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Plastics - Guide for vocabulary in the field of degradable and biodegradable polymers and plastic items

Plastiques - Guide pour le vocabulaire dans le domaine des polymères et des produits plastiques dégradables et biodégradables

Kunststoffe - Leitfaden für Begriffe im Bereich abbaubarer und bioabbaubarer Polymere und Kunststoffteile

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Foreword

This document (CEN/TR 15351:2006) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by IBN/BIN.

Introduction

Today, there are several sectors of human activity that can take advantage of degradable and biodegradable polymers, polymeric materials and items, namely the sectors of biomedical, pharmaceutical, packaging, agricultural, and environmental applications. Although they appear very much different at first sight, these applications have some common characteristics:

— the necessity to deal with the polymeric wastes when a macromolecular material or compound is to be used for a limited period of time,

— the fact that living systems have some similarities in the sense that they function in aqueous media, they involve cells, membranes, proteins, enzymes, ions, etc…,

— the fact that living systems can be dramatically perturbed by toxic chemicals, especially low molar mass ones,

Another characteristic of degradable polymeric compounds is that each sector of applications has developed its own science and thus its own terminology. In particular, surgeons, pharmacists and environmentalists do not assign the same meaning to a given word. For instance, “biomaterial” means “therapeutic material” for people working in the biomedical sector whereas it means material of renewable origin for specialists working in the sector of exploitation of renewable resources. The field of norms is another source of examples. Norms related to degradation, and/or biodegradation in these different sectors, have introduced definitions independently. The resulting mismatching and inappropriate use often lead to misunderstanding and confusion.

Because human health and environmental sustainability are more and more interdependent and, because science, applications, and norms are developed in each of these sectors, it is urgent to harmonise the terminology or to define a specific terminology when a general one is not available, so that they can be proposed to international normative organisations.

Such a task should be based on scientific and mechanistic considerations. The present technical report is an attempt to set up a common and simple terminology applicable in the various domains where degradation, biodegradation, bioassimilation, and biorecycling are major academic and industrial goals.

It is worth noting that elimination from the human (or animal) body of high molecular weight compounds is not possible unless macromolecules are degraded to low molar mass molecules. Indeed, skin, mucosa and kidney are very efficient barriers that keep high molar mass molecules entrapped in the parenteral compartments. As for the environmental life, eliminating a waste from the planet is not possible, so far. Therefore, any product or chemical that is not recycled or biorecycled is going to be stored in one way or another, i.e. as such or as biostable residue of degradation.

1 Scope

This guide provides the vocabulary to be used in the field of polymers and plastic materials and items.

The proposed terms and definitions are directly issued from a scientific and technical analysis of the various stages and mechanisms involved in the alteration of plastics up to mineralization, bioassimilation and biorecycling of macromolecular compounds and polymeric products; i.e polymeric items.

NOTE The proposed vocabulary is intended also to be in agreement with a terminology usable in various domains dealing with time limited plastic applications, namely biomedical, pharmaceutical, environmental, i.e., in surgery, medicine, agriculture, or plastics waste management.

2 Analysis of the alteration stages and mechanisms

2.1 Alteration stages

If one looks carefully at what can happen when a polymeric item is in contact with a living system, regardless of the living system (animal body, plant, micro-organisms or the environment itself), one finds different levels of alterations. These various levels are shown in Figure 1.

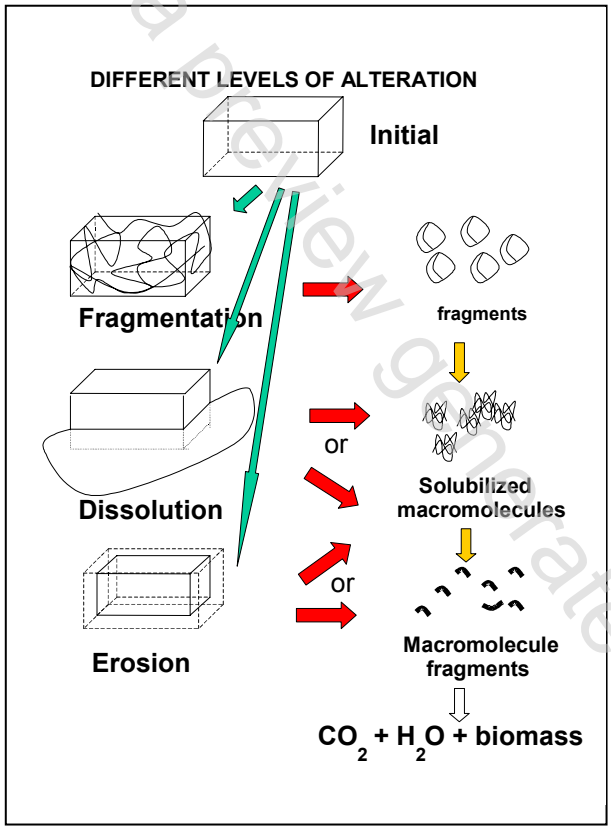

Figure 1 — The levels of alteration for a polymeric device

From this schematic presentation it appears that the formation of tiny fragments or dissolution does not necessarily correspond to macromolecule breakdown. Actually it reflects the disappearance of the initial device only. Whether the macromolecules that formed the original polymer-based item remain intact or are chemically cleaved with decrease of molar mass needs to be distinguished by specific words. This is