

Considerations on the recovery and recycling of plastic materials from computer equipment in Romania

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Abstract. The article presents an overview of the recycled plastics recovered from electrical and electronic equipment. The activity of recycling plastics represents the biggest challenge in harnessing efficient economically, especially due to problems related to collecting enough material segregat to make recycling economically viable. The activity of recycling plastics is important from the point of view of conservation of resources of crude oil. Life cycle, reduced to 2-3 years of computer equipment is the direct consequence of the increase in the quantity of wastes arising from the production of equipment. The plastic materials are, in terms of quantity, the second existing constituent in WEEE – approximately 21%. Barriers that limit the growth of recycling plastics from WEEE are the mix of plastics, contamination of plastics products, low price of plastics "Virgin", limited application.

Key Words: plastics, recycling, recovery, computer equipment, WEEE.

Introduction. Waste from computer equipment, record today a fast growing due to reduced life cycle of just two to three years. The main recyclable plastics (Figure 1) used in the manufacture of acrylonitrile butadiene styrene information are ABS, PC/ABS, Polycarbonate High Impact Polystyrene HIPS and Polyphenylene Oxide PPO (Iuga et al 2007).

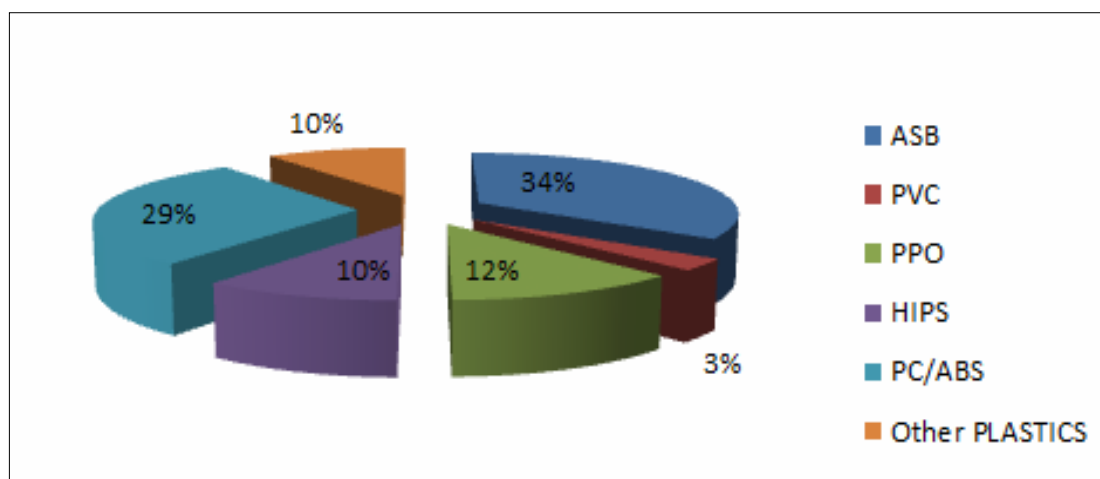


Figure 1. Thermoplastics recyclable materials share of computer equipment.

The paper analyzes the recycling of plastics recovered in waste computer equipment. Recycling eliminates pollution and conserves natural resources. The biggest benefit of recycling is not related to the storage of residues, but conservation of energy and natural resources and the prevention of pollution by using in the manufacturing process, material from recycling and less of those primaries. Recovered materials have already been

purified and processed previously, so that their use in the manufacturing process involves a task cleaner and a lower consumption of energy. The detailed analysis revealed that these environmental benefits of recycling are much more effective than any other actions to protect the environment.

Statistical data. By comparison with the recycling of packaging waste, the recycling of electrical and electronic equipment is more difficult, requiring separation technologies of various materials. In the process of recycling, the equipment is sorted according to type. Each device is disassembled into parts, plastics and metals. Follow the last part, extracting useful materials.

