Electrostatic separation of plastic mixtures ABS/HIPS and ABS-PC/HIPS from IT equipment using fluidized bed tribocharging

L. Calin[1], A. Catinean[1], M. Bilici[1], A. Samuila[1], L. Dascalescu[2]

[1]Department of Electrotechnics and Measurements, Technical University of Cluj-Napoca, Cluj-Napoca, Cluj, 400114, Romania
[2]Department of Quality, Industrial Logistics and Organization, IUT Angouleme, Angouleme, 16000, France
Presenting author email: laurflorentincalin@yahoo.com

Around 25.8 million tons of plastic waste are generated in the European Union every year (EU Communication, 2018). Less than 30% of such waste is collected for recycling, a significant part being treated in third countries. Plastics from WEEE represent 8% of this quantity and the recycling of these plastics requires, first of all, separation on polymer types. Between the technologies currently employed for this operation, the triboelectrostatic separation is distinguished as a clean and environmental-friendly technology characterized by low energy consumption, moderate cost, and simple maintenance (Wu *et al*, 2013, Calin *et al*, 2007, and 2008). The method consists in tribocharging the granular mixture components with opposite polarity using a tribocharging device (Boukhoulda 2017), then feeding the charged material into the electric field of a free fall electrostatic separator where the granule trajectories are deflected in accordance with the charge amount and polarity.

The paper presents an experimental study of the triboelectrostatic separation feasibility of two plastic mixtures, ABS/HIPS and ABS-PC/HIPS, from IT waste with balanced component mixture by weight of 50% – 50%, as well as unbalanced 10% – 90% and 90% – 10%. The granular mixture contains a size fraction (1-3) mm and was provided by a WEEE recycler. The components differ by color, facilitating the analysis of the separation results.

The laboratory equipment (Fig. 1) consists in a free fall electrostatic separator equipped with a fluidized bed tribocharging device, characterized by interchangeable tribocharging chambers.

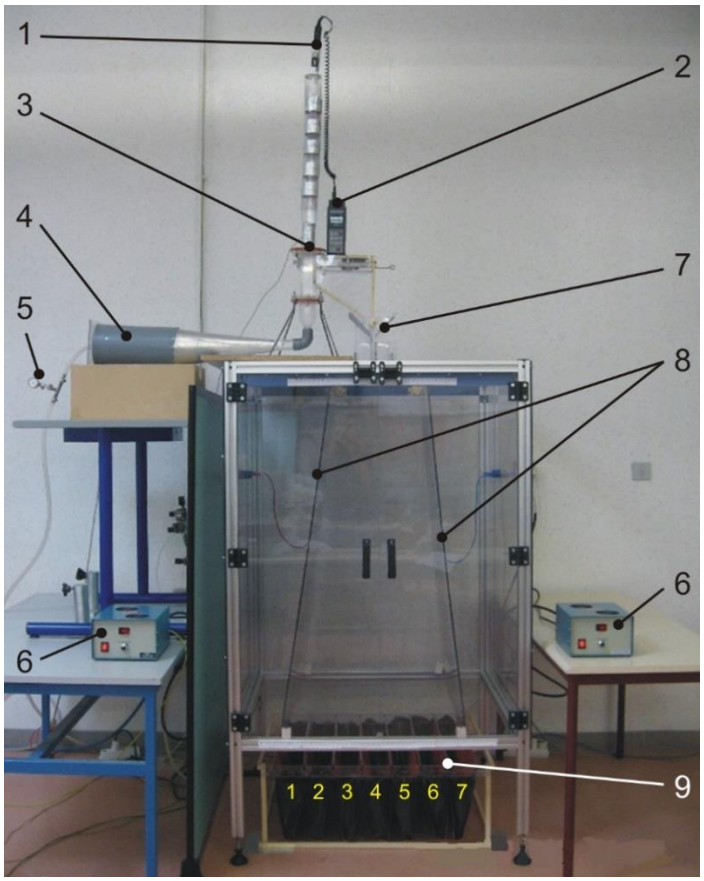

Fig. 1. Free-fall electrostatic separator experimental set-up: 1 – thermohygrometer probe, 2 – thermohygrometer, 3 – fluidized bed tribocharging device, 4 – fluidizing air heater, 5 – pressure gauge, 6 – high voltage supply, 7 – variable angle feeding device, 8 – plate electrodes, 9 – material fractions collector with seven compartments.

