

Thermal and Mechanical Properties of PVC and PVC–HDPE Blends.

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ABSTRACT

The objective of this study was to improve the physicochemical properties of mixtures of polymers and PVC–PVC * HDPE * by the addition of stabilizers deferential percentages (2%–5% –10%). According to the study of mechanics and in general it was found that the mixture containing recycled PVC once has mechanical properties – before and after higher than the other blends (HDPE / recycled PVC).the addition of PE in the blend PVC (50% HDPE 50% PVC) makes a big change in the structure of the polymer PVC (fall gradually properties tensile). The thermal stability of the blend HDPE / recycled PVC increases with the growth percentages of stabilizers. In addition in the same mixture this latter decreases with increasing rate of recycled PVC. The stabilizing 81KA Baeropan the stabilizer is the most recommended rate 2% and improved mechanical properties of PVC resin on the other hand Baeropan MC87–03 altered these properties has rate 10 % and 5%.

INTRODUCTION

Stabilization played a role in the high polymers and polymer blends. In order to make the macromolecule resistant to high mechanical and thermal stresses thermal stabilizers such as:

*BAEROPAN MC–81KA (BARLOCHER/FRANCE) : compound stab/ lub containing Ca / Zn.

*BAEROPAN MC–8703KA (BARLOCHER/FRANCE) : compound stab / lub containing Ca / Zn.

Have been added to the formulations of polyvinyl chloride and polyvinyl chloride, high density polyethylene. The first chapter on fundamental concepts studied polymers and devoted him to the study of polymer blend. The second chapter describes the degradation and stabilization of polymers, their physical properties and chemical mechanical methods of analysis. The third chapter illustrates the types of materials used in the preparation of our base mixture of PVC / HDPE and PVC sole.

EXPERIMENTAL METHODOLOGY

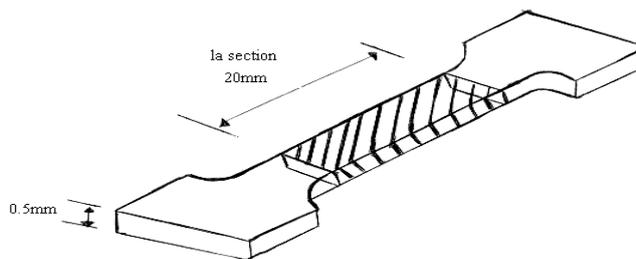
The materials used for the preparation of our blends PVC / PE are:

Polyvinyl chloride type Shintech SE 1200 ITOCHU (France): PVC–S–70 High Density Polyethylene (HDPE) produced by the national cable industry) ENICAB Biskra), it is marketed as granules.

The Tensile Test

The uniaxial tensile test is a test "simple" to implement. It consists in submitting a sample of the material to study to measure the tensile strength and elongation Δl . corresponding to a force F applied.

Figure 1: ALTER test



Mass Loss

The loss of mass was performed for all formulations, for 50/50 (PVC / PE) and even for plasticized PVC; it is based on weighing the input and the output of the different samples. Specimens obtained from plates were weighed and then were subjected to the same tensile tests (reference specimens). The other remaining specimens were worn in the oven for seven days at T = 100°C, after this period, they were weighed and subjected to tensile tests.

The Thermal Stability

The thermal stability was evaluated based on the time after which the pH changes color paper, which is an indication of the release of hydrochloric acid and represents the beginning of the thermal degradation of PVC.

Technique for Measuring Absorption Spectrometry by Fourier Transform Infrared (FTIR)

As more complete study of the thermal behavior of the mixtures produced based PVC / PE, using IR spectroscopy Fourier transform as a complementary method to the study of aging, in order to evaluate the thermal behavior of mixtures exposed to the direct action of heat for seven days under the same conditions of temperature and pressure [1].

