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REUSE OF POLYAMIDES FROM WASTE ELECTRIC AND ELECTRONIC EQUIPMENT IN CONCRETE COMPOSITIONS

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Introduction

The recycling of polymeric components from waste electrical and electronic equipment (WEEE), due to their high amount landfilled that needs to be eliminated from the environment, represents an important concern of the current society. Besides the thermal reprocessing of plastics, that is the main technique that leads to items with technical application, another important way to recycle consists in embedding the micro-plastics in concrete compositions. In our study, plastic components of WEEE, considered to be composed by polyamides (PA), were used to obtain concrete samples for different applications.

Polyamides are crystalline polymers obtained by polycondensation starting from a diamine and a diacid. Usually known as Nylon, the most used polyamides are PA 6, PA 66, and PA 610, the numbers referring to the carbon atoms present in the molecular structures of the acid and amine. In EEE, PA is used for central processing units, connectors, and other small EEE, Figure 1.

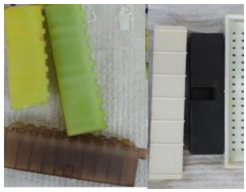

Fig.1. Used recycled items

Materials and methods

Different connectors from internal pieces of electric and electronic equipment were initially considered for testing (from floppy disk drives, motherboards, etc). The polyamide composition was separated from WEEE after a complete characterization by different techniques: burning test, solubility, density, Fourier transform infrared spectroscopy (FTIR), and thermal analysis. After identification, the plastic parts were finely cut as powder of 1-2 mm using a cutting mill SM 300, Retsch. Concrete samples of 4 cm^3 based on gypsum, sand and WEEE polyamides were obtained. The porosity, compactness, water absorption, and compressive strength of the obtained samples were analysed.

Results and conclusions

The burning test can be used for an initial identification of plastic materials based on the type of flame (color, intensity), odor, smoke, and ash. After flame, PA items burned slowly with melting and self-extinguishing. The odor was similar to celery, and no ash resulted after burning.

The solubility of polyamides was tested in different solvents, and satisfying results were obtained using formic acid. Densities of 1.12-1.17 g/cm^3 were obtained.

FTIR analysis highlighted the specific absorption band of polyamides and thermal transitions specific to PA were observed by DSC analysis, Figure 2.

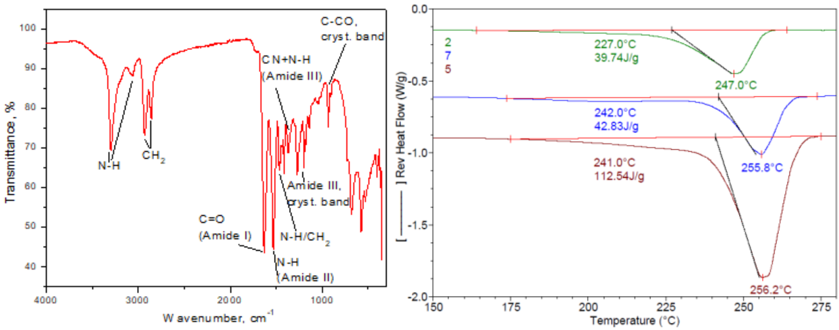

Fig. 2. FTIR spectrum and DSC results for polyamides identification

Concrete samples were obtained using 10% polymeric waste into sand/gypsum composition, Figure 3. It was observed that the addition of WEEE powder in the concrete sample's composition did not significantly alter the compressive strength. The prepared samples had uniform composition and lower density, are less porous and more compact. In addition, it has been observed that the water absorption of stone samples modified with WEEE polymer decreased in comparison with the control sample.

Fig.3. Aspect of concrete sample containing the WEEE polyamides

The resulting polyamide fraction, after separation of the other component polymers of WEEE, has been used as an additive material in the production of low-weight concrete samples, with low humidity absorption and improved antiphonal properties usable for interior walls in building construction.

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