Microencapsulated natural antioxidants as depollutant materials

Francisca Arán-Ais
Henoc Pérez Aguilar

INESCOP. Centre for Technology and Innovation. P. I. Campo Alto. C/ Alemania, 102. 03600 Elda-Alicante, Spain.

aran@inescop.es

Abstract

Hexavalent chromium is a substance harmful to health, which Directive 98/98/EC classified as a Category 1 carcinogen by inhalation, while direct contact with the skin produces the same effect. In addition, hexavalent chromium is also classified as an allergenic compound. The maximum concentration of chromium (VI) allowed for direct contact with human skin is laid down by Regulation (EU) 301/2014 (amending Annex XVII to Regulation EC Nº 1907/2006 of the REACH).

Hexavalent chromium is used for the production of stainless steel, textile dyes, wood conservation, leather, and as anti-corrosion coatings, among other applications.

The current chromium pollution problem is due to an uncontrolled discharge of chromium to the environment. This uncontrolled discharge is caused mainly by collecting systems from industrial wastewater effluents. Although specific technological processes for the removal of heavy metals from wastewater have been developed, their implementation is highly expensive and these compounds are very often employed in the industry.

This study proposes a solution to reduce the presence of chromium (VI) in wastewater by a reduction process from chromium (VI) to chromium (III), based on the use of natural antioxidants.

Nevertheless, the problem of using antioxidants is their low resistance to the technological processes and the different environmental conditions, such as the pH, the oxygen in the atmosphere or the temperature. In this sense, microencapsulation technology could increase the shelf life of a bioactive substance, such as antioxidants, and promote their controlled release under pre-established conditions.

In this study, a modified complex coacervation technique has been used for the microencapsulation of different natural antioxidants. The results obtained indicate that synthesised microcapsules are able to reduce up to 99% of the hexavalent chromium present in aqueous media in short contact times and low concentrations.

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