Utilization of polyethylene waste for designing foamy oil sorbents

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Recycling low-density polyethylene (LDPE) in its original form presents several challenges, including limited interest from converters, poor market demand for recycled products, higher sorting and cleaning costs, and reduced quality in the final products. It happens because recycled LDPE often exhibits lower mechanical strength and diminished aesthetic appeal than its virgin counterpart, making it rarely suitable for its original purpose, especially in packaging. Therefore, new applications for LDPE recyclates are needed to overcome these barriers and extend the material's lifecycle. One such solution involves converting LDPE waste into foamy sorbents for water purification.

The presented study investigated two strategies for recycling LDPE waste by exploring the potential of the modified waste to remove free oil spills. The first approach involves preparing and characterizing robust, mechanically stable foams using recycled waste from LDPE packaging. The process is based on parallel foaming and crosslinking of LDPE by peroxides. The final foamy structure (Foam 1) possesses around 75 vol.% of pores (46 vol.% open pores) and rapidly absorbs various organic liquids quickly (hexane, diesel oil, crude oil) in multiple cycles. The second target deals with the screening, testing, and characterizing LDPE-based foams that were initially used for various packaging and deposited as waste to explore their potential free oil sorbents. The foam that was used in this study has a significantly porous structure, having 96 vol.% of pores and more than 89 vol.% open pores (Foam 2). Whereas the sorption capacity of Foam 1 was 4-5 g/g, depending on the type of oil, Foam 2 absorbed those oils in the range of 8-12 g/g. The Foam 1 showed significantly better stability over multiple cycles and better mechanical performance.

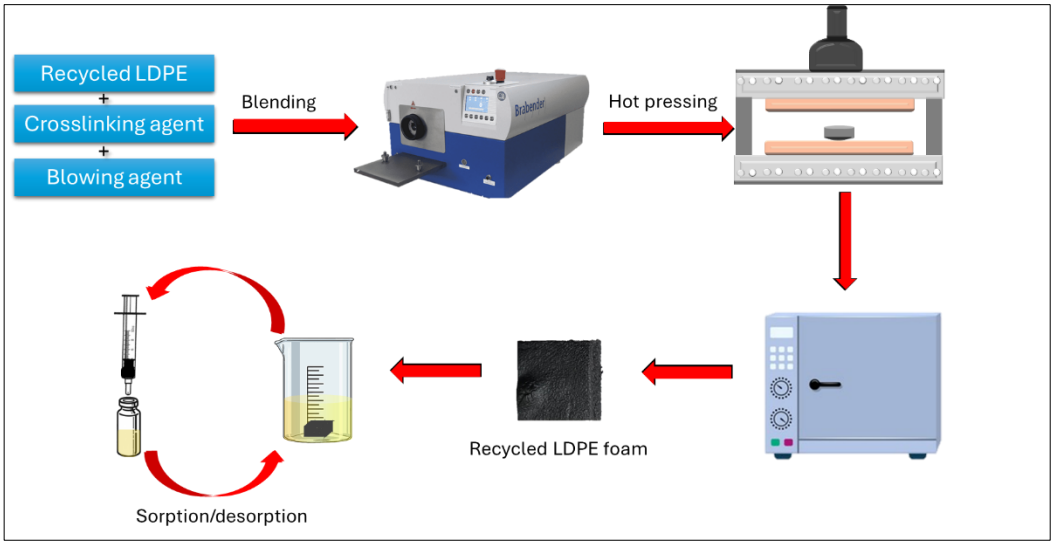

Figure 1. Graphical abstract of the preparation and application process of fabricated waste LDPE foams.