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Observations on the Solubility of Polyvinylchloride in Some Solvents Derived from Furfural

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The solubility of polyvinylchloride in different solvents derived from furfural has been determined as well as the viscosity of the solutions. The solubility fell to very low values with the appearance of double bonds in the solvents. The dependance of the logarithm of viscosity on the concentration was found to be linear.

INTRODUCTION

So far as we know no systematic investigations have been made of the solubility of polyvinylchloride (PVC) in different heterocyclic solvents which can be produced from furfural. The good solubility of PVC in tetrahydrofuran is universally known; tetrahydropyran is, according to O. W. Cass¹, also a good solvent for synthetic and natural resins, but generally not so active as tetrahydrofuran.

The purpose of this investigation was to determine whether more easily accessible solvents, which require fewer steps to be prepared from furfural as starting material, were good solvents for PVC and, further, to determine the influence of the ring saturation on the solubility of PVC in heterocyclic and homocyclic solvents.

EXPERIMENTAL

We therefore determined the solubility of PVC in the following solvents derived from furfural: furan (F), tetrahydrofuran (THF), furfuryl alcohol (FA), tetrahydrofurfuryl alcohol (THFA), dihydropyran (DHP), tetrahydropyran (THP), 2-methylfuran (silvan) (MF), 2-methyltetrahydrofuran (tetrahydrosilvan) (MTHF), as well as in some aromatic and hydroaromatic solvents as in toluene (T), methylcyclohexane (MCH), dimethyl phthalate (DMP) and dimethyl hexahydrophthalate (DMHP).

The obtained results are presented in Table I.

The viscosities of the solutions of PVC in 2-methyltetrahydrofuran, tetrahydropyran and tetrahydrofuran have been also determined and are represented in Fig. 1.

On the abscissa are the concentrations and on the ordinate the logarithms of viscosities in centipoises at 20°C. The dependance of the viscosity of solutions (v) on the concentration (c) of PVC in the solution can be represented by the following equations

$$\begin{array}{lll} \log v = 0.29 c - 0.17 & (\text{tetrahydrofuran}) & (1) \\ \log v = 0.32 c + 0.08 & (\text{tetrahydropyran}) & (2) \\ \log v = 0.37 c - 0.13 & (\text{tetrahydrosilvan}) & (3) \end{array}$$

TABLE I
Solubility of PVC in different solvents

Solvent	F	FA THFA	T	MCH	DMP	DMHP	MF	DHP	THF	MTHF	THP
% PVC in solu- tion	0	0	0	0	0.7	0.7	0.1	1.8	11	7	10

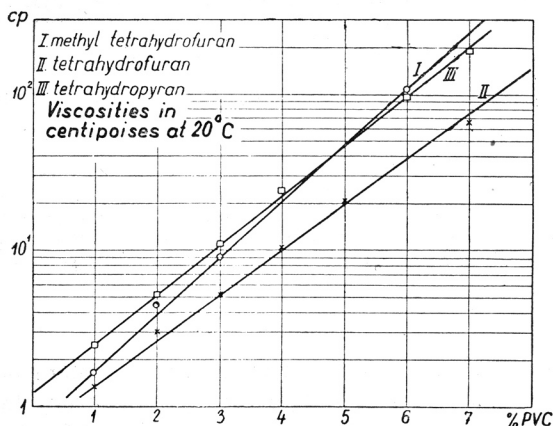


Fig. 1. Viscosities of PVC in different solvents

The determinations of solubilities were carried out by shaking the solvent with PVC powder (mean molecular weight 58,000 to 65,000) at $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and leaving to settle down overnight at that temperature. A part of the clear solution was taken by a pipette, evaporated, dried and the dry PVC weighted. It was not possible to determine the solubilities of PVC in viscous solutions (THF, MTHF and THP) with the same accuracy as in solutions of low viscosity. The viscosities have been determined in a Höppler viscosimeter with temperature control by an ultrathermostat.

DISCUSSION OF RESULTS

The interesting result which emerges from these observations is the negative influence of the olefinic bonds on the solubility in the solvents investigated. In compounds having two double bonds, such as furan and methylfuran, PVC is practically insoluble; if one double bond is saturated, as in dihydropyran, the solubility is slightly greater but still insufficient for any practical applications. Only after the saturation of both olefinic bonds the solubility of PVC becomes appreciable. The isomeric change from tetrahydrofuran to tetrahydropyran increases appreciably the solubility. The saturation of double bonds in homocyclic solvents, such as phthalates and toluene, does not contribute anything to the solubility of PVC in these compounds.

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REFERENCE

1. O. W. Cass, *Ind. Eng. Chem.* **40** (1948) 216.

IZVOD

Opazanja o topljivosti polivinilklorida u nekim otapalima, dobivenim iz furfurola

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Određena je topljivost polivinilklorida, kao i viskozitet dobivenih otopina u nekim otapalima, dobivenim iz furfurola. Prisutnost dvostrukih olefinskih veza u tim otapalima smanjuje topljivost na vrlo male iznose. Nađeno je, da postoji linearna ovisnost između logaritma viskoziteta i koncentracije polivinilklorida u otapalu.

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