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Ageing effect on different LDPE films used as warm house cover

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Abstract

The purpose of this study deteriorating effect of natural ageing on tri-layer and mono-layer polyethylene films used as glass house cover in the North Africa environment. The films was handed out by Agro film and composed of low denseness polyethylene (LDPE), holding admixture (e.g. color and infrared IR and ultraviolet UV stabilizers). This film was used to strengthen and set up a real warm house situated in the northern of Algeria. The influence of

growing old was, controlled by watching the modifications in mechanical (robustness and flexibility) features. The study has been conducted during a period of nine months of natural ageing. The films have been spontaneously matured and grow older. The results display that the environmental components have deteriorating effects on the sustainability and all properties of the polyethylene film.

The study illustrate clearly that the degradation parameters evaluated are directly linked to standard for estimating the efficiency of using warm house farming. The consequence of temperature and UVA radiation generated the most significant degradation on the film surface and accordingly a decrease in the whole life existence of the material.

Keywords: LDPE, Mono-layer and tri-layer films, Ageing, Degradation

Introduction

Weak intensity of polyethylene LDPE is one the most employed materials in plastic culture and its utilization as agricultural warm house covers is common application. The principle characteristics that have granted its success are especially its illuminance and clarity. On other hand, its good chemical immobility, like polyethylene all organic substances break down step by step under the combined influence of heat, solar ultraviolet UV radiation, mechanical stress, and chemical agents [1-3].

Low intensity polyethylene LDPE is actually the most worldwide known warm house covering material in the countries of the Saharan region. They point out of LDPE film to atmospheric conditions, such as solar beams in the range of 290-400 nm, damage its chemical formula and consequently its mechanical and Physical properties [4].

The influence of different effects and of multiple ageing determinant on the degradation of the film are usually controlled by calculating specific critical properties of the mechanical. Chemical adjustments in the PE polymer contraction can justify the degradation mechanisms. Changes in selected properties (e.g. mechanical physical and chemical) can be used to monitor the evaluation of ageing. So far, the principle property employed by industry for characterizing the degradation of PE is the elongation at break. According to relevant international standards, a lowering below the limit of 50% [5-6].

They have demonstrated that molecular orientation during film blowing influences tensile properties and are higher in the direction of the covalently bonded carbon-carbon chain than in the crosswise path that is dominated by weaker Vander bonds. Environment conditions such as solar rays , temperature, humidity, rain, snow fall and other environmental pollution influence ageing and mechanical properties of LDPR warm house covers [7-8].

Deterioration attitude of mono-layer LDPE films employed as glasshouse or so called conservatory house covers has been studied by lot of authors. However, the degradation behavior of multi-layer films is very lacking of Few studies [9]. Have considered the effect of ageing in the North–Africa climatic conditions.

In our study, the effects of ageing on the mechanical properties and comportment of a film made of tri-co-extruded layers of LDPE in a tough and severe environment of changeable temperature and UV radiation are investigated. The exposure has been performed over a time period ranging and from 0.0h to 6480 h (9 months). This study could be expanded to cover more areas with different environmental conditions to establish a generalized standard.*

Material and Methods

Material

Two different films (mono-layer and three co-extruded layers LDPE), developed and provided by Agro film SA (Setif-Algria) were employed in this study using three layers co extrusion technology. The total size of the three co-extruded layers film is 180µm with the proportions of ¼, / ½, and ¼ in the layers.

The raw LDPE (before extrusion) has density of 0.923 g/cm^3 and the average molecular weight is in the range 90000-120000. The melt flow index MFI of the raw LDPE IS 0.33 g/10min and the MFI with stabilizer is 10g /10min. The primary color of the film is milky yellow.

The real structure of the film is not known (Kept confidential by the supplier). The usually used warm house cover is made from a mono-layer film with 180 µm, same as the overall width of the tri-layer LDPE film. It has been demonstrated from the supplier that self-sticking between the three coextruded layer happens under an extrusion temperature of 70˚C [10-11].

Exposure protocols

Two warm houses have been built specially for studying the impact of the natural ageing on the performance of the LDPE cover .Samples have been taken every month over a duration time of nine months. To ensure the data reproducibility, large square samples of 30cm sides were cut, at each ageing period, from the cover from which sufficient test samples were prepared to conduct the experiments required. The climatic conditions undergone by thereof are displayed in Table 1. The weathering condition was usually typical in North Algeria.

