

SYNTHESIS AND CHARACTERISATION OF NANO-FILMS OF HYDROLYSABLE SYNTHETIC BIODEGRADABLE POLYMERS

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ABSTRACT: Biodegradation is the natural process by which organic chemicals in the environment are converted to simpler compounds, mineralized and redistributed through elemental cycles. Biodegradation can occur within the biosphere and micro organisms play a central role in the biodegradation process. A polymer material is called biodegradable if all its organic components undergo a total biodegradation. Hydrolysable polymers such as poly esters are often more prone to degradation but at the same time are often less suitable than hydrophobic polymers for many technical applications. Aliphatic homo polyesters such as poly (tetra methylene adipate (PTMA) and block copolymers such as poly (ethylene succinate)-b-poly (ethylene glycol) (PES/PEG) and poly (ethylene succinate)-b-(tetra methylene glycol) (PEG/PTMG) have been synthesized and the materials obtained showed thermoplastic elastomer behavior. The synthetic hydrolysable poly anhydrides are useful to biomedical applications due to the fiber forming properties. The aliphatic polycarbonate is useful as a biodegradable polymer for medical applications which displays hydrolytic degradation.

Key words: Biodegradation, Synthesis, Characterization, Nanofilms, Poly ethylene glycol, Aliphatic homo polyesters, Aliphatic polycarbonates

I. INTRODUCTION

Biodegradation is an event which takes place through the action of enzymes and / or chemical decomposition associated with living organisms (bacteria, fungi etc.) or their secretion products. Biodegradation might be better used as a term only when it is essential to distinguish clearly between the action of living organisms and other degradation modes (e.g. photolysis, oxidation, hydrolysis). Complex macromolecules such as lignin are extremely inert while synthetic polymers with hydrolysable backbones such as aliphatic polyesters are accessible to the biodegradative action of esterases despite the usual specificity of these particular enzymes.

Hydrophobicity is often regarded as a major obstacle to microbial (biodegradation) attack on polymers. Addition of surfactants in degradation studies with poly ethylene showed a considerable increase in the biodegradation rate compared with samples without surfactants (1). Ongoing studies incorporate surfactants in poly ethylene showing promising results as observed by attenuated total reflection Infrared spectroscopy, Differential Scanning Calorimetry (DSC) and Scanning Electron Microscopy (SEM) (2). *Bacillus cereus* (hay-bacterium) with a hydrophobic surface adheres most readily to propylene diene ter co polymers and low density polyethylene LDPE (3).

Synthetic hydrolysable polymers such as poly esters, poly carbonates, poly anhydrides and poly (amino acids) have been synthesized using traditional natural polymers like poly saccharides, proteins and lipids. Hydrolysable polymers such as poly esters are often more prone to degradation but at the same time are often less suitable than hydrophobic polymers for many technical applications (4).

In the present investigation aliphatic homo polyesters such as poly (tetra methylene adipate) (PTMA) and block copolymers such as poly (ethylene succinate)-b-poly (ethylene glycol) PES/PEG and poly (ethyl succinate)-b-poly (tetra methylene glycol) PES/PTMG have been synthesized and their subsequent hydrolytic degradation has been studied.

II. EXPERIMENTAL PROCEDURE

The grades of polymers used in the present investigation are poly (ethylene glycol) (PEO) (BDH, England) of molecular weights 6×10^3 and 1.4×10^4 . pH measurements were carried out by pH meter (Polmon) with an accuracy of ± 0.01 . The experimental solutions were maintained at the required temperature with an ultra-thermostat (1EC-RANDS SBC) with a thermal stability of $\pm 0.01^\circ\text{C}$.

A. Mechanical study:

Mechanical studies of the samples were performed by Instron made AGS-10 KNG Shimadzu (Japan). PTMA and block copolymers such as poly (ethylene succinate)-b-poly ethylene glycol (PES/PTMG) and poly ethylene succinate)-b-poly (tetra methylene glycol) PES/PTMG have been synthesized by various polymerization methods and their subsequent hydrolytic degradation has been studied in a pseudo cellular fluid buffered at pH 7.3 and maintained at 37°C .

Poly (tri methylene carbonate) has been synthesized using cationic and anionic initiators giving high molecular weight compounds. Aliphatic polycarbonates are derived from the polymerization of six membered ring molecules.

III. RESULTS AND DISCUSSION

An increase in the aliphatic chain length between the acid groups not only increases the molecular weight but also notably improves the hydrolytic stability (5,6). The linear macromolecule degrades to the monomers at high temperature.

It has been observed from the mechanical studies that the materials obtained showed thermoplastic elastomer behavior, the degradation rate depending on the poly ether composition.

IV. CONCLUSION

Oriented fibers and non oriented fibers show different degradation properties, especially with regard to the changes in mechanical properties. The changes in tensile strength are slower for the oriented material than for the non-oriented. Polymerisation of 1, 5 dioxepan 2-one gave a poly (ether ester) with amorphous properties, implying that it might be useful as an amorphous block in copolymers possessing elastic properties (7) and it should also be a candidate for hydrolytic degradation. Poly (tri methylene carbonate) with a rubber character at room temperature (8) is an aliphatic poly carbonate; it could be useful as a biodegradable polymer for medical applications which should display hydrolytic degradation. Poly anhydrides are useful in biomedical applications due their fiber forming properties

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