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THE BEHAVIOUR OF SOME BENZENE DERIVATIVES ON THIN LAYERS OF ALUMINUM OXIDE - COMPARATION WITH PLAIN AND Fe(III)IMPREGNATED SILICA GEL

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ABSTRACT

The behaviour of some carboxy and hydroxy benzene derivatives related to humic material was examined by thin layer chromatography on aluminium oxide as the support and water as developer. Their R_f -values were compared with those on plain and Fe(III)-impregnated silica gel plates.

INTRODUCTION

It is considered (1) that processes of alteration and dissolution of minerals from soils and sediments are a consequence of surface reactions occurring, beside the others (such as H^+ action), between OH groups on the surface of hydrous oxides and dissolved organic ligands through coordination and formation of surface complexes.

Investigations with natural occurring materials (2-4) revealed that in dissolution of metals through complexation the most important role have the compounds with carboxy and hydroxy functional groups the complexation activity of which follows the subsequent order: $-\text{COOH}$, $> -\text{OH}$, $> -\text{CO}$ etc. The compounds having the above mentioned groups, being mostly benzene derivatives, are either degradation products of humic material or are found as free molecules in soils and sediments (5-7). These facts initiated us to investigate the chromatographic behaviour of some benzene derivatives with active functional groups; thin layer chromatography on different supports with water as developer was performed as a model system to simulate natural conditions (8,9). In the present work thin layer chromatography on aluminium oxide as the support was investigated.

EXPERIMENTAL

All compounds tested and chemicals used were of analytical grade. Precoated plates of silica gel 60 F₂₅₄ (Merck) and aluminium oxide F₂₅₄ (type E) were used. Silica gel plates were impregnated with $\text{Fe}(\text{NO}_3)_3$ by spraying with a 1% ethanolic solution. Tap water was used as developer. Detection was performed by spraying with 0.05% ethanolic bromocresol green indicator reagent and by inspection

under UV light. The chromatograms were developed by the ascending technique. The ascent of solvent was 8-10 cm. R_f values were determined using the arithmetic mean of 2-5 runs.

RESULTS AND DISCUSSION

In Table 1. the results of chromatographic behaviour of benzene derivatives on aluminium oxide compared with the behaviour on plain and Fe(III)-impregnated silica gel are presented. It can be seen that benzene carboxylic acids and phenolic acids except gallic exhibit small mobility on plain silica gel plates. On the same layer hydroxy benzenes moved considerably while aldehydes show medium movability. This behaviour can be attributed firstly to the solubility of the compounds in water developer, but also to the level of interaction with the support. It can be presumed that no complexes (or very unstable complexes) were formed between the above mentioned compounds and support and that their R_f values are mainly the consequence of the solubility in water. The behaviour of the compounds on aluminium oxide seems to be dependent on the position of functional groups in the benzene ring. Regardless the kind of the group the compounds with functional groups (OH, COOH) in ortho position, except 1,2-benzenedicarboxylic acid moved tardily what can be attributed to the formation of com-

TABLE 1.
R_f-values of benzene derivatives on silica gel, Fe(III)-
-impregnated silica gel and aluminium oxide thin layers.
Developer: tap water

COMPOUND	R _f x 100		
	Silica gel	Fe(III)- impregnated	Aluminium oxide
2-Hydroxybenzoic acid (Salycilic acid)	5	90*	21
4-Hydroxybenzoic acid	10	82*	77
4-Hydroxy-3,5- -dimethoxybenzoic acid	4	84*	56
3,4,5-Trimethoxy benzoic acid	3	6*	72
1,2-Benzenedicarboxylic acid	32	11*	77
1,4-Dihydroxy benzene	93	88*	69
1,3-Dihydroxy benzene	80	91*	61
1,2-Dihydroxy benzene	92	89*	8
1,2,3-Trihydroxy benzene	91	15*	11
3,4,5-Trihydroxy benzoic acid (Gallic acid)	100*	15*	10
3,4,5-Trimethoxy benzaldehyde	51	47	47
2,5-Dimethoxy benzaldehyde	33	36	41

* Previously published (8,9)

plexes of small solubility in water, as well as to complexes of polymeric composition. All other compounds show medium or high mobility. Our previous (8,9) results obtained with Fe(III)-impregnated supports are listed for comparison. It can be pointed to some differences in the behaviour of the compounds on Fe(III)-impregnated silica gel and aluminium oxide supports. For example, salicylic acid and o-dihydroxy benzene moved considerably on Fe(III)-impregnated silica gel while on aluminium oxide they moved slowly. The opposite behaviour showed 3,4,5-tri-methoxybenzoic and 1,2-benzenedicarboxylic acids. Although the composition of both supports is rather similar, of hydroxy/oxide type, the above findings indicate that complexes of different characteristics depending of metal ion are formed in the experimental conditions applied. Decreased mobility of the compounds having three hydroxy groups on aluminium oxide as well as on Fe(III)-impregnated silica gel may be explained by formation of polymerization products (10) which are much less soluble in water. No differences in behaviour of aldehydes on any support indicate the complexing inactivity of the aldehyde group, and presumably depending only to their solubility in water.

By extending these findings to natural conditions it can be concluded that natural hydroxy/oxide layers of iron and aluminium can affect the retardation or movability

of simple organic molecules in soil and on the other side, organic molecules having carboxy and hydroxy groups can improve dissolution of hydroxy/oxides of iron or aluminium in soil and sediments.

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