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Application
Note 12

Absolute Measurement of Moisture Diffusion into Blister Packaging Systems

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This application note describes a rapid methodology, using a DVS automated gravimetric sorption analyser, for the determination of the permeability of blister packing systems.

Introduction

Blister packaging systems are often used as a primary barrier to the ingress of moisture into moisture sensitive products. These blister packaging systems often show substantial differences in barrier properties to the unformed polymer film due to localised defects/stresses in the polymer material as a result of the forming process. The DVS results may be used to assess batch-to-batch quality variations, or may be used to predict product life under a wide range of storage conditions for example.

Method

The basic principle of this methodology is to measure the uptake of moisture into a sealed blister pack filled with pre-dried zeolite molecular sieve pressed into a dummy tablet. The zeolite aggressively adsorbs any moisture that penetrates the blister pack, and thus effectively maintains a constant 0% RH environment inside of the blister pack. Since the DVS instrument accurately controls the relative humidity on the outside of the blister, it is then relatively easy to measure steady state diffusion for a range of concentration gradients. If the surface area of the blister pack is then known, a range of permeability constants may be readily calculated.

Results

Figure 1 shows DVS data for a single experiment looking at water vapour diffusion into a PVC blister capsule at 30°C. It is clear that steady state diffusion is achieved very quickly and that adsorption effects on the blister pack surface are almost negligible and occur in the first 10-20 minutes of each stage.

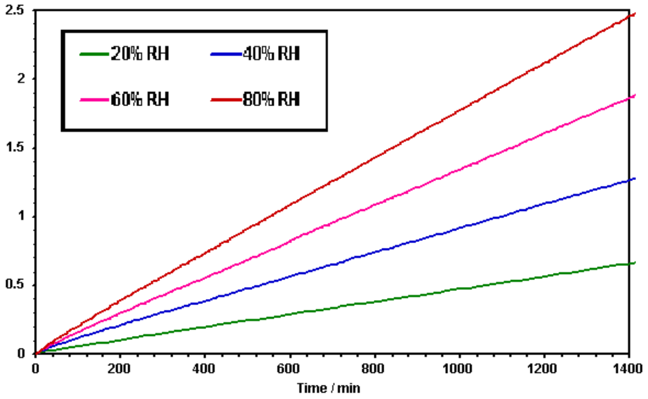

Figure 1. DVS diffusion data for a PVC blister at 30℃.

The diffusing flux may be readily calculated from the data by fitting a linear function to the steady state data using a standard regression analysis to obtain the slope of each line. The permeability constant may then be calculated if the surface area of the blister pack is known, and may be used to compare different blister geometries. In principle, if the thickness of the blister film is known, it is possible to calculate concentration dependent diffusion constants, however care must be taken when interpreting such data as the wall thickness in the blister may show marked local variations as mentioned previously.

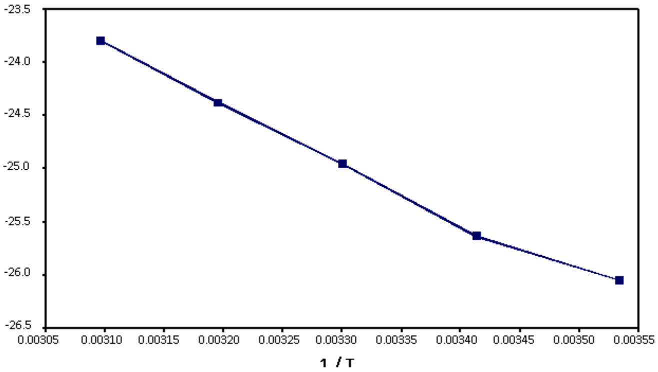

Figure 2. Arrhenius plot for moisture diffusion through PVC blister at 40%RH.

Measuring diffusion fluxes at a variety of temperatures may also be used to probe the kinetics of the diffusion process. Figure 2 shows a plot of In (Flux) against 1/T for diffusion of moisture through the same blister at 40%RH and yields a straight line, as expected for Arrhenius type behaviour. From the gradient of this line an *effective* activation barrier to moisture diffusion may be calculated. This parameter may then be used to rank the temperature dependence of the permeability of different blister packs to moisture diffusion, thus enabling a stability envelope to be defined for particular product/blister combinations.

Conclusion

This methodology may be used to quickly and reliably measure the moisture permeability for a wide range of blister packaging systems and allows simple QA/QC decisions to be made. As well, this technique provides useful data for the development of new packing systems with specific moisture permeability requirements.

Acknowledgement:

SMS acknowledge the contributions of Mr. C. L. Levoguer and Mr. J. Booth, for this Application note.