DEGRADATION OF PLASTIC TOYS WITHOUT ELECTRONIC DEVICES

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Introduction

Figure 1. Types of toys

The slow degradation of plastic toys from municipal solid waste landfills has caused their accumulation in the natural and aquatic environment (Achilias, 2007). The consequences of plastic waste in the environment have been: the impact on fauna, the uncontrolled combustion of plastic waste and the slow degradation.

Fauna commonly confuse waste with food or become trapped and present asphyxia, lacerations, infections, decreased reproduction and mortality (Cho, 2009; Waluda & Staniland, 2013; UNEP-NOAA, 2012; Li, Tse, & Fok, 2016).

Although no one knows for sure, the degradation of plastics can last up to 300 years. Aging tests have not been carried out for the particular case of toys. For this reason, it was decided to carry out the degradation tests of plastic toys without electronic devices in four types of toys: superhero-type dolls (SAN polymer), wrestler dolls (PE polymer), baby dolls (PVC polymer) and dolls (PVC and ABS polymer), using an accelerated weathering chamber.

Methodology

The toys that were analyzed to determine their degradation are shown in Figure 1. Their dimensions and weight were used as control parameters. The identification of the plastics that make up the toys was carried out with the help of a Perkin Elmer Spectrum Two model FTIR-UATR spectrophotometer. However, the spectra of each toy presented other compounds or additives, that is, plastics are not made up of just one polymer.

The methods used in this work to test the loss of physical properties of plastics were taken from the international standard used in general for accelerated weathering chamber tests, ASTM G151 and ASTM G154, which establishes that plastics must be placed in triplicate and maximum and minimum conditions of temperature and humidity of the climatological conditions of the study area, as well as the simulation of solar radiation by means of an ultraviolet fluorescent lamp with a wavelength of 340 nm.

The toys were randomly placed inside the weathering chamber and the weather conditions (40 to 2 degrees Celsius, 60 to 40 percent of humidity; and ultraviolet radiation) of the municipality of Colón, Querétaro, for a simulated period of time of 219 hours equivalent to 3 years. The weight of the toys was measured every 73 hours (1 year simulated).

Figure 2. Accelerated weathering chamber

Results & Discussion

Upon completion of the accelerated weathering chamber tests, the toys were reweighed and measured. The only ones who presented a difference between the weight at the beginning and at the end of the test were the wrestlers and the baby dolls. The others maintained their same weight and dimensions.

