

THE EFFECT OF LAYER THICKNESS ON  $R_F$  VALUES IN THIN LAYER CHROMATOGRAPHY

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## SUMMARY

Results quoted in the literature suggest that there is generally an increase of  $R_F$  value with layer thickness under ordinary conditions of thin layer chromatography. Under ideal conditions it appears that  $R_F$  values are independent of layer thickness, as expected theoretically. Several factors that can operate to cause  $R_F$  to vary with layer thickness are discussed.

The effect of layer thickness on  $R_F$  values under normal conditions has been investigated by PATAKI<sup>1</sup>, who observed a small increase of  $R_F$  with layer thickness over the range 0.25 to 1 mm. A more extensive study, wherein the conditions of adsorbent activation and of chromatogram development were varied, was later carried out by HONEGGER<sup>2</sup>. In this latter study it was shown that, when the plate was allowed to dry in air over 72 h and was then developed under conditions where there was good liquid-vapour equilibrium in the tank,  $R_F$  values were virtually independent of layer thickness. Under other conditions, however, it was observed that  $R_F$  values increased with layer thickness. It is clear from HONEGGER's work that it is essential that the activity of the adsorbent should be uniform throughout the layer if  $R_F$  values are to be independent of layer thickness.

Theoretically, on the basis that the phase volume ratio ( $A_l/A_s$  in the MARTIN and SYNGE equations) is independent of layer thickness, one may expect  $R_F$  values also to be independent. In practice, however, it is necessary to consider certain other factors that may or may not be important.

The effect of the design of the developing tank system has been examined by HONEGGER<sup>2</sup>. Where solvent vapour can be pre-adsorbed by the adsorbent (HONEGGER's SK or K tanks)<sup>2</sup> it is possible that a thick layer will not have time to reach good equilibrium with the solvent vapour; two situations at least can then arise:

(a) With a lower proportion of adsorbed solvent vapour in the thick layer a greater volume of solvent will need to flow to wet a given area of the plate and thus  $R_F$  values will tend to be higher the thicker the layer.

(b) GEISS *et al.*<sup>3,4</sup> have shown that dry solvent vapour can displace some moisture from a partially activated plate, thus increasing its activity. Since it is likely that this will occur more rapidly and efficiently with a thin than with a thick

layer of silica gel, it may be concluded that this effect also could lead to an increase of  $R_F$  value with layer thickness.

It is suggested, therefore, that both the above effects could operate together, or singly, to give the results recorded in the literature.

There is another possible effect of layer thickness that appears to have received little attention. With the more polar solvents, especially, the heat of adsorption of the solvent onto the layer can be appreciable, as is well known. But the dissipation of this heat should be less the thicker the layer, and one may thus expect the temperature to be greater in a thick than in a thin layer. In general, therefore, if there is a decrease in  $R_F$  with temperature as normally found with adsorption chromatography, then this heat effect also could lead to an increase of  $R_F$  with layer thickness.

The experiments carried out in this laboratory confirm that, with homogeneous activation of the layer and with the use of the S-tank,  $R_F$  values are independent of the layer thickness as expected theoretically, if the heat of adsorption effect noted above is not significant.

#### REFERENCES

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