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Separation of PET and PS with Air Separation

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The air separation of PET (Polyethylene terephthalate) and PS(Polystyrene) was carried out by taking advantage of the different abrasive resistance of two plastics. PET bottles and PS packages were shredded to small square pieces (5x5mm). Both plastic shreds were treated by a shear-type crusher. The PET shreds were bent and twisted by the crush so that they were blown up easily, but the PS shreds were not. After the crush of mixture of both plastics, air separation experiments were carried out using four types of air separators. The number and location of the baffle attached to them are different. With the separator with a baffle attached at the upper part, PET recoveries for the crushing time of 30, 60 and 90sec were 67, 98 and 99% respectably at the air flow rate of 3.5m/s, whereas PS recoveries were null regardless of the crushing time.

Keywords: PET, PS, Air separation, Shear-type crusher

1. Introduction

In order to recycle waste plastics, it is necessary to separate plastics each other. The separation of PS from PET is carried out usually by gravity separation. The densities of PET and PS range from 1.05 to 1.09 and from 1.35 to1.4 respectably (Stahl and Beier, 1997). PS floats and PET sinks with an appropriate dense medium.

In this study, the air separation of PET and PS was carried out by taking advantage of the different abrasive resistance of two plastics.

2. Samples and Methods

PET shreds used in this study are prepared by shredding colored PET bottles. Its thickness was about 0.4mm. PS shreds used in this study are prepared by shredding PS packages with 0.5mm in thickness. The size of PET and PS shreds is 5x5mm. Figure 1 shows the PET bottle and PS package used in this study.

We used four types of air separators in this study. Figure 2 shows the schematic diagrams of air separators, which was made from plastic boards . The number and location of the baffle attached to these separators are different. 1) the first one has no baffle 2) the second one has a baffle at the lower part 3) The third one has a baffle at the upper part 4) The forth one has two baffles. Figure 3 shows a electric hair blower used as an air supplier and a transformer. Air flow rate was adjusted by controlling the voltage with the transformer. The air flow rate was measured at the point of 10mm apart from the hair blower with an anemometer. Figure 4 shows a shear-type crusher with a rotary blade (25000rpm). Its capacity is ca. 600ml.

The experimental procedure was as follows; The mixture of PET and PS shreds was put in the crusher and crushed for designated time. After the

