1. Introduction

From all kinds of plastics, especially thermoplastic materials take the significant importance because of their good performance and advanced technologies of their processing [1]. Rheology and its experiments reveal information about the flow behavior of liquids but also the deformation behavior of solids, because it is the typical behavior of polymers. Changes induced by the environment with degradation effect can be evaluated by rheological measurements which monitor changes in viscoelastic properties of the tested polymers. The fundamental of rheological characteristics is viscosity which defines the internal resistance of material against its creep generated by external forces [2 - 3].

Viscosity has a high importance for polymer processing, the change of viscosity is determined by changes of particular factors (temperature, pressure, molecular weight and its distribution, structure of the polymer, presence of additives in the polymer), which are characteristic for the polymer and may vary according to the effect of degradation processes [4].

The principle of evaluation of tested material is based on evaluation of measured parameters which characterize the viscoelastic properties of polymers with respect to their molecular structure and their behavior in thermoplastic processes.

2. Experimental Results

Polymer samples of plate shape with dimension of 10 x 55 x 3 mm were exposed in different environment with degradation effect. Samples of PP and PE 500 (provided by Licharz company) were exposed to aliphatic hydrocarbon n-hexane, immersed in a separated container for period of 3 and 6 months. Accelerated aging tests of PE 1400 (Finathene XS 10 YCF) samples were carried out in UV chamber for a period of 139 days, which represents 700 cycles and intake energy of 5264 kJm⁻². One cycle in the UV chamber is represented by 4.8 hours of testing with delivered energy of about 7.52 kJm⁻² per cycle. Daily cycle runs for 3.8 hour (temperature of 62 ± 3°C; relative humidity of 50 ± 5%; intensity of radiation 0.55 Wm⁻²) and 1 hour night cycle (temperature of 38 ± 3°C; relative humidity of 50 ± 5%; intensity of radiation 0 Wm⁻²). Rheological measurements were performed by oscillating rheometer Physica Rheometer MCR 301 using Frequency sweep test (two parallel plates with diameter of 25 mm, in 1 mm distance from each other, T = 160 - 170 °C according to the nature of the material, amplitude of γ = 5%, angular frequency of ω = 500 – 0.051/s).

All measurements were carried out only in exposed surface layers that were replaced from exposed sample (in depth of 0 - 750 μm and 750 - 1500 μm for PE 1400; in depth of 0 - 300 μm and 300 - 600 μm for PE 500, PP), results and analysis are presented in the Fig. 1 – 3.
3. Conclusions

The experimental work shows following results: exposure of PE 1400 in UV chamber caused evident difference in measured parameters which change their values seen from the surface further to the depth (Fig. 1). The layer of 750 µm has significantly different viscoelastic properties – material becomes more fragile. Measurement of the sample layer in the depth of 750 - 1500 µm showed that the degradation is much smaller and measured curve is closer to the curve of unaffected sample. Measurements of PP and PE 500 exposed in n-hexane solution for 6 months period (Fig. 2 and 3) show the changes of viscosity, as well as G' and G" modulus in both surface layers but only in PP samples. PE 500 indicates no changes in viscoelastic properties in comparison with the original material.

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5. References