Process Evaluation Section

Development of a New Solventless Process For Making Adhesives

Problem/Opportunity

Over 2.5 million tons of pressure sensitive adhesives (PSAs) are annually produced in the world. The estimated total U.S. market alone for adhesives is about \$10 billion dollars. PSAs are commonly used in products such as labels, tapes, removable note pads and self-adhesive postage stamps. PSAs are made using tackifier and latex dispersions. The water-based process for manufacturing tackifiers is time consuming and very energy intensive, since the resin is first melted and then used to form a water-in-oil emulsion. This is then converted to an oil-inwater emulsion by phase inversion in the presence of continuous stirring. This process takes about 4 hours per batch and consumes over 9,000 Btu of thermal energy in the form of steam, per pound of resin, in order to melt the polymers and to maintain the molten polymer/water mixture at slightly below 100°C. It also takes about 0.05 kWh of electricity per pound of polymer to operate the shear mixers. Thus, there is an opportunity for significant energy savings and time reduction by improving the process. The present water-based process is also limited to polymers having a glass-transition temperature less than 100°C. Organic solvents have to be used for processing polymers with higher glasstransition temperatures.

Approach

A key objective of this research project is the development of a cost-effective and energyefficient process to produce commercial-quality tackifier dispersions containing resins having a wide range of softening points. Instead of using a melt process, we plan to develop a super- or sub-critical process to pulverize the lowmolecular-weight resins into particles of a few microns in size that can then be dispersed in water at room temperature rapidly and with minimal stirring. This process would not require the heating and cooling that is used in the current method. This process has advantages besides energy savings. With the new process, new formulations using higher melting polymers can also be produced using the new method to replace some of the formulations that are now possible only using organic solvents. This process is expected to consume about 1/3 the energy of the conventional process and to reduce the processing time from 4 hours to a few minutes.

Expected Results

The project is just starting. *Phase I consists of the following tasks:*

- 1. Experimental evaluation of the swelling and glass-transition temperature characteristics of polymers used in making tackifiers with various fluids at sub- and super-critical conditions.
- 2. Design and build an experimental apparatus for bench-scale experiments.

The plan for Phase II is to:

- 1. Conduct bench-scale experiments to produce powdered polymers.
- 2. Assess process economics.
- 3. Design and construct a large-scale reactor.

In Phase III we plan to:

- 1. Conduct large-scale tests.
- 2. Produce powdered polymers for our industrial partner to test in making actual tackifier products.
- 3. Update the economic analysis.