EFFECTS OF REPROCESSING OF OXOBIODEGRADABLE AND NON-DEGRADABLE POLYETHYLENE ON THE DURABILITY OF RECYCLED MATERIALS

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Plastics play a very important role in our daily lives. Throughout the world the demand for plastics, particularly plastic packaging, bags, thin films etc. continues to grow rapidly and consequently the fastest growing component of the waste stream. Although the efficiency of plastic recycling is increasing, plastics are often seen as a permanent environmental problem due to littering. The introduction of oxo-biodegradable polyolefins (OBD), containing pro-degradant additives, reduces this problem by enabling a significantly faster degradation of the plastic by oxidation. The pro-degradant additives form radicals that attack the polymer chains causing chain scissions and generation of low molecular mass oxidation products that can be consumed by microorganisms. There is however a concern that the pro-degradant additives, that act as catalysts and are therefore not consumed in the process, will present a problem when OBD materials end up in the conventional plastic recycling streams. The present study therefore highlights the effects of mixing OBD-materials with conventional polyethylene in order to evaluate the impact on the remaining service life of the recyclates.

The study included the use of two different OBDs, mixed in different proportions (10 and 20%) in a conventional polyethylene. The remaining service life of the mixtures was evaluated by monitoring the reduction in tensile strain at break after exposure to thermo-oxidative degradation at elevated temperatures, compared to a pure polyethylene. The oxidation process was monitored by Fourier Transform Infrared Spectroscopy (FTIR) as an increase in carbonyl index. Furthermore, the impact of stabilizer content in the mixtures was evaluated together with the effect of mixing partially degraded OBDs into the recyclate.

The effect of reprocessing of OBD materials with conventional materials is exemplified in Figure 1. It is shown that unstabilized LDPE without any prodegradant starts to degrade immediately and after about 38 days at 70 °C the elongation at break is reduced to 50 % of the original value. Of course the rate of degradation of the OBD materials is much faster and depends on the type and amount of prodegradant system. Addition of 1000 ppm Irganox 1010 to the LDPE material extended the time to 50 % reduction of elongation at break from 38 days to 224 days at 70 °C. The interesting result is that the addition of 10 % of the OBD material to the stabilized LDPE did not affect the thermooxidative stability of the material.

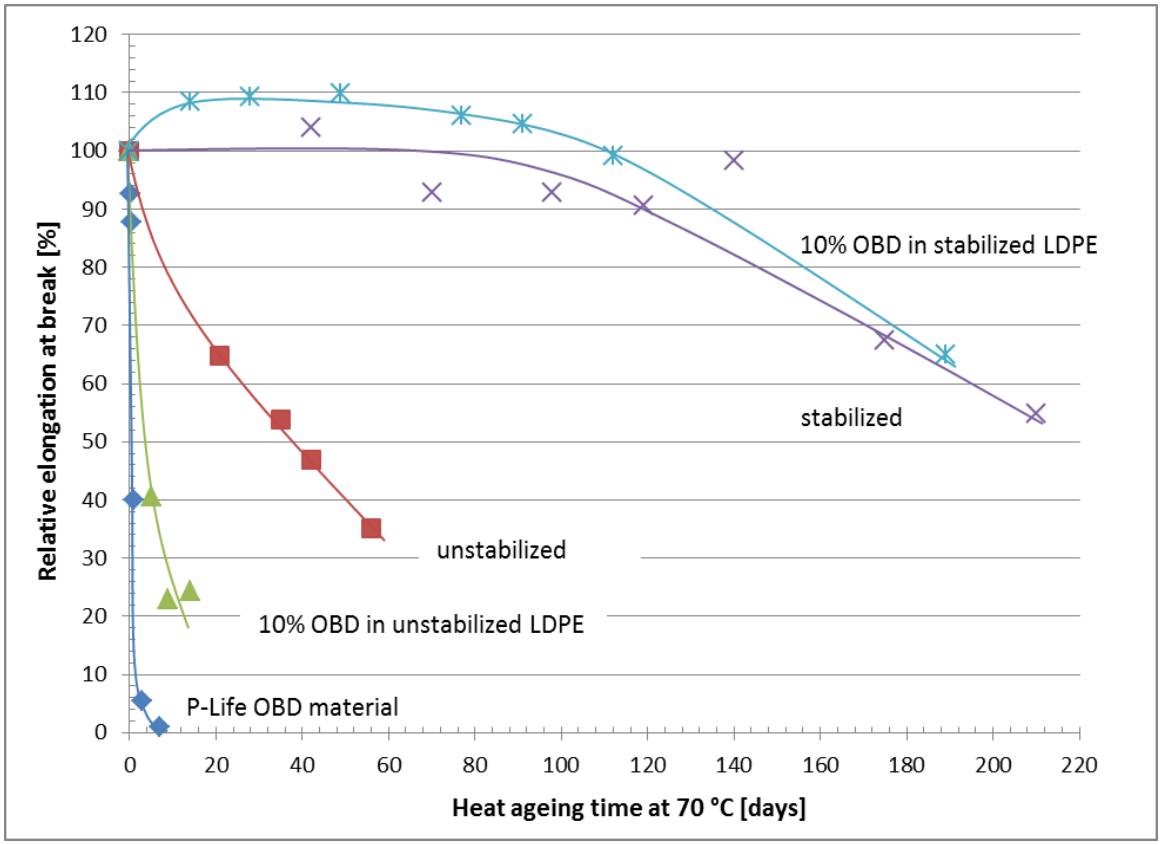

Figure 1. Elongation at break as a function of aging time at 70°C.

Our results lead to the conclusion that the incorporation of minor fractions, although a significantly higher fraction than expected in the real life, of OBD materials in the existing recycling streams will not present a severe effect on the service life of the recyclates as long as the polymer mixture possess a reasonable degree of stabilization.