RESULTS AND DISCUSSION

Aging Rate of the Breaking Strength:

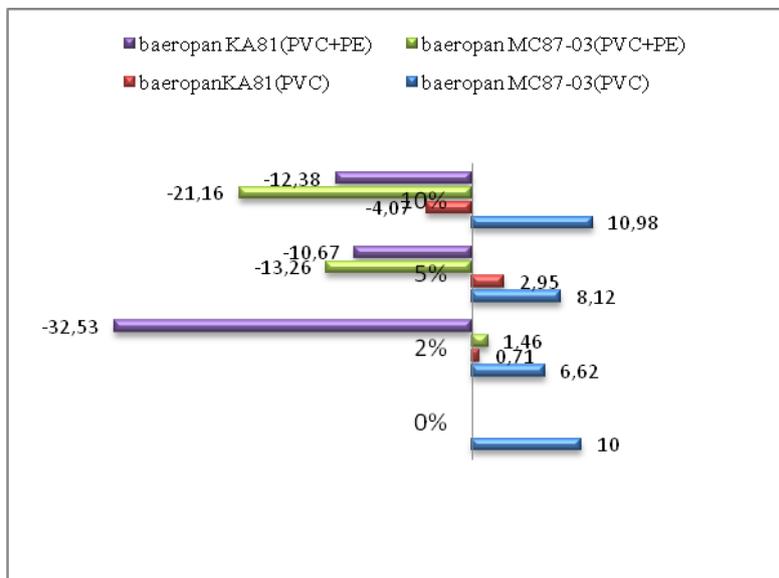


Figure 2: Percentage aging tensile strength.

According to Fig. 2 we see that the rate of aging tensile strength augment the rate of aging in tensile strength for mixing PVC increases at a rate of 10% baeropan MC87-03 compared to HDPE+ PVC mixture is labeled a fall aging rate in tensile strength 10% baeropan MC87-03. As a rate of 10% baeropan KA81 there was a decrease in the rate of aging resistance of PVC and PVC compound + HDPE.

A stabilizing rates above 2% there is an antagonistic effect which results in a change of the mass (5% -10.67% -12.38% 10%) see Figure 2 therefore rates above 5% are unfavorable for a stabilization of the rate of aging due to oxidation resistance augment the macromolecular structure by the oxygen in the air this result is Confirmed by IR spectroscopy data or spectrum I and J.

From the results, we can see the spectrum I safe ie that of the formulation of PVC HDPE + 10% + stabilizing KA81, a band characteristic of the C-Cl bond at 840cm⁻¹ in 3200 against -3600cm⁻¹, you do not notice the characteristic absorption band of OH. After heat treatment for a period of 07 days at 100°C, the same formulation, the infrared spectrum is markedly different spectrum (J). We see the effects of oxidation of the polymer chain, a net absorption in the 3200-3600cm⁻¹, exactly $\nu = 3529.49 \text{ cm}^{-1}$ (broadband) that we associate with the OH bond and another associated 3488.99cm⁻¹ (associated OH polymer) another absorption $\nu = 1240.14 \text{ cm}^{-1}$ and $\nu = 1070.42 \text{ cm}^{-1}$ which we attribute to the CO single bond to the effect of the oxidation chain is apparent, it translates the formulation prior peroxide, followed by degradation leading to the OH function associated hydroxides; following the diagram Figure 2.a.