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Table 1: The power emitted and the average temperature /moisture during ageing.

Time of ageing (months)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Temperature (°C)	19	29	34	32	27	25	15,5	12,5	8
Humidity (%)	44	34	29	34	43	40	62	70	69
Global energy (Langley's)	70	69	1,72	2,69	2,04	1,92	1,87	1,57	1,47

Tensile testes (creep)

The creep comportment of polyethylene films is mainly controlled by distortion of the amorphous phase, which itself affected by the numerous crystalline and the tautness of the tie molecules.

Using agricultural compounds to produce structural building outcome, often demand enhancement of their mechanical properties, especially the creep efficiency .Previous studies in the field revealed that the creep of agricultural composites differ with the type and content of matrices, coupling treatment, where the relative performance of the fiber-matrix interface is significant compared with the visco elastic of the compound [12-13].

Results and Discussions

Creep-recovery behavior

The creep test performance of the unblemished/pure and naturally aged films (up to a period of 9 months) was examined by assessed the creep-recovery test. The load was applied on a specimen in a direction parallel to the average molecular orientation obtained during the film processing [14]. The recovery starts immediately after the stress removal and for a period of 24h as well. The creep-recovery behavior was calculated for different exposure time (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 months) in Figure 1.

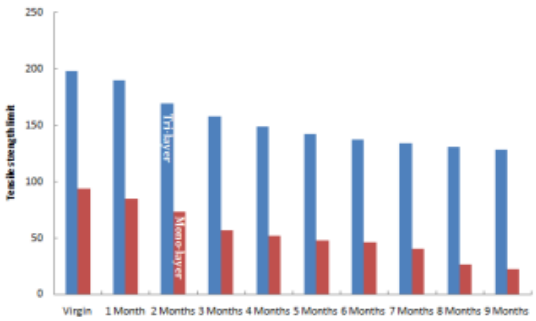

Figure 1: Total starain curves of monolayer and tri-layer films at different ageing periods.

The performance of a polymer during disclosure to rude environments can be highly intensified by adding the photo stabilizing additives such as ultraviolet absorbers, UVA, quenchers, free radical scavengers. Hindered amine as photo stabilizers, HALS and ultra violet absorbers UVA are frequently employed. Stabilizers prevent oxidation and so its negative effects on the average molecular weight and therefore the drop of the mechanical properties. Gachter et al. [15-16]

Figure 2 presents the variation of modulus of elasticity while growing elderly. Such deterioration in the mechanical comportment of the mono-layer and tri-layer films of LDPE is due to the modification emerging with ageing in the molecular structure of the material. Polymeric molecules are huge, on the molecular scale, and their unique valuable characteristics are entirely a result of their size.

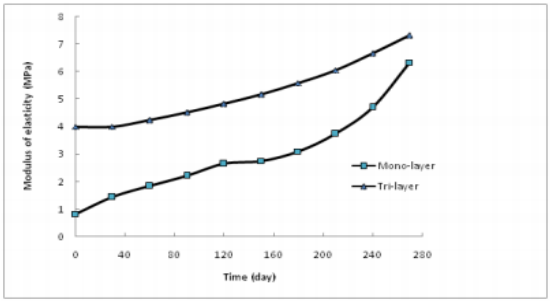

Figure 2: The variation of modulus of elasticity with ageing time.

Any damage in chain length decreases the tensile force and became a cause of premature failure. The progressive changes in the molecular structure due to ageing do not permit the polymer chains to redesign as before and lay down additional resistance following the initial of the material [17-18].

Conclusion

The effect of natural elderly growth on the specifics features of mono-layer and tri-layer LDPE film employed as a warm house roof has been investigated. The most breakdown deterioration in the mechanical characteristics (modulus of elasticity, fracture stress and elongation at break) has been measured. The study reveals that natural ageing of the film in North-Africa is almost equal to an aging at 40°C. Further, the sunlight radiation is a principle element of degradation and the anti UV additives are not optimized in this film. The combined effect of the temperature and UV-A radiation decrease the life time significantly. The data of the yellow color, correlated with the breakdown in the mechanical performance of the film.

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