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## FLAT-BED SEPARATION OF TAR SUBSTANCES ON SORBOFOL®

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### SUMMARY

The application of a new material for flat-bed chromatography, consisting of paper with the polymer built in, for the separation of aromatic hydrocarbons is demonstrated. The material, Sorbofol®, is interesting from the viewpoint of  $R_F$  values but its separating power depends on the present quality of porous organic polymers.

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Organic porous polymers based on ethylvinylbenzene have been used as lipophilic solid phases for thin-layer chromatography<sup>1-3</sup>. As certain difficulties appeared during the preparation and application of layers, a new material for flat-bed chromatography—a paper with the polymer built in—was developed in order to permit easy manipulation and storage. The properties of Sorbofol® have been described by DUFKA *et al.*<sup>4</sup>. The aim of this paper is to show some possible applications of Sorbofol taking as an example the  $R_F$  values of aromatic hydrocarbons that originate from tar.

Samples were dissolved in toluene and applied with a 10- $\mu$ l injection syringe on Sorbofol paper at a distance of 1.5 cm from the lower edge of the paper and 1-1.5 cm apart. The initial amount of the samples applied was in the range  $10^{-6}$ - $10^{-4}$  g, depending on the substances and the type of detection being used. The Sorbofol paper was placed in a developing chamber in such a way that the developing angle was 90°. The development was carried out by the ascending technique at room temperature. The aromatic hydrocarbons were detected by observing the fluorescence of the spots under a UV lamp, or they were sprayed with a saturated solution of tetra-cyanoquinodimethane in water-free acetonitrile in order to give the visible colour complex.

The variation of the  $R_F$  values of the individual aromatic hydrocarbons with structure is shown in Table I. The  $R_F$  values of the individual conformational isomers differ when both a non-polar solvent (pentane) and a polar solvent (a 3:1 mixture of ethanol and tetrahydrofuran) are used. However, the differences are greater in the polar system, particularly for benzofluorenes and benzofluoranthenes.

In Table II, the effect of an additional aromatic nucleus on the  $R_F$  value is shown. The decrease in  $R_F$  values is approximately the same in both solvents, except that for perylene the change in the  $R_F$  value occurs only in the polar system. The presence of a hetero-atom in the ring exerts a considerable influence on the  $R_F$  value, particularly in polar mobile phases, as can be seen from Table III. In Table IV, the effect of a substituent on the  $R_F$  values is demonstrated. A hydroxyl substituent, owing to interaction with the mobile phase, increases the  $R_F$  value of the derivative

TABLE I  
EFFECT OF STRUCTURE ON  $R_F$  VALUES

Compounds	$R_F$	
	Pentane	Ethanol-THF
2,3-Benzofluorene	0.50	0.35
3,4-Benzofluorene	0.53	0.47
1,2-Benzofluorene	0.52	0.56
3,4-Benzofluoranthene	0.29	0.22
11,12-Benzofluoranthene	0.32	0.37
Pyrene	0.50	0.36
Chrysene	0.40	0.39
Triphenylene	0.43	0.53
1,2-Benzanthracene	0.43	0.28
3,4-Benzopyrene	0.28	0.21
1,2-Benzopyrene	0.37	0.28
Perylene	0.24	0.32
1,2,3,4-Dibenzanthracene	0.30	0.38
1,2,7,8-Dibenzanthracene	0.35	0.42

TABLE II  
EFFECT OF NUCLEUS ON  $R_F$  VALUES

Compounds	$R_F$	
	Pentane	Ethanol-THF
Fluoranthene	0.41	0.31
3,4-Benzofluoranthene	0.29	0.22
Pyrene	0.50	0.36
3,4-Benzopyrene	0.28	0.21
Perylene	0.24	0.32
1,12-Benzoperylene	0.24	0.20

TABLE III  
EFFECT OF HETERO-ATOM ON  $R_F$  VALUES

Compounds	$R_F$		
	Pentane	Ethanol-THF	Ethanol
Pyrene	0.50	0.36	0.28
1-Azapyrene	0.29	0.59	0.44
Fluorene			0.34
Carbazole			0.66
Anthracene	0.49	0.35	
Acridine	0.46	0.60	

by displaying donor or acceptor properties. Methyl groups, which are electron acceptors, decrease the  $R_F$  value.