The components of the granular mixture acquire electric charge of opposite polarity by multiple granule-granule and granule-wall impacts. Previous tests were carried out in order to establish the material for the tribocharging chamber and the duration of the charging process for highest charge accumulation on granules.

The samples of granular mixtures were subjected to the fluidized bed tribocharging process, then introduced in the free-fall electrostatic separator. Separated material was collected in the seven boxes analyzed in Fig. 2. All experimental runs show recovery rates of approximately 90 % and a purity of about 99 %, for both components of the granular mixture.

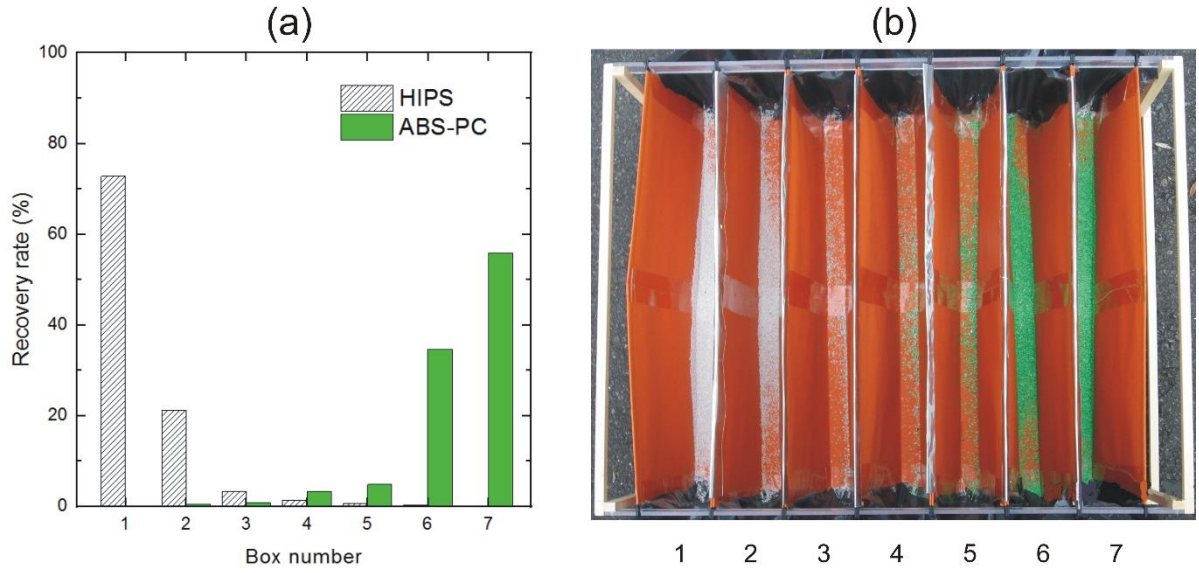

Fig. 2. Results of a 50 % ABS-PC – 50 % HIPS mixture separation: recovery rate box distribution (a) and photo of the collecting boxes for the same experiment (b).

These laboratory results put in evidence the feasibility and the high efficiency of the triboelectrostatic separation of ABS/HIPS and ABS-PC/HIPS mixtures using the fluidized bed as a tribocharging device.

References

1. ***, "A European Strategy for Plastics in a Circular Economy COM/2018/028 final"
2. G. Wu, J. Li, Z. Xu, "Triboelectrostatic separation for granular plastic waste recycling: A review", Waste Manage., vol. 33, 2013, pp. 585-597.
3. L. Calin, A. Mihalcioiu, A. Iuga, L. Dascalescu. Fluidized bed device for plastic granules triboelectrification. Particul. Sci. Technol., vol 25, 2007, pp. 205-211.
4. L. Calin, L. Caliap, V. Neamtu, R. Morar, A. Iuga, A. Samuila, L. Dascalescu. Tribocharging of granular plastic mixtures in view of electrostatic separation IEEE Trans. Ind. Appl., vol 44, 2008, pp. 1045-1051.
5. M. F. Boukhoulda, M. Rezoug, W. Aksa, M. Miloudi, K. Medles & L. Dascalescu. Triboelectrostatic separation of granular plastics mixtures from waste electric and electronic equipment, Particulate Science and Technology, vol 35:5, 2017, pp 621-626.