

NOTES

Effect of Formation of Yellow-Colored Complexes of UV Absorbers and PVC Thermal Stabilizers on Efficiency of Action of UV Absorbers

The measurements of absorption spectra in the visible region for PVC foils containing mixtures of ultraviolet and thermal stabilizers have shown the possibility of formation of yellow-colored complexes when the thermal stabilizer contained zinc and cadmium.¹ [Note: titles of figures in that work¹ are in error. Correct titles are as follows: Fig. 1—Zn, Ba, Cd carboxylate stabilizer; Fig. 2—Ba, Cd carboxylate stabilizer; Fig. 3—organotin stabilizer; Fig. 4—tin mercaptide stabilizer; Fig. 5—correct].

The above-mentioned complexes are formed immediately after preparation and do not affect absorption of ultraviolet light. Thus, initially they do not influence the quality of system protection against the destructive action of ultraviolet light.¹ However, it was still important to confirm that these complexes are also harmless during foil aging.

The present work contains the data obtained for PVC foils containing certain thermal stabilizers

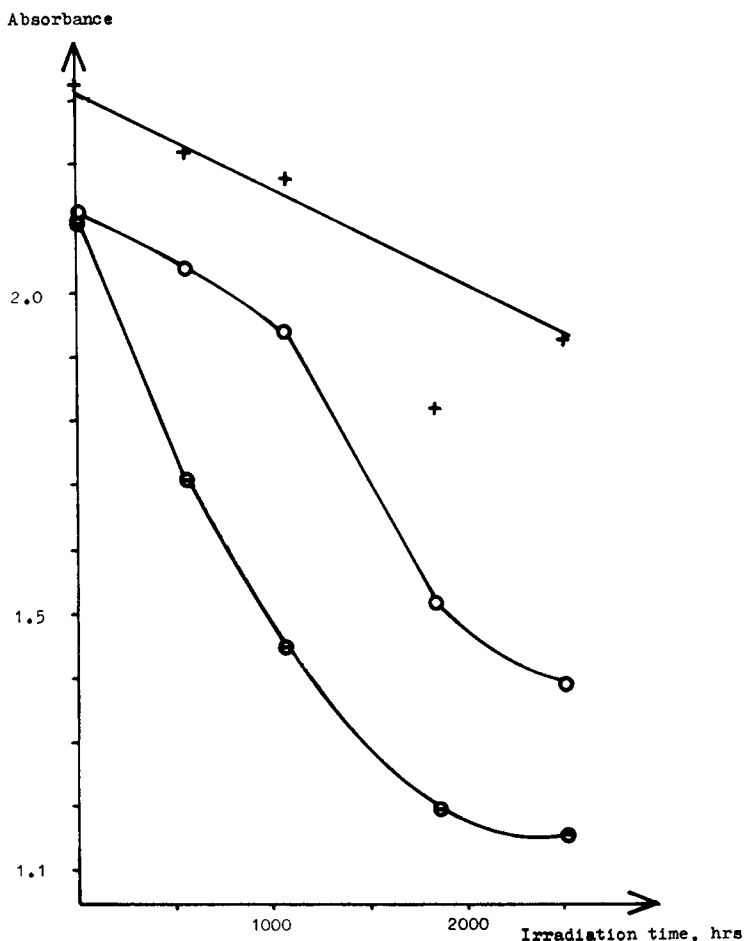


Fig. 1. Change in UV absorption at 340 nm of solution containing Tinuvin P during aging in Xenon: (o) Zn, Ba, Cd carboxylate stabilizer; (Θ) Ca, Zn carboxylate stabilizer; (+) dibasic lead phthalate.