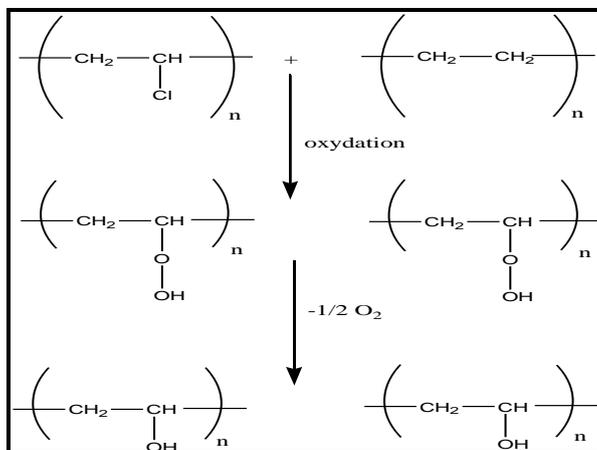
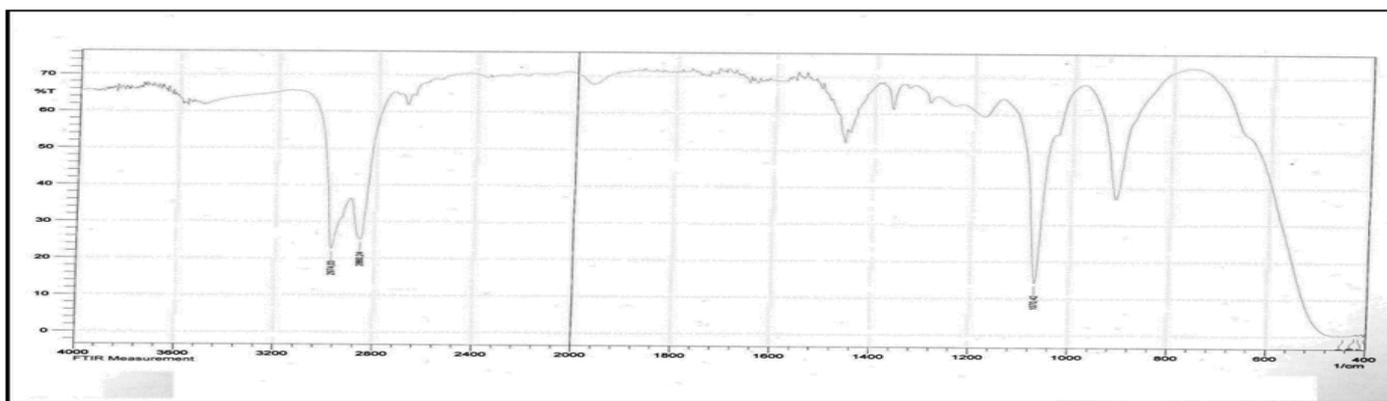
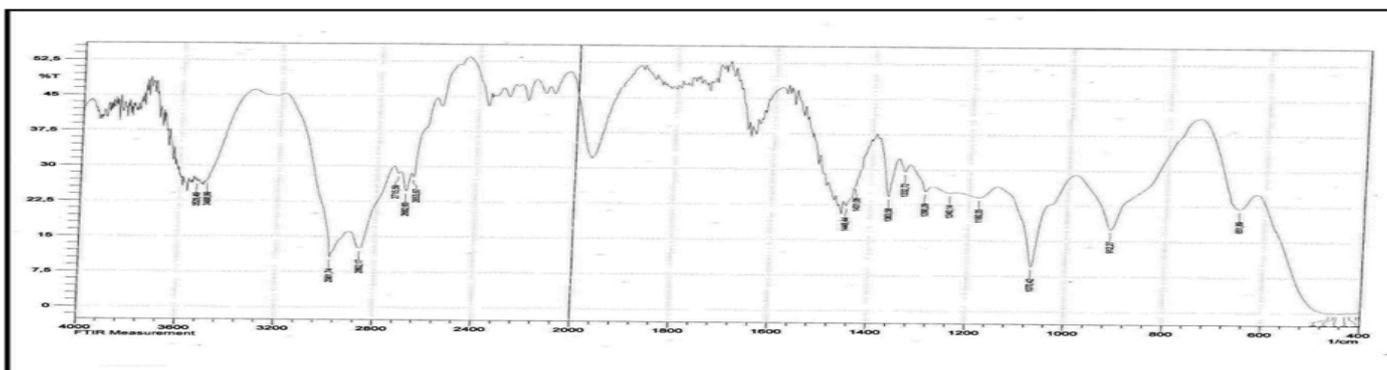


Figure 2.a: thermal degradation of PVC / HDPE and training hydroxide OH.



Spectrum I: F12 formulation (PVC + HDPE) before heat treatment.



Spectrum J: F12 formulation (PVC + HDPE) after heat treatment.

It follows that the increase in resistance after the heat treatment lies of baeropan KA81 in 2%, the mixture MC87-03 PVC+ HDPE [2,3].

Aging Rate of the Elongation at Break

According to the rate of aging of the elongation at break for 7 days, there is a large variation for the two mixtures according to the percentage of stabilizers, for example the increase of aging 5 and 10% of baeropan MC87-03, KA-81 and a low aging rate of 2%

for baeropan KA81 PVC + HDPE. we note that the BaeropanKA-81 shows a very low rate of aging for a quantity of 5 and 2% HDPE+ PVC mixture.

