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ENVIRONMENTAL CONSTRAINTS IMPOSED ON PLASTIC WASTE OF WEEE DISMANTLING MANAGEMENT

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ABSTRACT. Waste Electric and Electronic Equipment (WEEE) is a special stream of waste, due to the required collection, treatment and recycling conditions. The legislative collection ratio imposed in EU per inhabitant/year is 4 kg; therefore, an increase of collected amount of WEEE is expected. Plastics represent an important flow of dismantled WEEE and an appropriate management of it is requested, due the content in brominated fire retardants compounds. Even the environmental politics are very restrictive in the use of the hazardous compounds in the manufacture of EEE (Electric and Electronic Equipment), these substances are present in the waste, at the product end of life. The aim of this study is to present the environmental risks correlated with the legislative constraints for plastic waste of WEEE, in order to highlight the importance of an appropriate management and of recycling methods.

Key words: *WEEE, waste, plastic recycling.*

INTRODUCTION

The purpose of this study is to correlate the environmental risks with the legislative constraints for plastic waste arising from the dismantling of WEEE to highlight the importance of a proper management and the introduction of the recycling methods.

WEEE is a particular waste stream which has occurred in municipal waste. Herat and collaborators estimated that every year an amount between 20–50 Mt of WEEE is generated over the world (Herat, 2008) and just a small amount of it undergoes recycling, the other part is combusted without recovery of energy or dumped in landfills (Zhang, 2000).

WEEE waste stream is the fastest growing in the EU and is expected to reach 12 million of tons by 2020. The safe collection and the proper management of these waste is essential, because it contain substances that may cause pollution and health problems (Popovici, 2013). The disposal in landfills or the incineration is not recommended as management options for WEEE because of the formation of toxic by-products during combustion and toxic substances to leach to groundwater from landfills (Soderstrom & Marklund, 2002; Weber & Kuch, 2003; Spalvins et al., 2008).

Plastics are an important body part of WEEE dismantled and its proper management is required due to the brominated flame retardant compounds content (figure 1). Even if the environment policy is very restrictive with the use of hazardous components in the manufacture of EEE (electrical and electronic equipment), these substances were founded in waste at the end of life.

Fig.1. *WEEE plastic minced photo: Antoanela Popovici*

The three main types of polybrominated substances used in the manufacture of electronic and electrical devices are: polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE) and bisphenol tetrabromide (BFTTB). Flame retardants are used because of the fire repellent property that they give to the plastics and textiles. Poly-brominated diphenyl ethers placed in plastic composition and used on monitors and televisions components are: pentabrominated diphenyl ether (PBDE) (figure 2), octapolybrominated diphenyl ether (OBDE) and decapolybrominated diphenyl ether (DBDE).

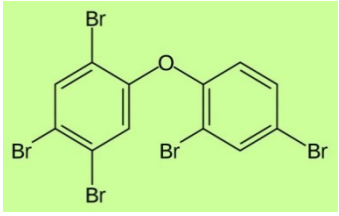

Fig. 2. *The chemical formula of the pentabrominated diphenyl ether PBDE (1,2,4-tribromo-5-(2,4-dibromophenoxy) benzene - IUPAC name) (Source: http://esis.jrc.ec.europa.eu/index.php?PGM=pbt)*

These substances are persistent organic pollutants (POPs) in the environment and are subjected to EC Regulation no. 850/2004 (EC, 2004).

Andersson & Blomkvist reported that PBDEs and PBBs are likely to bioaccumulate (Andersson & Blomkvist, 1981) and it's have been detected in blood (Sjödin, 1999) and human tissue (Fernandez, 2007).

In order to protect and improve the quality of environment and human health, RoHS Directive prohibits the use of PBBs and PBDEs. According to RoHS Directive the maximum allowed concentration of PBDEs and PBBs will be 0.1% by weight of homogeneous material (EC, 2002).

MATERIAL AND METHOD

For the purpose of providing a local data base for future selection of a suitable recycling methods, with the local implementation, were carried out handling operations to a fraction of WEEE with CRT (Cathode Ray Tubes) namely monitors and TVs collected in Romania. For this study were selected a number of 95 electronic waste equipments collected in Romania, especially televisions and PC monitors (Popovici, 2013).

Treatment operations WEEE fractions were subjected were the following:

- Weighing all equipment
- Manual disassembly of the equipment
- Cutting metal tube belt
- Cutting tube
- Remove the metal shield and electron tube
- Absorption of fluorescent powder
- Weighing of the resulting fractions

Brominated plastics occur in different proportions in the composition of the electrical and electronic equipment (EEE) (figure 3) and thus are founded in the generated waste. Due to the environmental pollution with polybrominated substances, the major electronics manufacturers began to phase out the brominated flame retardants contained in plastics.

