



Fungi may be Able to Degrade Tough Plastic

A recent American study shows for the first time that any organism, in particular fungi, can degrade phenolic resins, widely used in plastic formulations. The finding is an important first step towards the biodegradation and recycling of these compounds, which are known for their durability and resistance to attack by termites and fungi. Nevertheless, more research is necessary to better understand the mechanisms and controlling factors before it can be widely applied and commercially available.

Phenolic resins (PR) are synthetic polymers that have various commercial, industrial and manufacturing applications, particularly in the construction industry. They are used as industrial adhesives and in heavy-duty automotive parts, such as the plastic trim on car bodies and the plastic containers that hold air filters. They cannot be melted and remoulded like other plastics and they are resistant to the attack of fungi and termites, characteristics that make them a very valuable construction material. On the other hand, these same properties also make them extremely difficult to degrade and recycle. For this reason, after disposal, most PR ends up in landfills. There is increasing interest, such as the EU's "End-of-Life Vehicle" programme, as well as from PR manufacturers, for finding methods and techniques to recycle this material, and the use of fungi to biodegrade PR during recycling processes could be an attractive alternative.

Recently, researchers have tested whether wood-rotting fungi, which have been previously reported to decompose other organic pollutants such as DDT, TNT, and PCBs, could also degrade phenolic resins. They used a generic industrial formula to make the phenolic resins and placed them in cultures with the fungi. The researchers tested 11 different strains of fungi, including 5 species of white-rot and 1 species of brown-rot fungus.

The researchers first realised that the white-rot fungus was degrading the phenolic resins when they observed that the colour changed from yellow to a light pink, the colour of the phenol and formaldehyde molecules, components used to make the resins. The presence of those subunits was further verified using other laboratory techniques (gas chromatography and ¹³C analysis).

The finding that white-rot fungi can degrade phenolic resins is a significant discovery that provides new understanding of the mechanism of their degradation. The ability of white-rot fungi to create easily recoverable by-products from PR in a short period of time could be incorporated into a large-scale PR recycling process. This application would be of interest to the PR manufacturing, recycling and waste management industries. Being able to recycle phenolic resins would help to reduce the disposal of this type of material into landfills.

Nevertheless, this finding is just a first step. More investigation is required to understand better the factors that affect the process and how this process might be utilised and applied during recycling on a large scale.

The current study is the first one to demonstrate that the degradation of phenolic resins by fungi is possible and therefore it has valuable research implications, but its application for recycling requires further research.

Source: Adam C. Gusse, Paul D. Miller, and, and Thomas J. Volk (2006) "White-Rot Fungi Demonstrate First Biodegradation of Phenolic Resin", Environ. Sci. Technol. 40(13):4196 - 4199

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