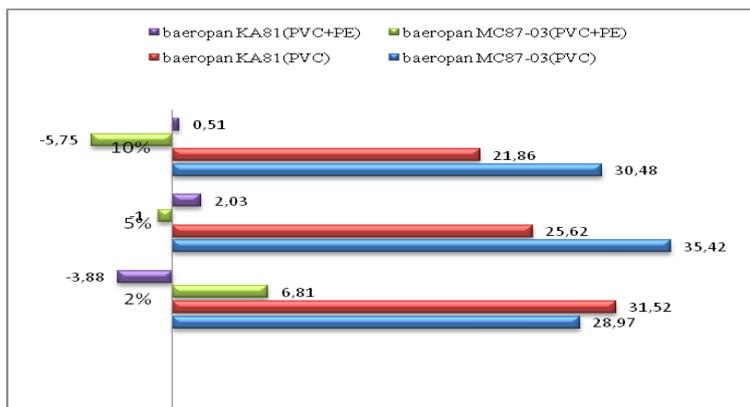


Figure 3: Aging rate of the elongation at break.

Finally, we conclude that the stabilizer baeropan MC81 to a rate of 2%, it increased to 31.52% until mixture PVC, we conclude that the elastic properties are degraded due to the phasing DIDP plasticizer, which gives rigidity to the structure and thus a deterioration of elastic properties. Per cons for mixing (PVC-HDPE), it is not necessary to mention an apparent variation in the rate of aging the elongation at break (6.81%- 2%) for mixing PVC HDPE because the crystallinity of the HDPE prevents the degradation of the oil DIDP.

Mass Loss

We have represented in Figure 4 the variation of weight loss as a function of aging time for the temperature of 100 ° C. On remarque un bon comportement thermique du stabilisant baeropan KA-81, used for the two mixtures PVC and PVC-HDPE. These results confirm those found for variations in strength, elongation and aging rate (0.1 mg/cm²).

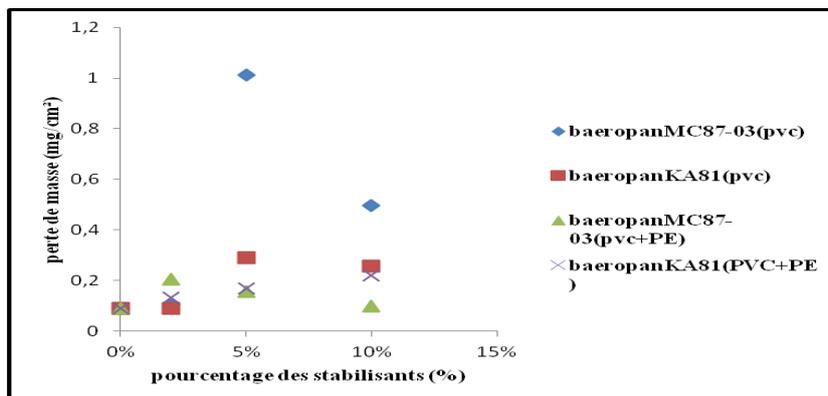


Figure 4: Study of the mass loss formulations after 7 days of heat treatment at 100 ° C.

The rate of the stabilizer equal to 2%, gives the best results when used against the stabilizer baeropan MC-8703, there is a loss of mass of 1.0mg/cm² for PVC thing is attributed to volatilization of the oil phase DIDP.

We can explain this strong mass loss that the oil used as plasticizer is a low viscosity oil very volatile. This weight loss is due to evaporation of volatile products [4,5].

Study of the Thermal Stability Static

For thermal stability, it was found the lowest stability time 2% baerpan MC87-03 for PVC and HDPE rather long time stability with a rate of 10% of the stabilizer baeropan KA81.

We notice sufficient time for degradation t = 65 min (PVC), t = 53min (PVC + HDPE), which is explained by volatilization of stabilizing at around 250 ° C. For PVC and HDPE blends with rates stabilizing 5 and 10%, the image is reversed [05]. Chlorine is trapped in a quantity sufficient stabilizer associated with the mixture (PVC and HDPE). These results are confirmed in the analysis by infrared spectroscopy FTIR, we can see the drain characteristic absorption C-Cl bond at a value of $\delta = \text{frequency } 665\text{cm}^{-1}$.