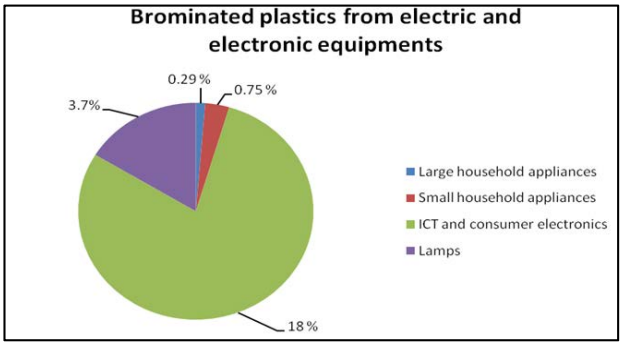

Fig. 3. *The percentage of the brominated plastics present in the electrical and electronic equipment (Source: http://ewasteguide.info/node/4074, processed)*

According to representatives of the Romanian collective organizations of EEE producers, more than 2,500 tons of TVs and monitors CRT were collected in Romania in 2012 (Popovici, 2013).

After the treatment operations, from a total of 1,450 kg of the treated equipment was obtained 133 kg of plastic (Popovici, 2013). The calculations related to the present percentage of the brominated plastics in the EEE (TV, monitors) (figure 3), shows that from 1,450 kg of the treated equipment were obtained 23.94 kg (~ 24 kg) of brominated plastics. Extending the calculation to Romania, in 2012, from 2,500 tons of TVs and monitors collected were obtained by dismantling 229.31 tons of brominated plastic (figure 4).

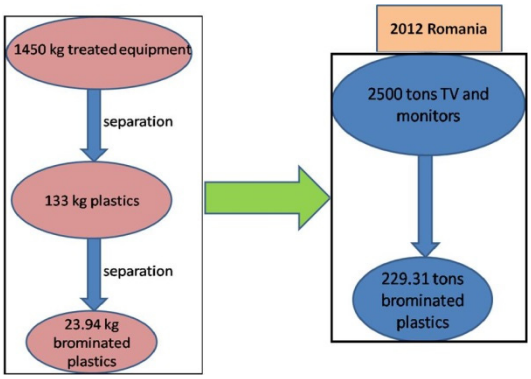

Fig. 4. *The calculated amount of brominated plastic which could be obtain from the WEEE (TV and monitors), in Romania, in 2012*

RESULTS AND DISCUSSION

From the calculations, in 2012 an estimated quantity of 229.31 tons of brominated plastic was landfilled on municipal landfills. According to the conducted studies by Wager and collaborators, the most common polybrominated diphenyl ethers founded in the CRT monitors, are: OEDB and DEDB, which means that these compounds are present in WEEE from monitors and TV (Wager, 2010). For the recycling of brominated flame retardants materials are necessary thermal/ metallurgical processes with a proper treatment of the emitted gases, otherwise this type of waste must be eliminated in the authorized landfills. The recycling of the brominated materials is preferable as management option but the energy recovery can be considered as a second option (Wager, 2010).

In case of the burning plastics containing brominated flame retardants must used appropriate techniques to reduce the fine dust from them to avoid the direct exposure of humans. By burning the brominated materials at low temperatures are released toxic emissions, which can cause serious hormonal disorders. Due to their migration and evaporation from the plastic materials, these substances have been found in the indoors dust and in the air (Wager, 2010).

The Directive on WEEE (EC, 2012) and the Romanian legislation (GD 1037, 2010) provide that plastics containing brominated flame retardants need to be removed from the waste WEEE collected. The legislation also provides very high targets for collection, recycling and reuse of WEEE and the reducing to a minimum landfilling (Iepure, 2012).

The recycling of plastics from WEEE is important because the WEEE Directive sets high targets for recycling. The problem is that there are no widely available operational techniques for separating plastics containing brominated flame retardant substances from the rest of the plastics.

CONCLUSIONS

Because the plastics with brominated flame retardant substances content are not separated during the WEEE dismantling, they reached and will reach on the municipal landfills, even the Romanian regulation restrain this (GD 1037, 2010)

In 2012, in Romania, from the 2,500 tons of WEEE (TV and monitors) have resulted approximately 229.31 tons of brominates plastic waste which reached on municipal landfills. According to the projections, the WEEE waste stream is the fastest growing in the EU, therefore also in Romania. Even if starts the removing of the flame retardants in the plastics manufacture, they still exist in large quantities and it is necessary to find ways for disposal/recycling.

Nomenclature

BFTTB - Bisphenol tetrabromide
DBDE - Decapolybrominated diphenyl ether
EEE - Electric and Electronic Equipment
OBDE - Octapolybrominated diphenyl ether
PBB - Polybrominated biphenyls
PBDE - Polybrominated diphenyl ethers
POPs - Persistent organic pollutants
WEEE - Waste Electric and Electronic Equipment

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