Monsanto

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SUBJECT : Hot Melt Adhesives

REFERENCE

TO : J. R. Darby

Hot melts are used primarily in two markets, adhesives and coatings. In the adhesives area, the largest market is paper converting (sealing folding carton and corrugated paperboard). Other major adhesive uses are bookbinding, shoe soles, and laminating fabrics. Hot melt coatings use essentially the same ingredients as hot melt adhesives, but the base material is usually a wax instead of a resin such as ethylene vinyl acetate. Coatings are used to a great extent for their aesthetic appeal (e.g. frozen food cartons), but in addition are used to provide moisture barriers, and a good printing surface.

In adhesive hot melts, waxes are still used, but they do not constitute the base material as in coatings. Instead, various synthetic polymer resins, such as ethylene vinyl acetate, are used. These base resins are then modified with waxes (to lower melting point) and other resins in order to achieve the desired properties, such as, a certain degree of adhesiveness combined with toughness and elasticity. The proper combination of these properties will depend on the particular application for which the adhesive is to be used.

The other resins used to modify the properties of the base resin have been mainly rosins, rosin ester, polyterpenes, petroleums and hydrogenated hydrocarbons. A particularly effective modifier resin is Aroclor 5460, a chlorinated terphenyl.

Testing for adhesiveness is a complicated job, since an adhesive may be quite effective for one substrate and ineffective for another. For example, most combinations of resins and waxes will give 100% fiber tear when used to adhere kraft paper, but wood-to-wood bonds require more careful formulating. Since toughness and flexibility are very desirable properties for many hot melt adhesive applications (book and magazine binding, shoe soles, corrugated flaps on cartons, etc.), we chose to use these properties as criteria for selection of hot melt formulations. By drawing down a film of suitable thickness on release-treated

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glass, cutting dumbbells from the film, and determining elongation, tensile strength, and toughness, on the Instron, we were able to cover a very wide range of hot melt formulations and obtain data on flexibility (elongation) and toughness which were relatively easy to obtain and to reproduce.

For the most part, Elvax 210 and Elvax 260, were used as the base resin. The number of waxes available is very large; we limited ourselves to two microcrystalline waxes and one paraffin wax. Aroclor 5460 was compared against other tackifying resins, such as Goodyear's Wingtack 95 and Reichhold's Sta-tac 100. Our procedure was as follows: into a 100 ml beaker, weigh 25 g of the solids being used (e.g. 10 g Elvax 210, 10 g Aroclor 5460, and 5 g of wax). Heat on a hot plate until fluid and stir until a homogeneous solution is obtained. We have found that a hot plate is satisfactory for lower melting resins such as Elvax 210, but for higher melting resins an oil bath kept at a constant temperature (200°C) is more satisfactory.

If the hot melt is sufficiently fluid, there will probably be few, if any, air bubbles entrapped. In viscous liquids, it may be necessary to put the beaker in a vacuum dessicator in order to get rid of the air bubbles. The hot liquid is then poured onto a release-treated glass plate, and a film quickly drawn. We used a 25 mil knife, which, because of the 100% solids content, gave a 25 mil film. After removal from the glass plates, its films were conditioned for several days, dumbbells cut (we used a sambone die) and tensile properties determined on the Instron (crosshead speed, 1"/min. This could be increased to 5"/min for very flexible films). Data for elongation and toughness are plotted on triangular coordinate paper, so that the optimum ratios of base resin/wax/tackifying resins can be selected.

An illustration of the type data we obtained is shown in the table below. It will be seen that excellent elongations and toughness can be obtained with 40% Elvax 210 if most of the remainder of the formulations is Aroclor 5460. If Wing-Tack 95 is used, 80% base resin is required for the same performance. Since the base resins are the expensive part of the formulation, the use of Aroclor 5460 cuts down on raw material costs.

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	Per Cent Ingredient							
Elvax 210	80	80	40	40	40	40	40	40
BeSquare 185 Wax			50	30	10	50	30	10
Aroclor 5460	20		10	30	50			
Wing-Tack 95		20				10	30	50
Per Cent Elongation	480	600	35	130	640	60	85	105
Toughness	3.8	5.7	0.6	1.9	5.1	1.1	1.3	1.3

A more detailed write-up of our procedure and results will be forthcoming in the new future.

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