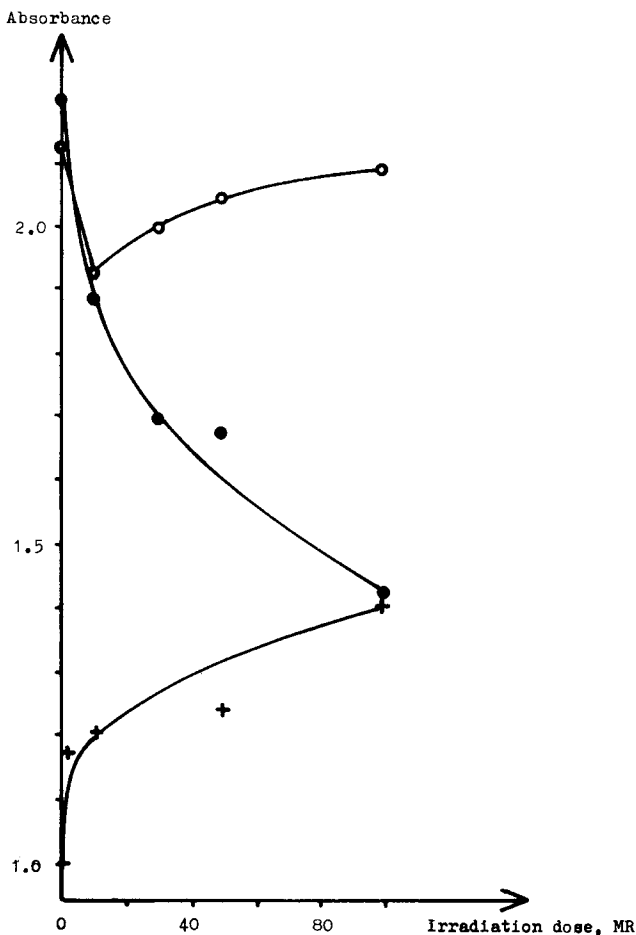


Fig. 2. Change in UV absorption at 340 nm of solution containing Tinuvin P during aging in cobalt bomb: (o) tin mercaptide stabilizer; (⊖) Zn, Ba, Cd carboxylate stabilizer; (+) control (without Tinuvin P).

together with 2-(2-hydroxy-5-methylphenyl) benzotriazole which were aged in a cobalt bomb and the Xenotest.

EXPERIMENTAL

As material for the investigations, UV absorber 2-(2-hydroxy-5-methylphenyl)benzotriazole (Tinuvin P) was used, as well as the following thermal stabilizers: tin mercaptide (Ergotherm BTGO), Zn, Ba, Cd carboxylates (Nuostab V 1277); Ca, Zn carboxylates (Irgastab ABC-1); and dibasic lead phthalate (Ergoterm DFO).

Foils 0.5 mm in thickness containing 100 wt % PVC, 60 wt % DOP, 2 wt % stabilizer, and 0.5 wt % Tinuvin P were prepared. These foils were aged in Xenotest 150 (temp. 30°C, relative humidity 65%, UV transparent filter) and in a cobalt bomb.

The absorption of UV light at 340 nm of foil solution in cyclohexanone at UV absorber concentration of 0.5×10^{-5} g/cm³ (counting according to the quantity of Tinuvin P initially introduced) was measured. The results were calculated as absorbance $A = 1/T$.

The experimental data are shown in Figure 1 for samples aged in Xenotest and in Figure 2 for samples aged in the cobalt bomb.

DISCUSSION

From Figure 1 one can see that during aging under the effect of UV light, UV absorber activity is considerably decreased and quantitative changes depend substantially on the kind of thermal stabilizer used. In the case of dibasic lead phthalate used as a thermal stabilizer, the decrease in absorbance of the ultraviolet stabilizer is steady and, in fact, linearly connected with the irradiation time.

The presence of two other stabilizers in the composition is the cause of the faster and unsteady changes which could be explained by the different activity in complex formation. These two stabilizers contain zinc, which is known to form complexes with benzotriazole derivatives.

These results are also confirmed by the data obtained from the samples irradiated by γ rays. From Figure 2 one can see the tangible difference in UV absorber stability owing to the kind of thermal stabilizer used. Foils containing mixtures of benzotriazole derivative and Zn, Ba, Cd carboxylate stabilizer have lost all their ability to absorb UV light at 340 nm after a dose of 100 Mrad was applied, whereas the foils containing tin stabilizer still contained substantial activity to absorb UV light.

Based on the above-mentioned data, it can be said that the formation of colored complexes between UV absorbers and PVC thermal stabilizers affects disadvantageously the durability of PVC foil.

References

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