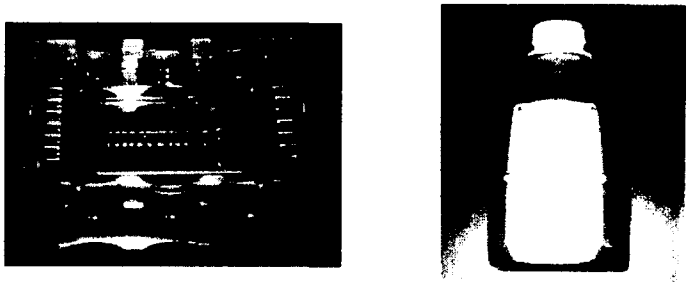


Figure1 PS package and PET bottle used in this study

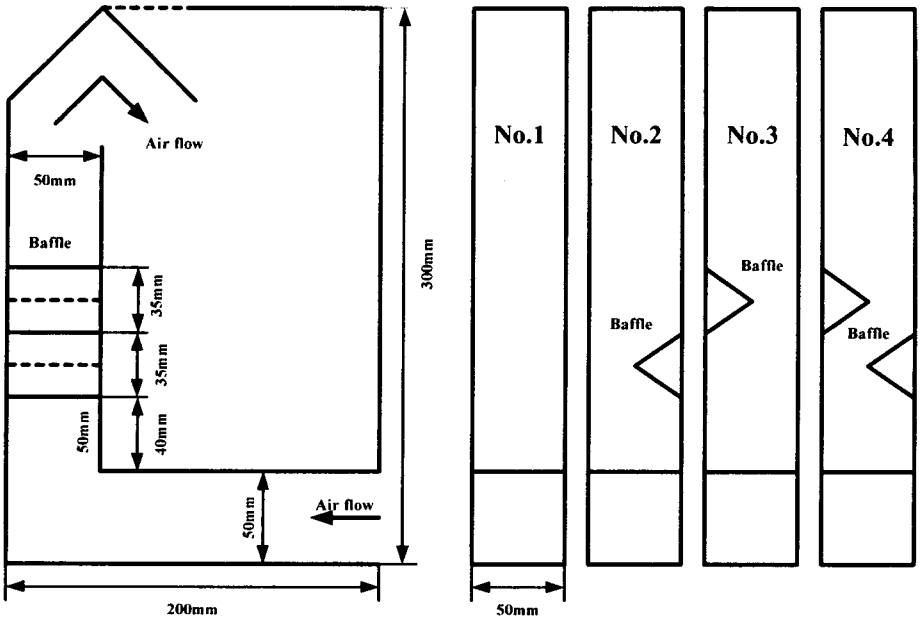


Figure 2 Schematic diagrams of air separators
No.1: without baffle, No.2: with a baffle at the lower part, No.3: with a baffle at the upper part, No.4: with two raffle

crush of the mixture of PET and PS shreds, the mixture was put at the corner of the air separator. Air was supplied at determined flow rate for five minutes. The shreds of PET and PS that got blown up were separated by handpicking in terms of color and weighed respectably. Each recovery was calculated.

3. Results and discussion

1.5 g of each PET and PS shreds were mixed and crushed for 30, 60 and 90 sec. Afer the crushing, the mixtures were separated with No.1 air separator. Figure 5 shows the recoveries of PET and PS as a function of air flow rate. The recovery of PET sheds increased with increase in the air flow rate and also increased with the crushing time. At the air flow rate of 2.0m/sec, the recoveries of PET shreds for crushing time of 30, 60 and 90sec were 8, 29 and 86% respectably. At this air flow

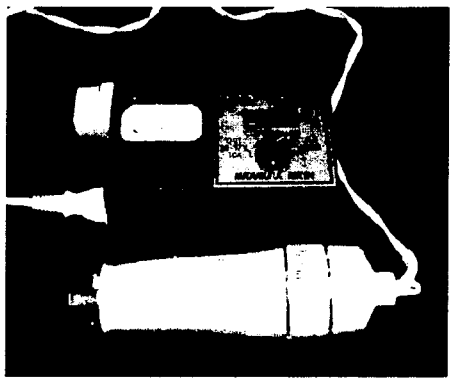
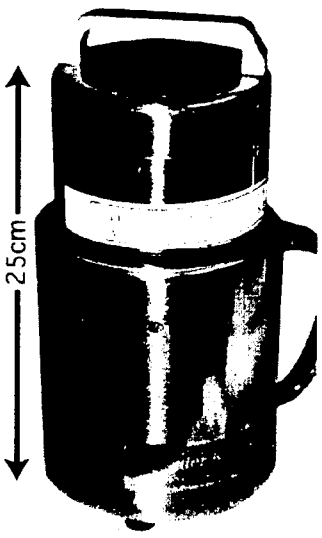


Figure3 Photograph of a hair blower used for air supplier and a transformer



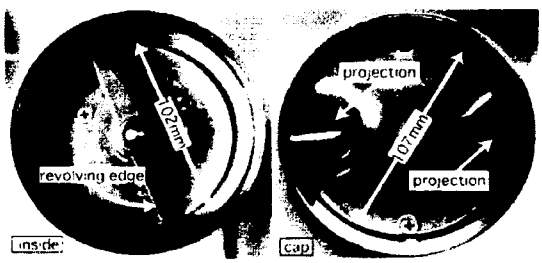


Figure 4 Photographs of a shear-type crusher

rate, the recoveries of PS sheds were 0% regardless of crushing time. The PS recovery increased with the increase in the air flow rate, and 100% of PS shreds was recovered at the air flow rate of 4m/s . Separation of PS and PET was difficult at the air flow rate range over 3m/s.

In order to decrease the recovery of PS shreds , separation experiments were carried out using air separators with baffles. Figure 6 shows the results of the experiments using the air separator with a baffle attached at the lower part. The recovery of PS did not decrease enough. At the air flow rate of 3m/sec, PS recoveries for the crushing time of 30, 60 and 90sec were 1, 0 and 3% respectably.

Figure 7 presents the results of the separation experiments with the air separator with a baffle attached at the upper part. Recovery of PS sheds decreased, but PET recovery also decreased at the lower air flow rate range. At the air flow rate of 3m/sec, PET recoveries for the crushing time of 30, 60 and 90 were 67, 98, and 99%, whereas PS sheds were not recovered.

