

Abstract

The present biodegradation process consists in the use of a fungus, *Paecilomyces lilacinus* IMI 117109, for the degradation of commercial ground tyre rubber. Prior to the biodegradation treatment, the tyre crushing is washed to eliminate possible contaminations that may interfere with the process. Subsequently the fungus is cultured in the presence of the tyre rubber in a liquid medium and shaking conditions. In a second step, the excess of liquid medium is removed. After the incubation period, the growth of the fungus in the material can be observed and its degradation is showed. This process of fungal biodegradation is an alternative to the degradation processes currently employed, allowing to reduce the accumulation of used tyre rubber and taking advantage of the products of its biodegradation for its reuse in the tyre industry or its use in other industrial processes.

Overview

The latest official data indicate that in Spain more than 250,000 tonnes of used tyres are generated annually and it is estimated that there are approximately 4 million tonnes more accumulated in landfills. The current legislation requires the elimination of tyre dumps and the management of the waste by those responsible for placing it on the market.

During the last years biodegradation processes applied to polluting materials have been developed with a view to the subsequent use and reuse of their components. The biodegradation of rubber is a matter of great interest because it could be a complementary path to the existing tyre management.

The process of vulcanization suffered by natural rubber in tyres is responsible for its desirable mechanical and thermal properties but, at the same time, it makes more complex to reuse them. This process forms disulfide bridges between the polymer chains. Further steps during the manufacture of the tyres involve the addition of multiple additives, required for vulcanization or the acquisition of various properties in the final product. Such additives are mostly toxic, introducing an additional problem to the biodegradation process.

In this patent a biodegradation process for commercial ground tyre rubber (**Fig. 1**) is described using the fungus *Paecilomyces lilacinus* IMI 117109. Fungal growth is an unmistakable sign of the biodegradation process that is taking place in tyre grinding (**Fig. 2**).



Fig. 1 Commercial ground tyre rubber used as starting material.

Description and main features of the invention

1) Minimal culture medium

In order to carry out the biodegradation of the commercial ground tyre rubber the fungus is cultivated in a liquid medium of mineral salts in which the tyre crushing constitutes the only source of carbon for the microorganism.



Fig.2 Low temperature scanning electron microscopy (LT-SEM) image of the fungus growing inside the commercial ground tyre rubber.

2) Material cleanness

Prior to the incubation of the tyre with the fungus, the grind is washed under certain conditions: ratio of crushed weight / volume of sterile water used, temperature, agitation and time. This washing removes the organic residues and microorganisms that could interfere or displace the biodegradation reaction.

3) Two-phase cultivation

The cultivation of the fungus with the ground tyres in the medium of mineral salts is carried out in two phases. In the first one an excess of liquid medium and agitation is used. This phase is necessary for the activation and correct distribution of the fungus in the material. In the second phase, the excess of liquid medium is removed, leaving a static solid-wet culture, in which the fungus continues growing on the crushed.

4) Possibility of using other microorganisms

This biodegradation process can be applied employing other microorganisms as long as they possess the metabolic capabilities for the degradation of the ground tyre, adapting the culture conditions to the particular physiology of the selected microorganism.

Patent information

Title: Procedimiento de biodegradación fúngica de triturado de neumáticos.

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Publication number: ES 2 293 864 (A1) (B2)

CPC: C08J11/10; C12N1/14; Y02W30/702

Application number: 200703236

IPC: C08J11/10; C12N1/14

Priority date: 2007-12-05