

ENVIRONMENTALLY BENIGN PSAs FEATURED AT RECYCLING SYMPOSIUM

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THE TAPPI 2000 RECYCLING SYMPOSIUM ON MARCH 5–8 at the Hyatt Regency Crystal City in Washington, D.C., will provide a detailed story on the development of an environmentally benign pressure sensitive adhesive (PSA) that marks the beginning of a new era in paper recycling. Sponsored by the United States Postal Service (USPS), the United States Department of Agriculture Forest Products Laboratory (USDA-FPL), the Adhesives & Sealants Council (ASC), the American Forest & Paper Association (AF&PA), and TAPPI, the symposium will feature 21 technical sessions that address a unique cooperative effort involving teams to address all aspects of stickies in pulp.

The development of an environmentally benign PSA for use by the USPS is a success story that proves the synergistic benefits available through cooperative programs among government, private industry, universities, and industry organizations. The speakers at the TAPPI 2000 Recycling Symposium will provide detailed information on their contribution to this success.

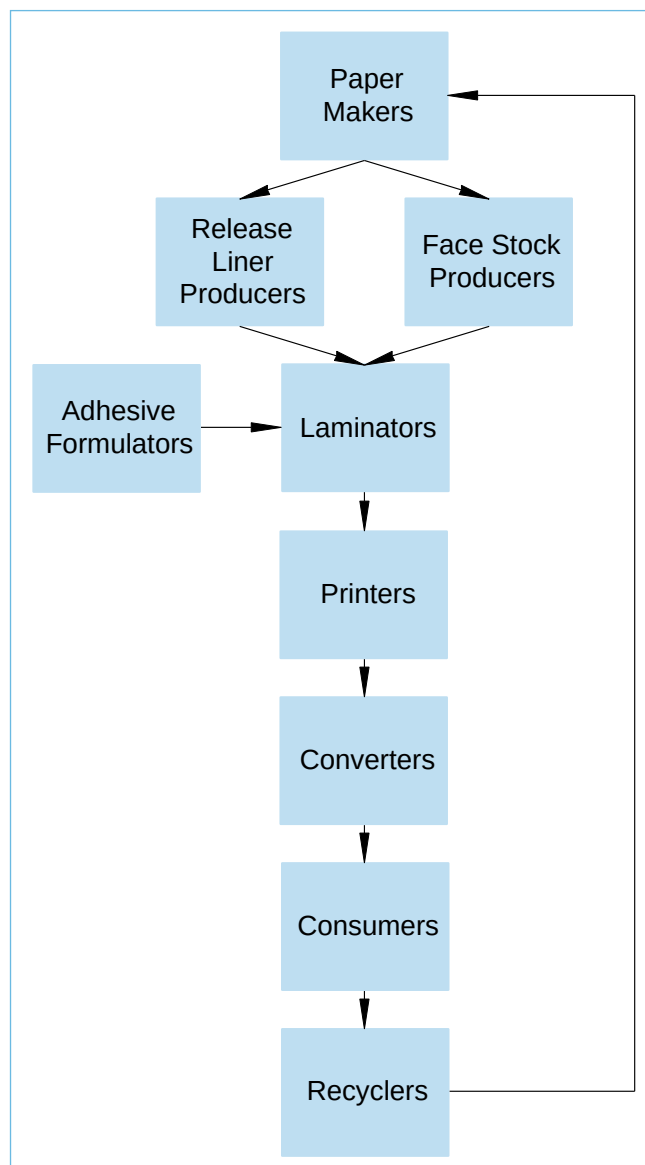
Joseph Y. Peng of the USPS and a conference chairperson for the symposium notes that “everyone involved in the recycling, adhesive, printing, and converting industries must attend this symposium to experience the unique cooperative approach used to develop the new generation PSA with the benefits of the resulting data base and universal tests. Symposium attendees will readily see how this new era in paper recycling presents a valuable approach to problem solving. This market-driven solution is novel for the pulp and paper industry.”

