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The implementation of polycaprolactone (PCL) as an eco-friendly material in toy design development

ABSTRACT

Due to a substantial impact of hazardous materials in toy design, numerous toy companies have opted for an eco-friendly toy by promoting a legacy of innovation rather than waste and degradation. Furthermore, one of the most significant polymers for being recognised as a safe toy material is Polycaprolactone (PCL). However, in Malaysia, the study of Malaysian parent's level of awareness in buying eco-friendly toys, their behaviour in purchasing and managing toys at home, as well as the preferences of play type for their children, is not widely discussed. Thus, forty (40) Malaysian parents have participated in an online survey conducted by the research team. The result of the study found that most Malaysian parents has a low level of awareness in buying eco-friendly toys for their children, lack the skills needed in handling broken or unused toys, and have selected criteria to be considered when purchasing a toy. Furthermore, a set of semi-working toy design was successfully developed using PCL as a proposal for potential future development and production. It is hoped that the outcome of this study will contribute to inspire future toy designers to account for Malaysian parent's preferences when developing eco-friendly toys.

KEY WORDS
Design thinking, sustainability, polycaprolactone, toy design, eco-friendly, product design

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Introduction

Nowadays, environmentalists are concerned about how plastic takes account to about 90 per cent of the toys market, especially in terms of how toys are contributing to health and environmental effects. According to Babayemi et al. (2018), worldwide plastic creation expanded from 1.5 million tons (Mt) every year in 1950 to 245 Mt in 2008, and it has been projected that it could significantly increase by 2050. Its utilization has expanded twentyfold in the past 50 years and is expected to double again in the following twenty years. Plastics present a convoluted waste management challenge at their finish of life, albeit plastic is a waste stream with recycling and recuperation potential. The challenge of plastic waste management, particularly recycling, is quick turning into a worldwide issue. Compared to the rate at which virgin plastics are produced, the rate of recycling lags far behind, and a much higher extent of plastics is being discarded in landfills, dumpsites, and ocean than at any other time. This disposition transforms the Arctic Ocean ice into a sink for micro-plastics and can last in the marine condition for many years.

In addition, during recycling the emission of volatile organic compounds may pose acute and chronic health risks in the recycling process. A wide scope of plastics contains endocrine-disrupting chemicals, for example, phthalates or brominated or chlorinated flame retardants. Such contaminants are not usually taken out in the recycling of household plastic (Hahladakis et al., 2015). According to Ismail et al. (2020), the most commonly utilized plastic material in the assembly of delicate children toys are polyvinyl chloride (PVC), which have been