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Influence of the Nature of the Liquid on the Migration of Plasticizer, Plasticized PVC

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ABSTRACT

The addition of plasticizers to the polymers having strong polar forces which tend to become brittle, fillers, lubricants and other additives, to impart the plastic with excellent mechanical properties and stability. Such a range of packaging material possibilities and the excellent cost / performance ratio sufficient to explain the interest in plastics and the prodigious development of production and use thereof in the pharmaceutical, cosmetics, chemical, food, and medical-surgical applications where there is a permanent solid-liquid or solid-solid contact. However, some of these additives are able to migrate from packaging into stored products thanks in part to their small size: this is the case of di-octyl phthalate (DOP) as a plasticizer for vinyl chloride (PVC). where there occurs the phenomenon of migration of plastic additives to the stored product and consequently the PVC loses its plasticity and mechanical properties for which it was selected. The study of plasticizer migration mechanism is therefore of considerable scientific and industrial interest due to environmental contamination in the case of polymers used for storage or transportation of liquid food, drugs or cosmetics. For this, a significant number of recommendations from governments defines approved plasticizers and are based on their toxicity, taking into account the risk of contamination of the stored food.

Keywords: Polyvinyl chloride, Simulants, Plasticizer, Diffusion.

1 Introduction

The use of plastic containers such as Polyvinyl Chloride (PVC), as packaging products in different industries where there is permanent solid-liquid or solid-solid contact between the container and the contents allows these packaging to play the role of barrier against external aggressions (oxygen, ultraviolet, microorganisms), but at the same time there is the phenomenon of migration of additives from the plastic material towards the stored product and as a result, the PVC loses its mechanical properties all by contaminating the environment. The aim of the work is to study the phenomenon of migration of a plasticizer from plasticized PVC towards certain solvents, the specific study of the reaction process involving the different migration kinetics makes it possible to determine the components of the diffusion coefficients through plates flat. In order to evaluate this migration, a study of the transfer of plasticizer (DOP), from plasticized PVC to certain simulants (n-hexane) and solvents (n-heptane, ethanol) was carried out. The migration kinetics of DOP and simulant liquids as well as the diffusion coefficients were determined.

2 Experimental

From the plates with an initial DOP content equal to 50%, samples of 2.5 cm side are cut and then weighed. For the first step which corresponds to the kinetics of transfer of the plasticizer to the simulator liquids: Ethanol, heptane and Hexane and the simulators to the plate. each of the PVC plates is immersed in a hermetically closed bottle filled with different simulator, the bottle is placed in a thermostatic bath making it possible to maintain the constant liquid temperature equal to 25°C with stirring using a magnetic bar constant. the kinetics of transfer is monitored for 15 days; the plate is removed every 24 hours and it is weighed again and the liquid is analyzed with GC.

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3 Results and Discussion

Les figures 1 et 2 illustrent les transferts entre le plastifiant et les liquides à la température ambiante et à une concentration en plastifiant de 50%.

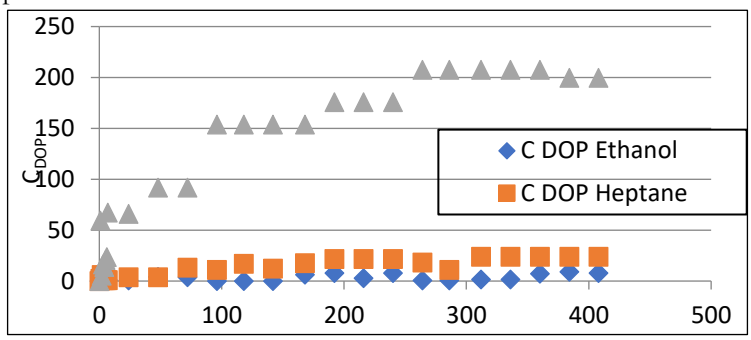

Figure 1: Kinetics of migration of DOP towards the simulator liquids.b) migration des trois solvants: éthanol,

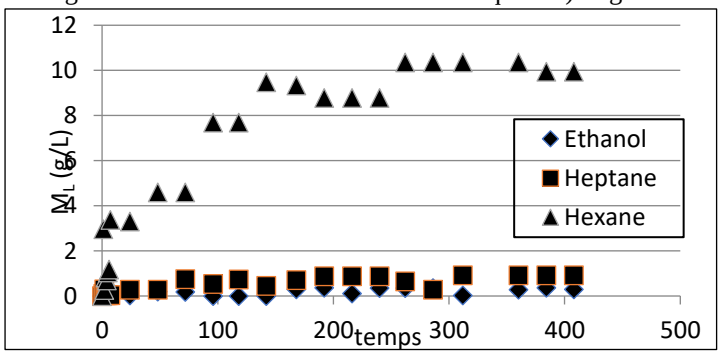

Figure 2: Migration kinetics of the three solvents: ethanol, heptane and hexane towards the PVC plates.

Table 1*: brings together the values of the diffusion coefficients "D" for the three solvents used:*

Type of solvent	**D_{DOP} .10^9 (cm^2/s)**		**D_{liq}.10^9 (cm^2/s)**	
	Short time	**Long time**	**Short time**	**Temps long**
Ethanol	7,184	8,339	12,290	9,353
Heptane	7,667	6,761	8,572	17,467
Hexane	11,652	14,199	8,517	19,721

4 Conclusions

A simultaneous transfer of the liquid to the PVC plate and of the plasticizer to the liquid is always established. In addition, the increase in liquid transfer is accompanied by an increase in DOP migration. The plasticizer is eliminated much more easily, and therefore in greater quantity, when it is in contact with n-hexane, on the other hand, equilibrium is reached more quickly with ethanol and n-heptane when the DOP is eliminated. La valeur des coefficients de diffusion montre que la nature du solvant est un facteur à prendre en compte lors de l'étude des phénomènes de transfert.

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