SUCCESS STORY

The USPS began the program, “Environmentally Benign Pressure Sensitive Adhesives for Postal Applications,” to develop stamps that do not adversely affect the environment. A key innovation in the program was the creation of vertical teams to integrate the efforts of researchers, manufacturers, converters, printers, and recyclers. **Figure 1** shows a diagram of all the parties involved in stamp production. The figure illustrates the need for vertical teams since each operation influences subsequent ones. Although the USPS falls in the diagram as a consumer, the organization also served as an “umbrella” to assemble the participants of the cooperative effort.

In the United States, stickies cost the paper industry more than US\$ 650 million per year in the recycled pulp industry. From their introduction in the late 1980s, the annual volume of PSA stamp usage has increased to approximately 85% in 1998. This growth equates to use of about 38 billion PSA stamps in the total stamp program of 43 billion. Growing concern regarding their impact on the environment has accompanied the increasing popularity of the PSA stamps.

By definition, a PSA is a permanently tacky material that can bond to a wide variety of substrates at room temperature using only minimal pressure. Stickies are contaminants that are naturally tacky or become tacky on exposure to pressure, temperature, or both. They originate from residues of adhesives and coatings, plastic films, inks, and similar ingredients that find their way into a stream of recycled paper material. Because of their permanently tacky nature, PSA materials are prime contributors to formation of stickies. PSA use on postage stamps



1. Parties involved in stamp production emphasizing the need for vertical teams because each operation influences subsequent ones

could therefore potentially create a problem with recycled paper products.

The USPS took the initiative, provided the resources, and formed teams to examine all aspects of recycling postage materials containing PSA. The adhesive industry formulated new PSA materials to be screenable. USDA-FPL worked with everyone involved to develop a standard method to evaluate recyclability of paper containing PSA. This cooperative effort resulted in the development and successful testing of the environmentally benign PSA.

TECHNICAL PROGRAM

Opening session

During the Opening Session, Peng will address conference registrants on "Original purpose of environmentally benign PSA program." Lynne A. Thoma of Specialized Technology Resources, Inc., will deliver a paper called "Overview of environmentally benign PSA program development efforts." By covering the program purpose and the response of industry to this, their presentations will set the stage for many specific papers on individual aspects of the program.

Said AbuBakr of USDA-FPL in his talk on "Lessons learned from the process of developing and evaluating the new-generation PSA" will show how the program "started with a problem, finger pointing, and blaming." It ended "with a solution and a useful product with ownership from all parties participating in the process." AbuBakr notes, "A collective approach in defining the problem, providing solutions, and developing standard methods of testing proved to be very successful."

A symposium session on "Formulation of benign PSA" features speakers from Solutia, Inc.; Avery Research Center; Air Products & Chemicals, Inc.; Dyna-Tech Adhesives, Inc.; Franklin International; and 3M. Paul McCaslin of Avery Research Center will talk about two strategies used to develop PSA materials with reduced stickies. According to McCaslin, "One approach is to design the PSA to agglomerate during repulping so that the resulting clusters of polymeric material in which the PSA is typically found can be captured during pulp screening. Another approach is to tailor the PSA properties so that it is dispersed in the aqueous phase during repulping and separated from the paper when the water is removed." The key element of the dialogue between recyclers and the adhesive converting industry initiated under the USPS program umbrella was the determination that the strategy involving dispersion was not the preferred approach for paper recyclers. The recyclers wanted to remove the PSA as early as possible in the recycling operation without adding additional capital equipment.

A companion session will feature "Fundamental studies of PSA behavior." This session includes "Recyclability of next-generation PSA for postage stamp applications: Interactions between printing methods and adhesive type" by Kevin T. Hodgson, Christopher Ashley, and Michael Pearson at University of Washington. Another paper is "Effect of release liner materials on paper recycling" by Richard Venditti, Richard Gilbert, and Andy Zhang at North Carolina State University.

