PROCESS FOR THE DECONTAMINATION OF RECYCLED PLASTIC

TECNOLOGÍA PATENTADA

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RESUMEN

The University of Alicante **research group E4CE (Engineering for Circular Economy)** has developed a procedure for the **decontamination of recycled plastic materials**.

This technology's innovation lies in the decontamination stage carried out by extraction using a water-soluble extracting agent and rinsing.

This technology eliminates contaminants present in the recycled plastics to improve their quality to be used in high added value applications.

The technology, which is protected by a patent application, has been developed on a laboratory scale. Companies interested in the commercial exploitation of this technology through license agreements and/or technical cooperation are sought.



INTRODUCCIÓN

Due to the continuous increase in the use of plastic products, the generation of this waste has become a global problem in today's society, so its recycling and subsequent use as a raw material are necessary to reduce the amount of plastic going to landfills. At the same time, the use of plastic as a raw material lowers production costs and increases the added value of the product, since there is a growing awareness of the need to take care of the environment. Consequently, the demand for recycled products in the market increases.

While plastic waste from industries can be treated by mechanical recycling to obtain high-quality material, domestic plastic waste has a high content of food scraps and cleaning products absorbed into the polymeric matrix, becoming contaminants. Besides, waste sorting technologies are not fully developed. Thus, a high-grade plastic (for example, packaging) contains impurities from another, less pure material in the manufacture of used additives that may pose a danger to the consumer (e.g., bisphenol A, phthalates, etc.).

The contaminants that can be removed by the conventional mechanical method are mostly physical impurities such as soil, dust, surface organic residues, etc. However, the technology is not sufficiently developed in the case of chemical pollutants within the plastic matrix and contaminants adhered to the plastic's surface by the use of adhesives (for example, paper labels).

Of the technologies patented to date, practically all have some limitation, and none of them remove organic contaminants such as NIAS (unintentionally added compounds: degradation products of the plastic itself, by-products, adhesive residues, impurities from the previous stages of use, etc.) including both volatile and heavy components. Existing technologies only remove volatile organic compounds (VOCs), oxidizable compounds, and water-soluble contaminants.

DESCRIPCIÓN TÉCNICA

To improve the quality of recycled plastics, the research group E4CE has developed a procedure for removing organic contaminants (NIAS) in recycled plastic materials that work at atmospheric pressure using a non-volatile and water-soluble extracting agent.

These contaminants are found both inside the polymer matrix and on the surface of the plastic. Organic compounds have been shown to migrate from the plastic matrix into the solvent, thus reducing their concentration in the plastic.

The **procedure for the decontamination of recycled plastic** developed at the University of Alicante consists of the following stages (*Figure 1*):

1. **Separation and shredding of the plastic:** separation can be carried out using identification techniques such as NIR (near-infrared spectroscopy), MIR (middle-infrared spectroscopy), infrared thermography, LIBS (Laser-induced breakdown spectroscopy), or X-ray fluorescence. While shredding is carried out by a blade crusher, a mill, or cryogenic shredder, to reduce the size of the material to flake or dust.

2. **Washing** (with or without surfactant, oxidizing agents can also be used to remove surface impurities), rinsing, and drying (mechanically).

3. **Decontamination** carried out in the decontamination module, where the contaminants and additives present in the recycled plastic are removed.

4. **Water recovery and extracting agent recovery systems** to be recirculated and reused, making the process sustainable.

Water recovery can be carried out by ultrafiltration and flocculation-decantation, or by crystallization and flocculation-decantation. Meanwhile, solvent recovery is carried out employing ultrafiltration membranes and subsequent filtering.

It should be noted that the decontamination stage is carried out independently from the conventional recycling process so that its input can be plastic already recycled from other recyclers. Therefore, it is a system for improving the quality of the recycled product (upgrading).