The properties of Sorbofol with various contents of porous polymer were compared.  $R_F$  values of pyrene are shown as an example for polymer contents of 30, 40, 50, 60 and 70% (w/w) in Table V. The  $R_F$  values decrease according to general expectations with an increase in the amount of polymer present. With an increase in the amount of porous polymer the flow-rate through the Sorbofol also decreases.

We tested whether the treatment of Sorbofol with solvents had any influence

TABLE IV  
EFFECT OF SUBSTITUENT ON  $R_F$  VALUES

Compounds	$R_F$		
	Pentane	Ethanol-THF	Ethanol
1,2-Benzanthracene	0.43	0.28	
9,10-Dimethyl-1,2-benzanthracene	0.42	0.34	
Naphthalene			0.67
2,6-Dimethylnaphthalene			0.50
Fluorene			0.34
2-Hydroxyfluorene			0.72

TABLE V  
EFFECT OF POLYMER CONTENT IN SORBOFOL ON THE  $R_F$  VALUE OF PYRENE

Content of porous polymer (Synachrom) (wt.-%)	$R_F$
30	0.70
40	0.62
50	0.52
60	0.51
70	0.36

on the chromatographic behaviour of substances. Sorbofol was washed with propanol, then with acetone and finally dried either at room temperature or at 125° (Fig. 1).

In Fig. 1, the flow-rates of a solvent through treated paper (curves 1 and 3) and an untreated paper (curves 2 and 4) are presented. The solvent flow-rate is more rapid for the treated Sorbofol paper in both instances. The drying temperature has no effect on the flow-rate (curves 1 and 3 hold at both 25° and 125°). However, the  $R_F$  values of the substances and the efficiency of the layer remain the same.

However, it is necessary to emphasize that the spots are relatively diffuse, so that the plate efficiency is low (e.g., for carbazole the HETP is about 1.1 mm, and the number of theoretical plates is 130 with an  $R_F$  value of 0.63 and with an amount of 0.1  $\mu$ g). The result is that with considerably large differences in  $R_F$  values of aromatic hydrocarbons, the separation of the spots of the components from the mixture is poor, particularly when larger amounts of the substances are applied.

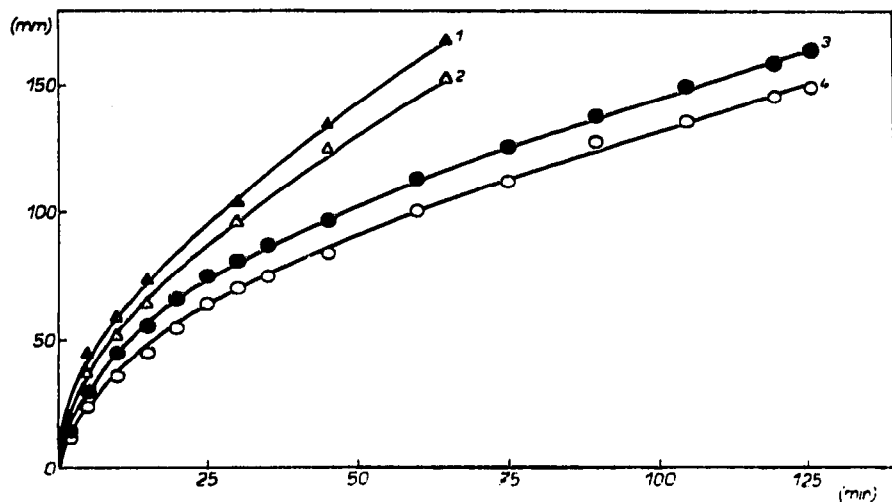


Fig. 1. Effect of Sorbofol treatment on the solvent flow-rate. 1 = Treated Sorbofol, acetone-propanol (1:1); 2 = untreated Sorbofol, acetone-propanol (1:1); 3 = treated Sorbofol, ethanol; 4 = untreated Sorbofol, ethanol.

In conclusion, it can therefore be said that the use of Sorbofol as a non-polar material for thin-layer chromatography is interesting from the viewpoint of  $R_f$  values, but the separation power depends on the present quality of organic porous polymers.

#### REFERENCES

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