In Romania, the difference between the quantity of equipment put on the market and the amount of equipment collected from consumers is the largest in the European Union. In other words, we collect the least, both as an absolute figure, and as a percentage of the amount we consume (Figure 2) (<http://www.salvatidelta.ro/RaportReciclare.pdf>).

According to the European norms and legislation in Romania they transpose, up in 2008, the average annual rate of collecting electrical waste must reach 4 kg/inhabitant. In 2008 was collected an amount equivalent to one-quarter of this target, i.e. approximately 1 kg/inhabitant. Moreover, even the electrical wastes collected are treated less than 40%, and only 26% are monetized through reuse or recycling (Figure 2). Most of the countries of the European Union recycle or reuse over 70% of electrical waste collected.

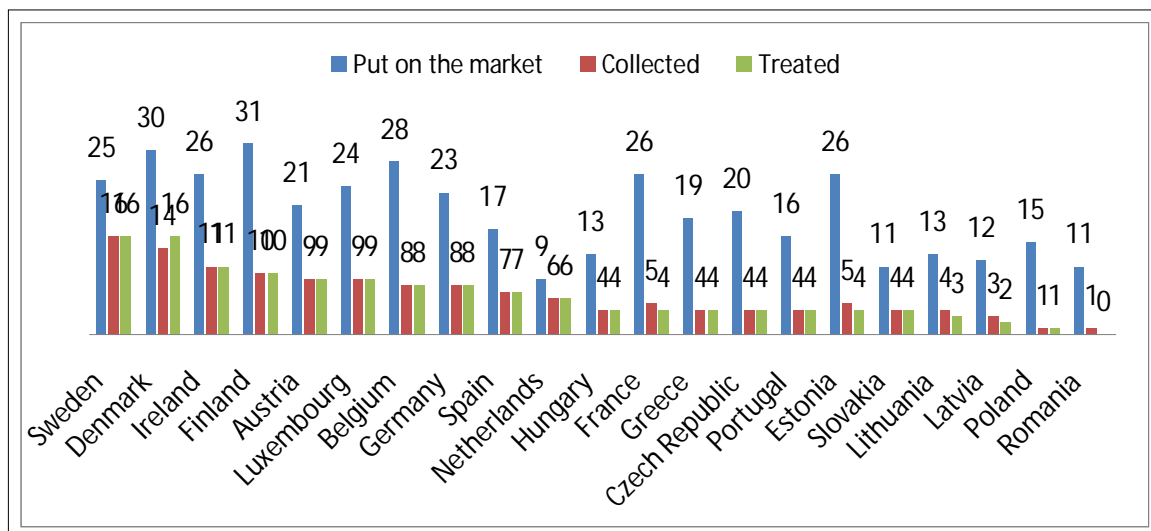


Figure 2. The amount of electrical waste products put on the market, collected and treated, kg/person 2008 (<http://www.salvatidelta.ro/RaportReciclare.pdf>).

In 2008, according to the rules referred to above, in Romania ought to be harnessed between 70 and 80% of the amount of electrical waste collected, depending on the type of equipment. Recovery rate was about 37%. As regards reuse and recycling, targets vary between 50 and 75%. Rate achieved was approximately 26% (Figure 3) (<http://www.salvatidelta.ro/RaportReciclare.pdf>).