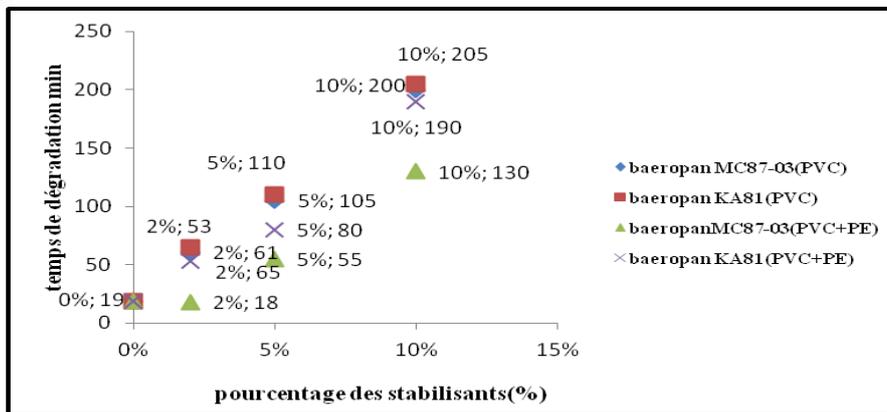
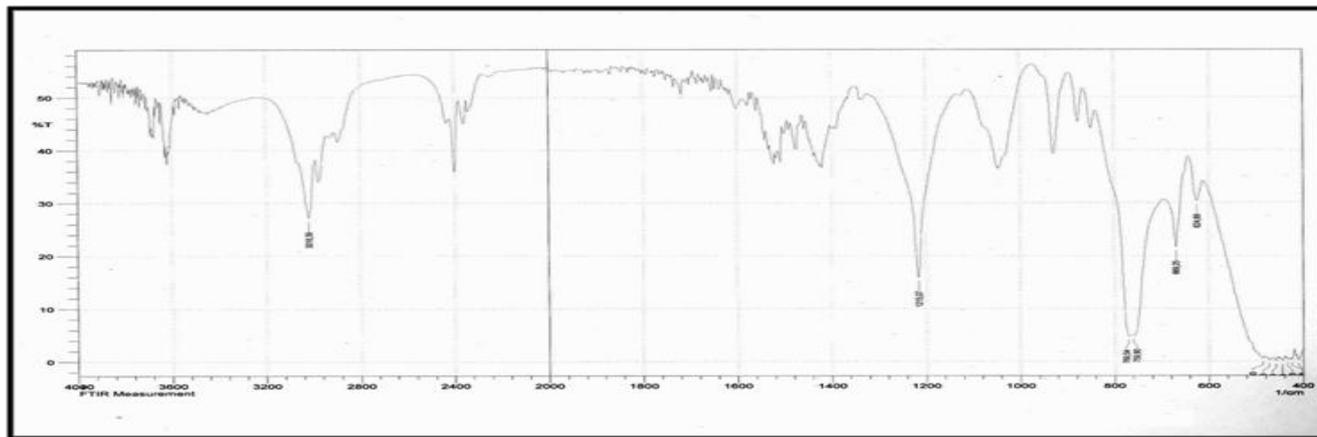
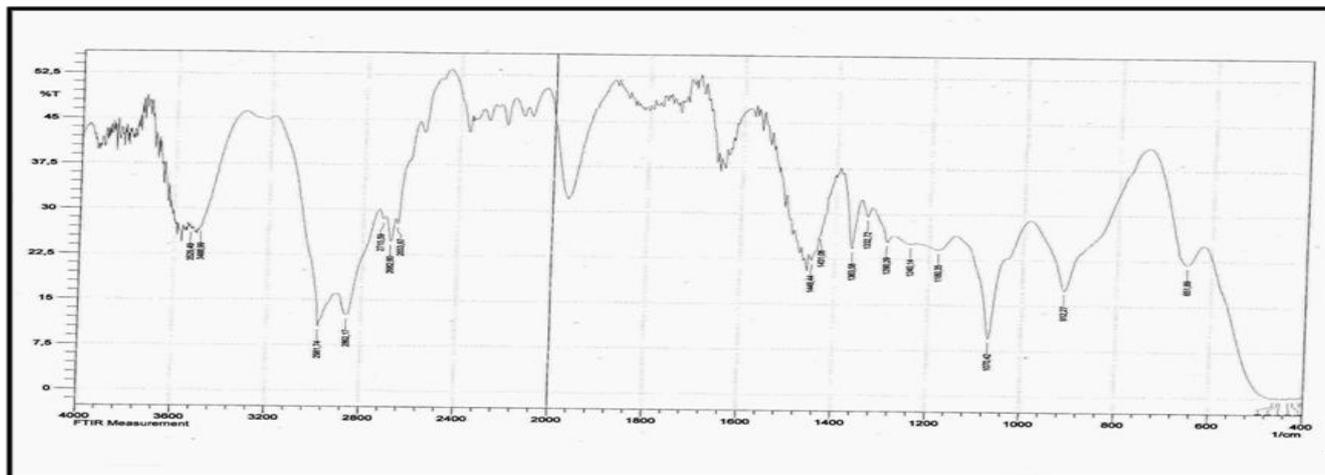


