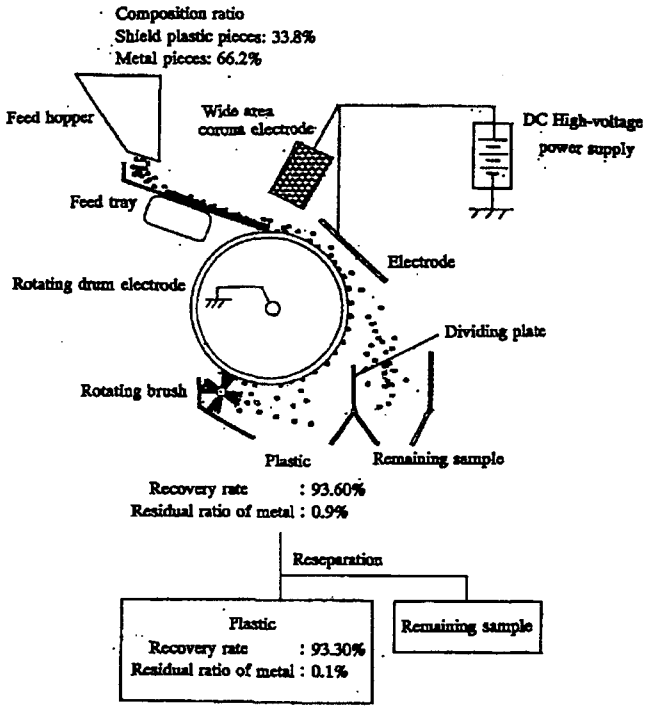

Fig.3 Metal rejection results from pulverized cable

4. Conclusion

In the paper, we have described separation test results for waste cable recycling when applying the plastic electrostatic separator (ES-30F) and electrostatic metal rejector (ESP-30C). The main content is as follows.

(1) In the separation of a plastic mixture of the cable shield materials PVC, PE and Eco-PE, we obtained a high-purity of at least 99% in all cases.

(2) We were also able to separate PE and XL-PE that a task which has previously been difficult.

(3) The electrostatic metal rejector can be applied to high-purity recovery of plastics and metals from pulverized waste cable material.

<References>

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