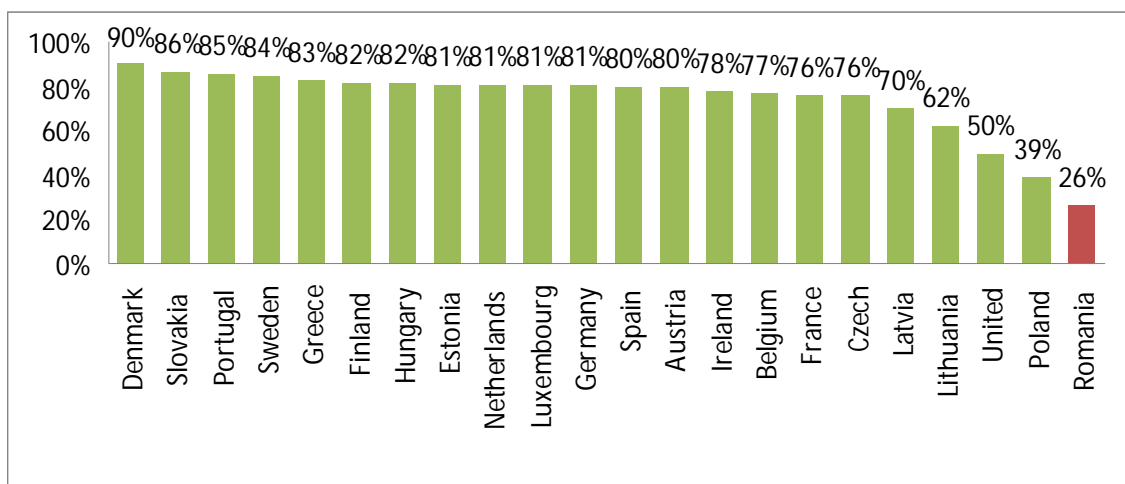


Figure 3. Percentage of electrical waste reused or recycled in the total collected, 2008 (<http://www.salvatiodelta.ro/RaportReciclare.pdf>).

National legislation on the recovery and recycling of waste computer equipment. Romania, as a Member State of the European Union, has the obligation to comply with European legislation, question directives and regulations issued by the European Commission and the Council of Europe. European Union policy in the field of waste management shall be indicated in the European Community's strategy on waste management, being implemented in a number of legislative acts.

Legislative framework:

- the Government decision No. 1037/2010 (MB 728/02.11.2011) on waste electrical and electronic equipment;
- the Order of the Ministry of Environment and Water Management 901/2005 concerning the approval of specific measures for the collection of waste electrical and electronic equipment which present risks for contamination by the safety and health of staff from collection points (MO No. 910/12.10.2005);
- the Order of the Ministry of Environment and Water Management and the Ministry of Economy and Trade 1225/721 of 2005 approving the procedure and criteria for the evaluation and approval of collective organizations take-over of responsibility concerning the annual objectives for the collection, reuse, recycling and recovery of waste electrical and electronic equipment (MO No. 1161/21.12.2005), with subsequent amendments and additions;
- the Order of the Ministry of Environment and Water Management and the Ministry of Economy and Trade 1223/715 in 2005 on the procedure for registration of producers, and reporting of data relating to electrical and electronic equipment and waste electrical and electronic equipment (No. 1/MO 03.01.2006), with subsequent amendments and additions;
- the Order of the Ministry of Environment and Water Management, Ministry of Economy and Trade and the National Authority for Consumer Protection 556/435/191 in 2006 on the mark specifically applied to electrical and electronic equipment placed on the market after 31 December 2006 (MO No. 608/13.07.2006);
- the Order of the Ministry of Environment and Forests 1441/2011 on establishing the methodology of formation and management of financial guarantee for manufacturers of electrical and electronic equipment (MO No. 379/31.05.2011);
- the Order of the Ministry of Environment and Forests 2264/2011 approving the methodology for calculating the annual rate of sorted collection of waste electrical and electronic equipment (MO No. 715/11.10.2011) (www.anpm.ro/articole/deseuri_de_echipamente_electrice_si_electronice-28).

WEEE recycling centers in Romania. A third of the counties of Romania has a permanent solution for recycling old electronics and knowhow:

- EcoPlast Industries Group, address: Mamaia Blvd. No. 171 Bis, Constanța, 900565, e-mail: office@ecoplast-group.ro;
- S.C. MM RECYCLING LLC, Aurel Vlaicu Blvd. No. 290A, 900498, Cluj-Napoca, phone: 0723/372.163, Fax: 0723/111.791; www.mmrecycling.ro;
- Gremlin Str., No. 9, Constanța, Tel: 0241.586605, Fax: 0241.586606, www.gremlincom.ro;
- Europlastic Industry SRL, Mihail Kogălniceanu Str., No. 3B, Câmpina, Prahova, www.europlasticind.ro;
- S.C. Tango Scraps Recycling Company SRL, STAR Str., No. 44G, Galați, phone: 0740041256, Fax: 0236312061;
- GreenWEEE International S.A., Industrial Park, DJ Frasinu 203D Buzău – Slobozia, km. 5-6,127642, Aim, Buzău, Romania, Tel: + 4 0338 100.601, 602, 603, Web: www.greenweee.ro, www.greenweee.eu;
- Ecotic, address: Porch, no. 5A, Sector 4, Bucharest, CP: 041201, phone: 031-805-5742/0372-77-27-27, Fax: 021.332.32.38, www.ecotic.ro;
- ECOSYS RECYCLING, To September 13, no. 90, JW Marriott Hotel, floor 8, room 813, sector 5, Bucharest, postal code: 05713, www.ecosysrecycling.ro;
- Arcon Industrial Services, address: Corneliu Coposu Blvd., No. 3, bl. 101, Bucharest, Sector 3, 030601, phone: + 40 21 3228451, e-mail: sales@arcon.ro;
- ELECTRONIC RECYCLING F & M s.r.l., Town Măgurele, Atomiștilor Str., No. 64, Ilfov county, www.reciclare-calculatoare.ro;

Recovery of plastics from computer equipment. Plastic represents, in terms of quantity, the second existing constituent in WEEE – approximately 21%. Of these, styrene (ABS, SAN, ASA, PS, HIPS) and polypropylene (PP) constitutes about 70% of all plastics used as we can see in Figure 4; these polymers should be considered as priority for improving the recycling of WEEE plastics.

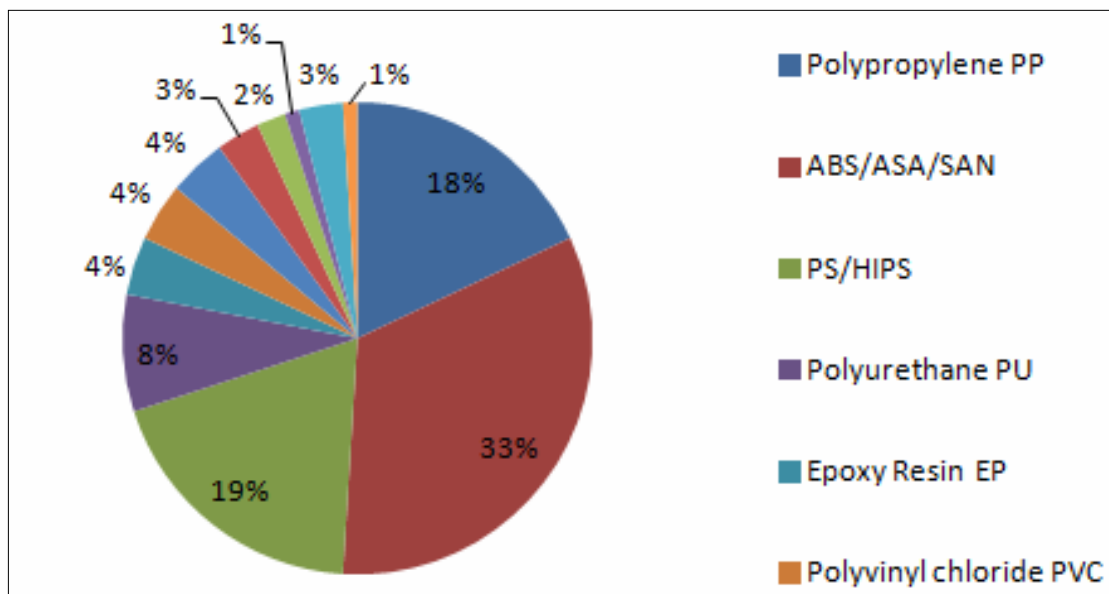


Figure 4. Types and structure of plastics that come into the EEE.

