DEVELOPMENT OF MECHANICAL RECYCLING TECHNOLOGY FOR WASTE POLYOLEFIN COMPOSITES BASED ON HIGH-SPEED CENTRIFUGAL BEATING TECHNOLOGY

Takashi Yamawaki[1], and Yoshimi Ozaki[1]

[1] Plastic Waste Management Institute 1-4-1 Shinkawa Chuo-ku, Tokyo 104-0033, Japan
e-mail: yamawaki@pwmi.or.jp

Abstract

Most of the waste disposed of in the automotive interior parts production process are landfilled or incinerated due to the composite nature, which is difficult to recycle. If floor materials, which are typical fiber-resin multilayer automobile parts, can be separated into the resin and fiber components, a high level of recycling can be achieved. We decided to launch a project to apply the high-speed centrifugal beating method and develop a technology using floor materials as the specific model. By setting the beater screen diameter to 5 mm and peripheral speed to 110 m/s and adding a fiber-component re-beating process, the 96% purity of PE and 74% recovery rate were achieved. The recycled PE pellets were added to the currently used conventional material by 40% to fabricate prototypes in the primary-carpet fabric production line. It was confirmed that the production of primary carpet fabric was obtainable and the prototypes met the moldability and quality standards. The sound-insulating floor materials can be recycled into PE resin material through the beating technology, and if the conditions for collecting 80 tons or more of the floor material per month are fulfilled, recycling can be economically viable.

Keywords: *high-speed centrifugal beating method, recycled PE, multilayer automobile parts, landfill, mechanical recycling*

1. Introduction

The plastic interior parts used in the automotive industry include instrument panels, sheet, ceiling liners, door trim, and floor carpets. Because most of these interior parts are composite comprising base and surface materials and are molded or trimmed into different profiles, the amount of waste is substantial. It is estimated that the waste rate is 30% or more depending on the shape. Most of the waste disposed of in the production process are landfilled or incinerated due to the composite nature, which is difficult to recycle. Improvement of recycling ratio is required in accordance with the Basic Plan based on the Basic Act on Establishing a Sound Material-Cycle Society.

2. Materials and Methods

Materials

Waste automobile floor mats obtained from the production process

The material retains the fiber layer (polyester + rayon) shape by the molding property of polyethylene resin sheet and is composed of approximately 40% fiber and 60% resin.

Methods

High-Speed Centrifugal Beating Method was used in the experiment described below, and the produced recycled resin was molded into recycled products using the molding technology.

Issue (i)

(1) Shredding of the test specimen (i) (sound-insulating material)
(2) Pulverization of the pieces produced in (1)
(3) Separation and recovery of each component (fiber and resin)
(4) Pelletizing of the recovered resin
(5) Prototyping of a primary floor material using recycled resin pellets
(6) Molding of the primary floor material produced in (5) into a floor mat

Issue (ii)

(7) Fabrication of a fiber web/mat from the fiber recovered in (3)

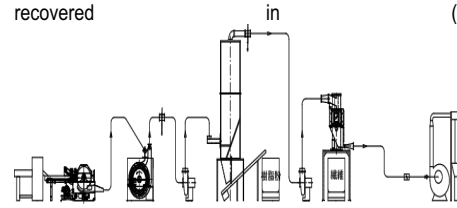

Figure 1 Conceptual model of the continuous production line

3. Results and Discussion

By setting the High-Speed Centrifugal beater screen diameter to 5 mm and peripheral speed to 110 m/s and adding a fiber-component re-beating process, the 96% purity and 74% recovery rate were achieved. The recycled PE pellets with the target purity were added to

the currently used conventional material by 20% or 40% to fabricate prototypes in the primary-carpet fabric production line. Although a small amount of PET components formed in a sea-island structure was observed in the molten PE, it was confirmed that the production of primary carpet fabric was obtainable. The primary fabric was processed into prototype parts on an automobile parts molding line, and it was confirmed that the prototypes met the moldability and quality standards. During the prototype process, another possibility was revealed that the mixture of fiber-rich components from accessing the resin in the separated fiber component and binder fiber may be used to fabricate recycled mats. Consequently, further improvement in the resin recovery rate is expected by introducing the resin-rich components produced from the process into the beater once again.

For the purpose of putting this technology into practical use, a simple system with a single beater equipped with a fiber exhaust unit with a 3–5 mm screen is proposed. And it becomes economical viable, if 80 tons or more of the material to be processed is collected per month.

4. Conclusions

By using a high-speed centrifugal beating method and setting the beater screen diameter to 5 mm and peripheral speed to 110 m/s and adding a fiber-component re-beating process, the 96% purity of PE and 74% recovery rate were achieved from a waste automotive floor materials . The recycled PE pellets were added to the currently used conventional material by 40% to fabricate prototypes in the primary-carpet fabric production line. It was confirmed that the production of primary carpet fabric was obtainable and the prototypes met the moldability and quality standards. The sound-insulating floor materials can be recycled into PE resin material through the beating technology, and if the conditions for collecting 80 tons or more of the floor material per month are fulfilled, recycling can be economically viable.

References

[1] A. Koyama Y. Sawada and T. Nishishita. Fundamental Study on for Recycled PVC sheets used construction Waste. Architectural Institute of Japan, Kanto Conference Preprint (2006) pg745–pg746.