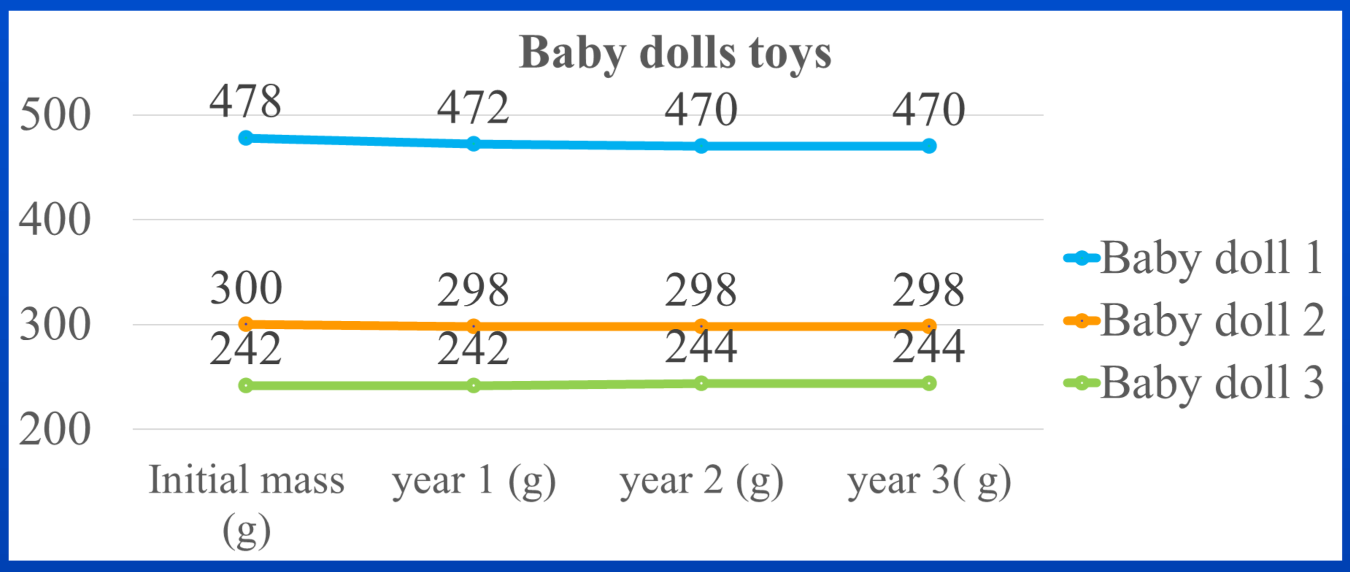

Figure 3. Behavior of baby dolls mass respect to time

Two of the baby dolls decreased their weight by 1.6 and 0.6% respectively. This could be due to the fact that one of them had a strong aroma, characteristic of PVC plasticizer additives. The structure of PVC is too rigid and must contain a good amount of this additive to achieve its flexibility.

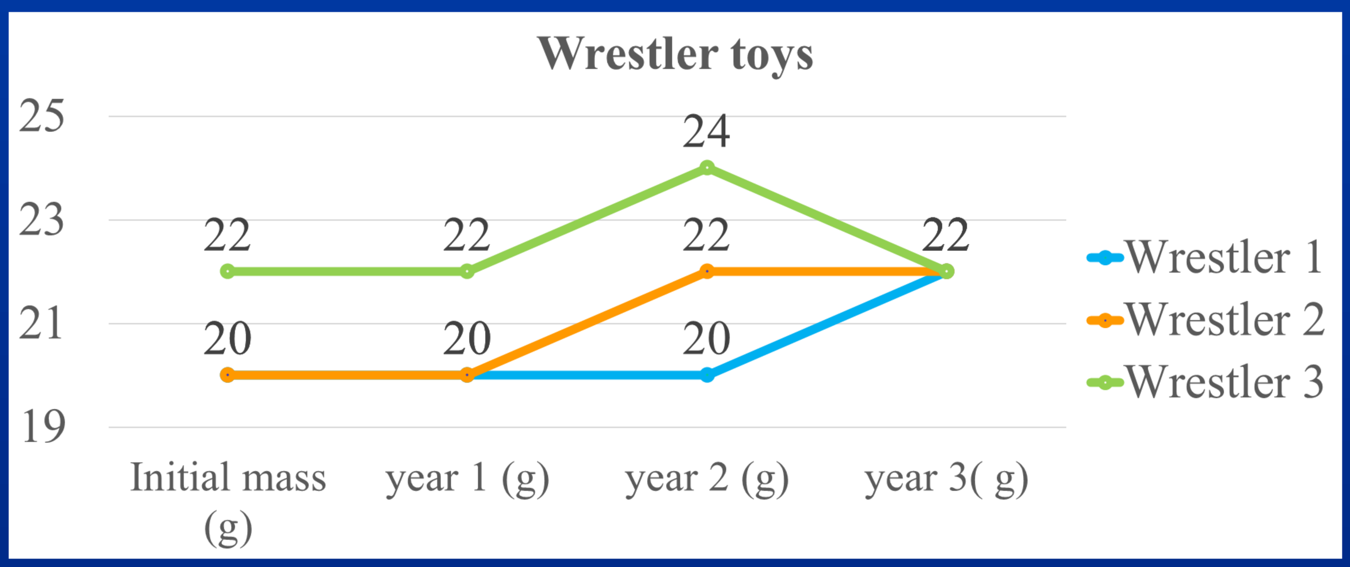

Figure 4. Behavior of wrestler mass respect to time

In the case of the wrestler dolls, only 2 increased their weight by 1% caused by the expansion of the plastic, despite the fact that the type of plastic is rigid.

Conclusions

The degradation of this type of toys will take a long time and will harm the environment. It could be recommended that a management plan for toys with these characteristics be developed, where manufacturers can implement a circular economy in the recovery of toys and reuse them to develop new, or failing that, other companies can process their products with discarded toys.

References

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