Recovery technologies of waste plastics processing equipment includes the following stages

1) Computer equipment remediating. The objective of this pipe is to withdraw from the flow that it will follow the waste computer equipment components presenting risks to the environment or to the health of the operators involved in the recycling process (www.icpmrr.ro).

2) Dismantling of computer equipment. Stage that as presented in the technology developed can be manual or mechanized, based on existing technical facilities. Manual dismantling is carried out with the help of kits, screwdrivers angle grinder with abrasive disk and diamantat, and drilling machines and mechanical dismantling is done using concasoarelor with hammers in multistage or concasoarelor with chains (www.icpmrr.ro).

3) The separation between them. Is done manually in case of scrapping or using magnetic traps, traps with Foucault currents, hydro-gravitational and densimetric traps in case of scrapping, mechanical.

4) Establishing the main phases and the election machinery in the flow of the recovery of plastics. At this stage are provided for particle preparation operations (grinding and classifying) for the process of sorting through the separation by density using water-based suspensions, drying and tribo-electrostatic separation operations for the separation of plastic between them. Plastics floating in the water (and PP) are separated by plastics heavier than water (HIPS, ABS, PS and PC). After separating the two fractions of densimetric plastics are dry in installations of centrifugal type with hot air and then are placed in the electrostatic separator. In a first stage separates the HIPs, and ABS and PC are collected along to be sorted in the second stage of tribo-lectric separation (<http://www.icpmrr.ro/PDF/Proiect%20CEEX%20113-2005.pdf>).

Separation technologies

Electrostatic separation. Electrostatic separation consists in selective sorting of particles loaded with load or polarized, under the action of electric field. The separation occurs due to the fact that the various materials loaded with tasks which gives the electrostatic are loaded in different time intervals. In this way, being obliged to travel a certain distance on a rotating metal drum related electric grounded, recommendation on the drum at different times (Dăscălescu et al 2012).

Corona-electrostatic separation. In an electrostatic corona-separator with bearer, granular mixture cylinder subjected to the process of separating East filed with a certain speed, on the surface of earthed metal electrode. The electric field is generated between the cylindrical electrode and one or more electrodes connected to a high voltage source (http://www.inginerie-electrica.ro/acqu/pdf/2007_17.pdf). Non-conductive particles are loaded in the corona and are fixed on the surface by the force of the rotating image electrode (Dăscălescu et al 2001). Conductive particles are loaded through electrostatic induction, in contact with cylindrical electrode and are attracted to the high-voltage electrode (Haga 1995; Călin et al 2008). Accordingly, the factors that influence the process of separation include high level tension, electrode configuration, power flow, particle size, the speed of rotation of the cylindrical electrode (Iuga et al 2011).

Mechanical recycling of plastics. Recycling is much more than a waste processing method. It is an important stage of the flows of materials and the volume of recycled materials (as an expression of recycling rate for example) can be a subtle measure in assessing the maturity of economic activity. Recycling serves to performance ranking of positions they occupy specific technologies to produce the same products. Recycling policies are properly designed and applied if recycling is effective in terms of all aspects of environmental, economic and social.

Most plastics used today are thermoplastics, which means that the material can be melted and reformed. Most thermoplastics are very suitable for mechanical recycling, at least in theory.

As shown in Figure 5, mechanical or material recycling of plastics involves a number of treatments and operations: separation of plastic by resin, washing to remove dirt and contaminants, grinding and crushing to reduce the plastic particle size, extrusion by heat and reprocessing into new plastic goods (Aguado & Serrano 1999).

