NATURAL ANTI-OXIDANT ADDITIVES FOR BIO-DEGRADABLE POLYMERS

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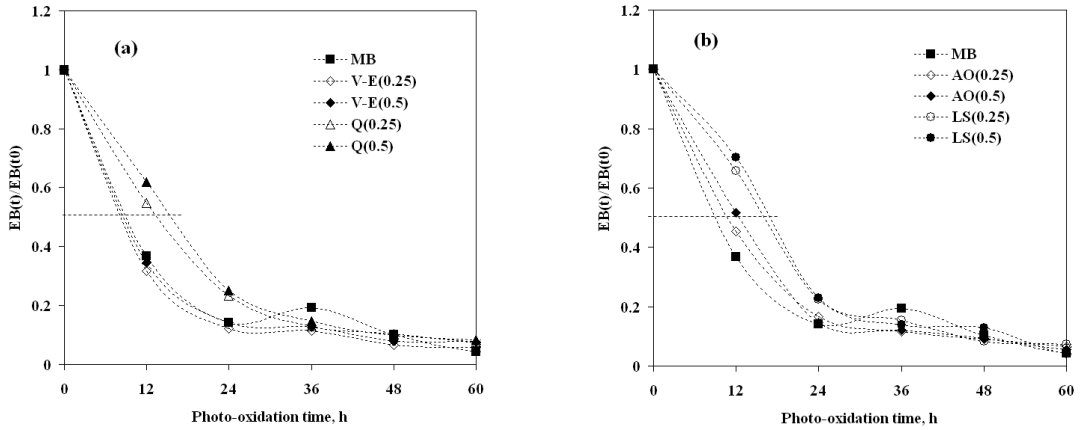
In the last years the introduction of large amount of biodegradable polymers in many conventional applications is a very important tool in environmental-friendly management of the polymers. The applications of the biodegradable polymers in the agricultural field as covering film, mulching film, packaging,etc are a very promising and challenging issue[1-2]. Commercial starch-based biodegradable polymer, i.e. a new Mater-Bi® (MB), was additivated with natural stabilizers as tocopherol and quercetin in order to formulate biodegradable film for outdoor applications free by synthetic compound and with good photo-oxidation stability. Moreover, the photo-oxidation behavior of these MB films was compared to the behavior of MB films loaded with synthetic anti-oxidant and light stabilizer systems. In Figure 1, the dimensionless elongation at break (EB) of all the investigated films, subjected to the accelerated weathering as a function of the exposure time are reported. All dimensionless values were calculated by dividing the values of EB at a given exposure time by the EB value measured before photo-oxidation. Adding natural anti-oxidant, as α-tocopherol (Vitamin E) at both 0.25 and 0.5 wt% does not change the trend of the dimensionless elongation at break, see Figure 1 (a), while, a benefit effect can be noticed by adding the flavonoid system, i.e. quercetin at both low and high concentrations, especially at short exposure times. The decays of the dimensionless elongation at break at long exposure times for unstabilized MB film and stabilized films using natural (see Figure 1 (a)) and synthetic stabilizers (see Figure 1 (b)) are very similar. At short exposure time the synthetic anti-oxidant and even more the light stabilizer are able to slow down the loss of the MB film ductility's. The trends of the

dimensioless tensile strenght and elastic modulus (not reported) confirm the observed trend for EB.

Mechanical and spectroscopical results suggest that the quercetin additivated MB film shows similar behavior to the MB film additivated with the same amount of synthetic light stabilizer, which is suitable for outdoor greenhouse agricultural applications. Both natural and synthetic anti-oxidant systems are not able to prevent the formation of radicals and consequently to slow down the photo-degradation of the MB films. Finally, the quencetin compound seems to work better the vitamin E and the improvement in the photo-oxidation behavior of the biodegradable film are very similar to these obtained using synthetic light stabilizer.



(a) (b)

Figure 1. Dimensionless elongational at break of Mater-Bi® film and MB additivated (a) with natural stabilizing systems and (b) with synthetic stabilizing systems

Using same natural and synthetic stabilizers for stabilization of the bio-polyester film, as PLA film, do not give similar results. In particular, the stabilized PLA films show reduced durability than the unstabilized PLA film. This unexpected result could be understood considering the ability of the stabilizing molecules to plasticize the matrix and consequently, to improve the oxygen propagation into the bio-polyester matrix.

1. Bastioli C, Ed., “Handbook of Biodegradable Polymers”, Rapra Technology Limited, Shropshire, UK, 2005.
2. Platt DK,Ed.,“Biodegrad Polym-Market Rep”, Rapra Technol Lim, Shropshire, UK, 2006.

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