

Title: **Recycled HDPE from milk bottles: Cross-contamination problems and possible solutions**

Main Author:

Name: Aymara Blanco Romero
Organization: Rey Juan Carlos University
Country: Spain

Co-Authors:

Co-author 1: Rafael Juan Rodríguez
Organization: Rey Juan Carlos University
Country: Spain
Co-author 2: Carlos Domínguez Vizcaya
Organization: Rey Juan Carlos University
Country: Spain
Co-author 3: Beatriz Paredes Martinez
Organization: Rey Juan Carlos University
Country: Spain
Co-author 4: Rafael A. García-Muñoz
Organization: Rey Juan Carlos University
Country: Spain

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Images:

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Abstract:

Plastics play a very important role in the packaging sector as they provide protection and preservation to food, keeping its quality and avoiding its waste. They are light, and therefore saving fuel and CO₂ emissions during transport. However, plastics entail problems such as the high generation of waste due to their easy production and low cost manufacturing and their single-use applications in many cases. Moreover, the incorrect waste management of plastic debris causes a major environmental pollution.¹ The Circular Economy (CE) system is bringing some light to reduce these concerns. CE is based on waste management through the 3R's (Reducing, Recycling, Reusing). Nowadays, mechanical recycling is the most widely used recycling method for thermoplastic polymers. It consists of four stages, classification, separation, washing and extrusion. Recyclates can be mainly of two types, post-consumer (PC) and post-industrial (PI). PC are those plastics that have completed their expected use and have been discarded, while PI, also called scrap, are those that have undergone transformation in an industrial process, but due to defects or other problems, have not been distributed. Therefore, PC are more exposed to impurities and degradation phenomena.²

The present work is focussed on recycled HDPE (rPE) obtained from post-consumer milk bottles, which are commonly contaminated with PP, since it is the polymer used to make the bottle caps. The integration of polyolefins of similar densities (PP and PE) in the same recycling flow constitutes a problem that introduces a PP cross-contamination in HDPE recyclates.³ Hence, the effect of rPP contamination from post-industrial caps on the post-industrial properties of HDPE milk bottles is investigated through various contamination scenarios ranging from 2.5 to 7.5 wt.%, from the minimum to the maximum content, in order to cover different separation efficiencies. A deep mechanical characterization of blends prepared in a twin-screw extruder has been carried out. Different approaches to improve the mechanical properties of these recyclates have been explored, highlighting the use of compatibilizing agents⁴ that allows finding new opportunities for these recycled HDPE and enhance the circular economy in this sector.