Figure 5: Study of the thermal stability of static.



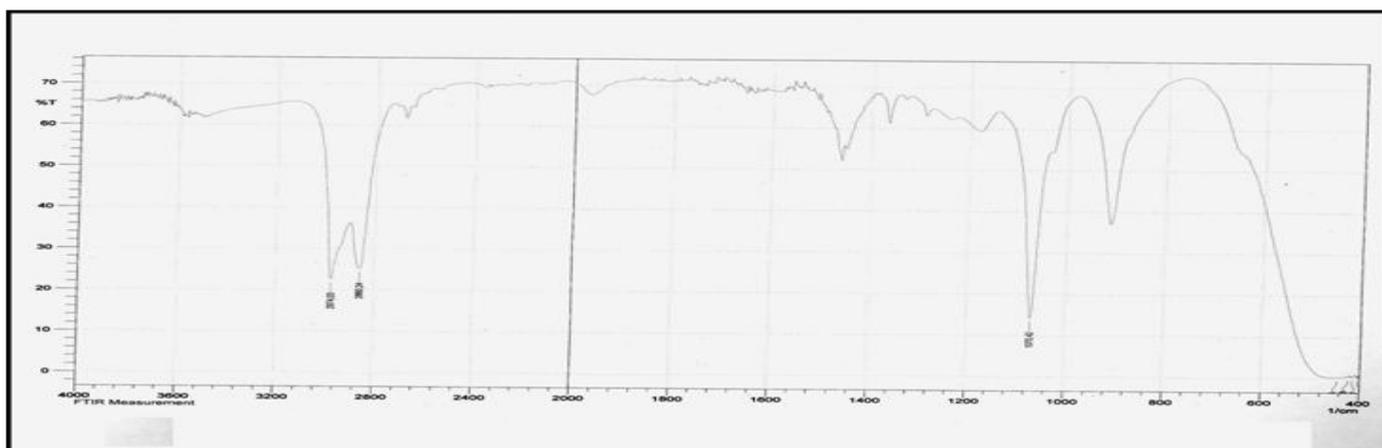
Spectrum E: F9 formulation (PVC + HDPE) before heat treatment.



Spectrum F : F9 formulation (PVC + HDPE) after heat treatment.

Spectrum F (mixture PVC +HDPE) the absorption peak $\delta = 651 \text{ cm}^{-1}$ disappears after heat treatment, because the amount of stabilizer used is not sufficient for stable macromolecular structure of the mixture against by the use of a rate of 10% baeropan stabilizing KA81dans mixture (PVC + HDPE) confers thermal stability of the macromolecular structure after heat treatment. These results are confirmed with spectrum I ($\delta = 651\text{cm}^{-1}$), so the amount of stabilizer stabilizes the macromolecular structure and trap the start of the chlorine in the form of chloride gas hydrogen HCl.

Spectrum J: F12 formulation (PVC + HDPE) after heat treatment.



CONCLUSION

- An increase in the values of elongation rate 2% in both stabilizers and low elongation falling in the mixture PVC+ HDPE 2% baeropanKA81 rate.
- The addition of PE in the blend PVC (50% HDPE +50% PVC) makes a big change in the structure of the polymer (PVC drop gradually tensile mechanical properties)
- For the aging rate in tensile strength, is that the resulting increase in resistance after the heat treatment is in the rate 2% and 5% baeropanKA81, MC87-03 HDPE+ PVC mixture.
- Determination of the thermal stability of the specified amount of heat stabilizer is still active in the sample.

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