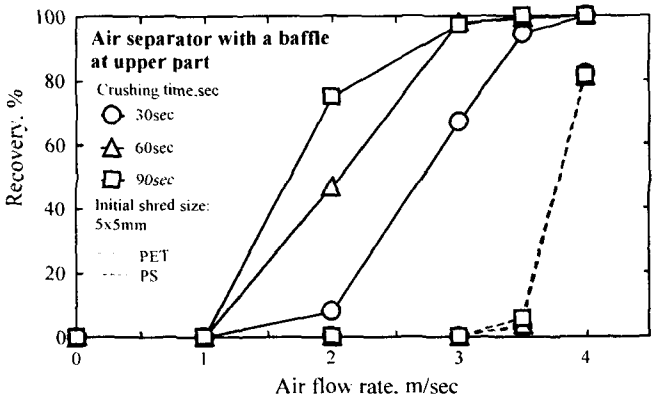


Figure 7 Air separation of PET and PS shreds using separator with a baffle attached at the upper part.

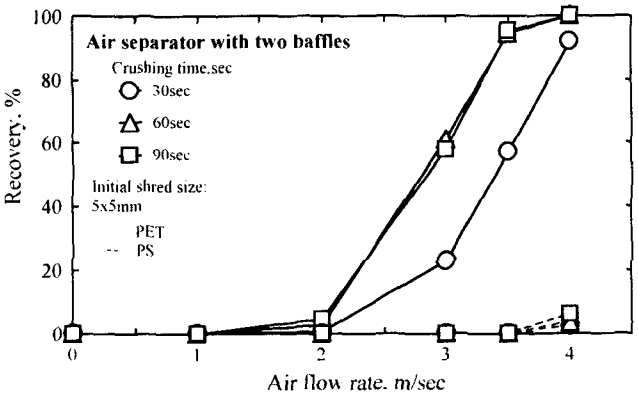


Figure 8 Air separation of PET and PS shreds using air separator with two baffles

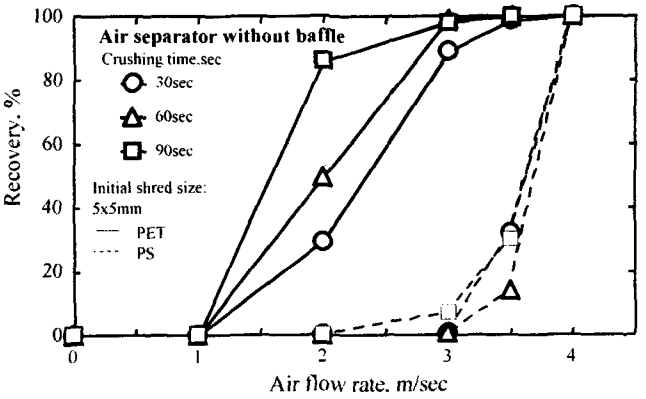


Figure 5 Air separation of PET and PS shreds using separator without a baffle

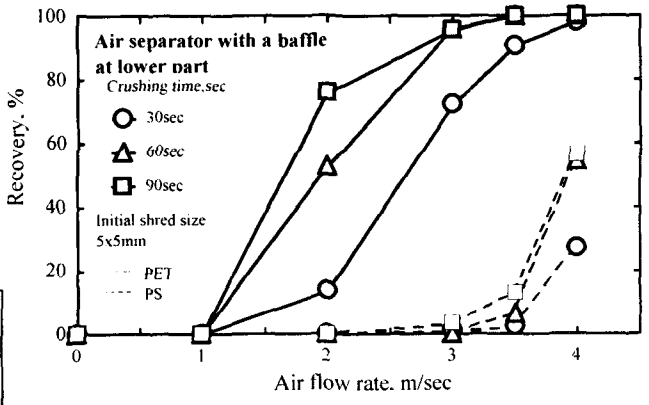


Figure 6 Air separation of PET and PS shreds using separator with a baffle attached at the lower part.

Figure 8 presents the recoveries of PET and PS using the air separator with two baffles. These recoveries decreased remarkably. At the air flow rate of 3.5m/sec, PET recoveries for the crushing time of 30,60 and 90sec were 57,94 and 95% respectably while PS recoveries were null regardless of the crushing time.

4. Conclusion

After the crushing of the mixture of PET and PS shreds with the shear-type crusher for more than 60sec, over 98% of PET was recovered with air separator with a baffle attached at the upper part whereas PS was not recovered at all.

References

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