CUSTOM BIOSYNTHESIS OF POLYHYDROXYALKANOATES : TOWARDS POLYMERS WITH PROGRAMMED (BIO)DEGRADATION?

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Polyhydroxyalkanoates (PHAs) are polyesters of bacterial origin, making up a very promising family of polymers in terms of both their properties for use and their environmental impact. For a large number of marine and terrestrial bacteria, PHAs are an ideal carbon and energy storage material, due to their low solubility and high molar mass [1]. The chemical composition (nature of the monomer units making up PHAs and their proportion in the chain) and therefore the physico-chemical properties of PHAs depend closely on the bacterial strain and the carbon sources available.

Firstly, the conference will present various examples of PHA production in order to show how the choice of substrates incorporated at the start of the biosynthesis process can influence the chemical structure and morphology of the PHAs produced and thus adjust their physico-chemical and functional properties. A number of studies illustrating the 'custom' production of PHAs will be developed, using both commercial substrates [2] and co-products from industrial effluents [3,4]. In-depth work has been carried out on a Halomonas strain, of marine origin, to characterise it and exploit it as advantageously as possible [5].

Secondly, recent results obtained using different approaches will illustrate the ability of these polymers to biodegrade very spectacularly in a marine environment. Significant differences in behaviour have been observed with regard to the composition and morphology of PHAs [6]. The main factors intrinsic to PHAs (chemical structure, molar mass, free volume, glass transition, mobility, crystallinity, solubility, hydrophilic/hydrophobic balance, etc.) will be explained and it will be shown to what extent they can influence the behaviour of polymers with regard to biodegradation, particularly in a marine environment [7,8]. In this environment, understanding the mechanisms of biofouling is also a key issue for assessing the ecological impact and fate of plastics. Assessments of the physical surface properties of polymers (hydrophobicity and roughness) combined with microbiological characterisation of the biofilm (cell counts, taxonomy, composition and heterotrophic activity) have been carried out using a wide range of techniques [9-11]. Taken together, these studies provide original data and new insights into the colonisation of HAPs by marine micro-organisms.

The results already obtained and those to come are aimed at developing models to help in the design of 'tailor-made' (bio)degradable polymers. Their (bio)degradation could be controlled, or even programmed, by playing on previously identified physical and chemical factors intrinsic to PHAs, as well as extrinsic factors relating to the environment.

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