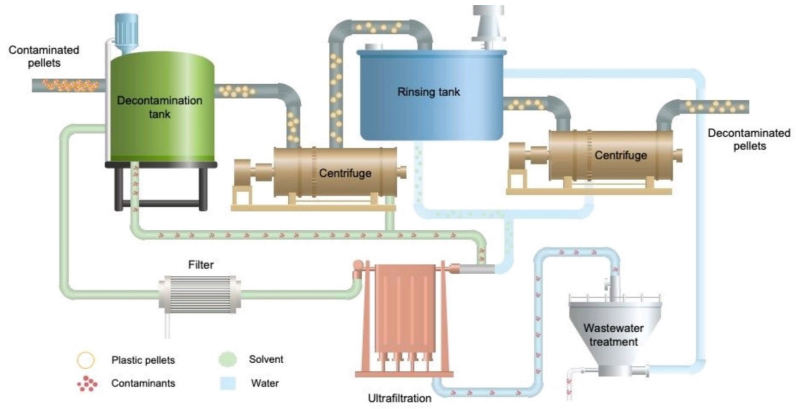


Figure 1. Schematic diagram of the extractor's decontamination and recovery unit.

VENTAJAS Y ASPECTOS INNOVADORES

MAIN ADVANTAGES OF THE TECHNOLOGY

This technology has the following advantages:

- It improves the quality of recycled plastics regardless of their origin, whether post-industrial or post-consumer. Therefore, it solves, to a certain extent, the problem of recycling domestic plastic waste, increasing its recyclability.
- A recycled material free of organic contaminants is obtained, increasing the added value of the product.
- By increasing the quality of recycled plastic, the range of new opportunities for these materials will expand because they can be used in many applications (e.g., packaging in the cosmetics, hygiene, and food sectors).
- It removes a broader range of organic compounds, from the most volatile to the heaviest.
- It is a sustainable procedure, as it allows recirculation and reuse of both water and the extracting agent
- By working at atmospheric pressure, the technology is simple and easy to implement.
- The decontamination module can act as an independent module for the recycling process. In this case, the input to the process would be the recycled pellets, and it can become a system for improving the quality of the product already recycled by other companies.
- The decontamination stage can be carried out before or after regranulation.
- Only nontoxic agents are used in the process.

INNOVATIVE ASPECTS

This procedure introduces two innovative aspects concerning existing technologies on the market.

It is a method capable of removing non-volatile contaminants present in the plastic. The existing technologies on the market cannot eliminate non-volatile pollutants, which is a limitation when introducing recycled plastic into such essential sectors as food or pharmacy.

On the other hand, as it is a closed cycle where all the extracting agent and the water used are recovered, the process is sustainable both from an environmental and economic point of view.

ESTADO ACTUAL

The system has been developed on a laboratory scale, treating approximately 0.1 kg/h of plastic, depending on its origin.

It has been tested with plastics of different natures: PE (polyethylene), PP (polypropylene), and PET (polyethylene terephthalate).

It would be necessary for its commercialization to build a demonstration plant that processes 500 kg/h to validate the technology and the products obtained.

APLICACIONES DE LA OFERTA

The novel process described above allows the decontamination of plastics from household and industrial sources. This process is intended to remove contaminants, and with them, unintentionally added compounds (NIAS) found in the plastic matrix and surface, dirt such as solid particles, adhesive residues, or labels.

This invention is framed in the field of the processing of plastics of varied nature, such as PE, PP, PET, etc., coming from the plastic waste, either of industrial or domestic origin.

COLABORACIÓN BUSCADA

Companies interested in acquiring this technology for commercial exploitation through technology transfer agreements (see below) are sought:

- Patent license agreements.
- Technical cooperation agreements (R&D projects) for using the technology or application in other waste or sectors.
- Partners for a technology-based company to implement this technology.

Profiles of companies sought:

- Recycling of plastic waste.
- Manufacturers of plastic packaging.
- Producers of virgin raw material.

DERECHOS DE PROPIEDAD INTELECTUAL

A patent application protects this technology:

- Title of the patent: "Procedure for the decontamination of recycled plastic."
- Application number: P201931143.
- Application date: December 20, 2019.

SECTORES DE APLICACIÓN (2)