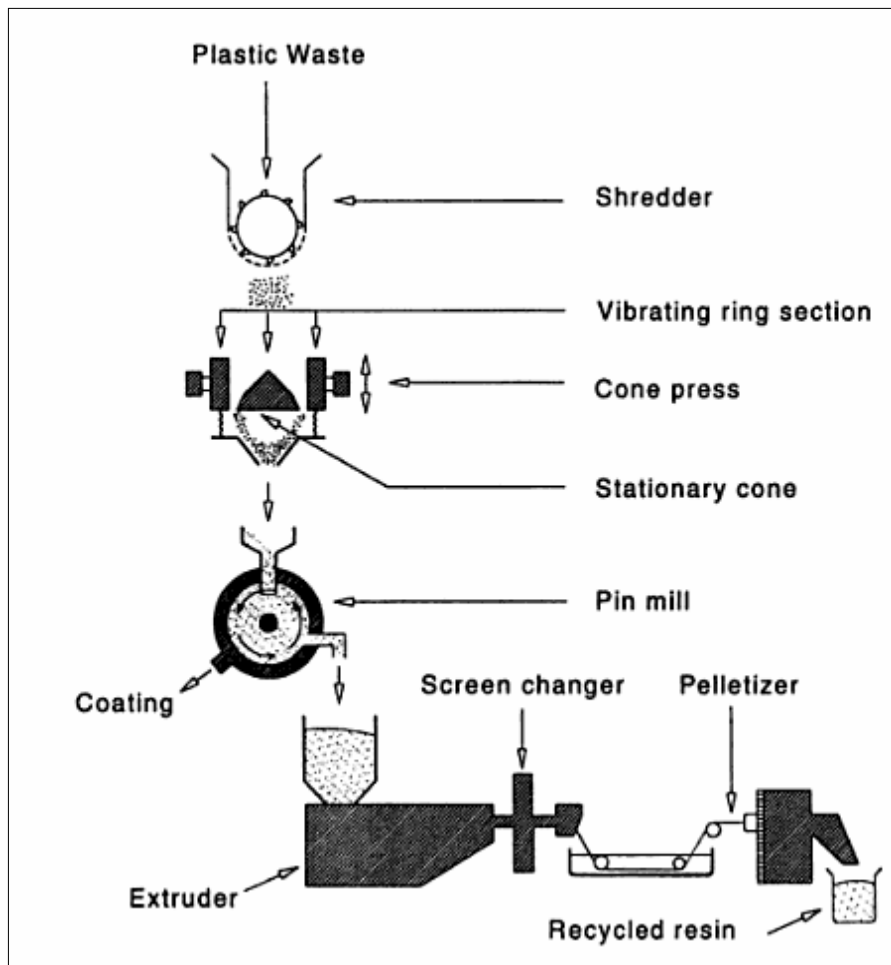


Figure 5. Process of the mechanical recycling of plastics (Aguado & Serrano 1999).

Conclusions. Waste electrical and electronic equipment is a relatively new problem for an economy in development, like that of Romania, flow of waste recycling being integrated in the industry just a few years.

The life of computer equipment is relative short and decreases continuously as a result of rapid changes in the characteristics and performances.

In Romania, the difference between the quantity of equipment put on the market and the amount of equipment collected from consumers is the largest in the European Union. In Romania it is selectively collected about a quarter of the amount of electrical and electronic waste, provided the objectives of European norms (1 kg per inhabitant compared to 4 kg inhabitant to Directive No 2002/96/EC).

Prior to mechanical recycling, plastics must be sorted, either manually by the operators to them finishing in polymer type and/or color, either by automated techniques as x-ray fluorescence, infrared spectroscopy, electrostatic separation, flotation.

Electrostatic separation processes have been developed especially for non-ferrous particles. They can be a viable solution for sorting different types of plastics contained in computer equipment. Market potential of electrostatic separation technologies can be estimated according to the quantities of computer equipment available for recycling and processing capability of the equipment.

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Received: 20 February 2013. Accepted: 25 February 2013. Published online: 21 April 2013.

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How to cite this article:

Salanță O. C., Soporan V. F., Bungărdean C. M., 2013 Considerations on the recovery and recycling of plastic materials from computer equipment in Romania. *AES Bioflux* 5(2):208-214.