A session on "Release coatings" emphasizes the importance that other components of a typical PSA construction have in the development of an environmen-

tally benign PSA. "Release liner manufacture, its properties and utility" by Darrell Jones of Dow Corning Corp. will examine the chemical nature, physical characteristics, and coating methods for silicone release coatings and the substrates commonly employed.

Practical applications

Considerable effort in the development program for an environmentally benign PSA involved testing and practical applications of various components of the study. One symposium session is "Converters' experience with benign PSA." In this session, Al Kuhl of Spinnaker Coating will discuss "Curl control in PSA stamp paper." His presentation will focus on coating and drying of PSA stamp paper from emulsions. In the session entitled "Printers' experience with benign PSA," Ian Ashton of Banknote Corp. of America will trace the progress for his company's first production of PSA postage stamps in 1992 to their present manufacture of offset PSA stamps in roll-to-sheet operations using nine print towers, in-line die cutting and sheeting, electronic register control, and automatic density controls.

The session chairperson, Michael Landa of Avery Dennison Fason Roll North America, states that the "significance of the session is to educate the audience in the manufacture of self-adhesive materials. They will learn that the converters not only create the adhesives that can be potential contaminants in the recycling process but also function as significant customers for paper. The session will report on the dialogue among recyclers and the people who potentially produce the contaminants in the recycling process."

Carl Houtman of USDA-FPL is the chairperson for a panel on "Pilot experience with benign PSA" and a session on "PSA quantification methods." Houtman noted that the purpose of the symposium "is to let the paper industry know about the substantial body of work done to help solve a problem in removing PSA. The goal of the team was to reformulate the adhesive to meet all the necessary requirements with easy recyclability. The program is a model for meeting market challenges. It did not involve research first followed by finding a home in the marketplace. It featured a review of the problem with design of the research and process to solve that problem."

Loreen Ferguson of American Fiber Resources, Diane Chadderdon of International Paper, Joe Albrycht of Mississippi River Corp., Wally Bergstrom of P.H. Glatfelter, William Mayo of International Paper, and Kenneth Wolfe of Westvaco Corp. are the participants in a panel discussion on "Recycling mill trials." The final stage of the USPS program required practical evidence that the new adhesive systems would work in commercial recycling mills. The panelists will discuss benchmark PSA trials to qualify

individual mill sites and candidate PSA trials to qualify the twelve PSA materials as environmentally benign products.

The mill trials are the last step in the development of an environmentally benign PSA under the auspices of the USPS program.

Satisfactory mill trial results will demonstrate that the total protocol for development of such an adhesive is valid. Wolfe evaluated in his normal process at Westvaco material containing two experimental adhesives at a defined level compared with an adhesive currently used. In describing the importance of the trial to Westvaco, Wolfe noted that the company "must be careful in the selection of the waste sources we use. We know what we need to meet customer expectations for the final product. We also know our equipment capabilities. The trial will allow us to add to our bank of knowledge about what our operation can and cannot use. Satisfactory trial results will demonstrate that benign adhesives are available. When the adhesives enter the waste stream in stamps and other applications, the ability of a mill such as ours will be able to handle the waste stream better."

A review of "USPS recycling efforts" is the title of a symposium featuring papers by representative of USPS on "Greening the mail initiative" by Charles Vidich, "Undeliverable standard mail recycling" by Debi Chapman-Hermann, "Postage/envelope products" by Charles Delaney, "Expedited mail/package services" by Michael Barr, "Electronic asset management" by Michael Fanning, and "Green post offices" by Ujwala Tarnaskar.

The session entitled "International experience with PSA" will feature the global implications of the work to develop an environmentally benign PSA. Speakers from France, Germany, and Finland will discuss environmental concerns in their countries and the work to fight stickies in paper recycling. In a paper on "Europe looks to the USPS PSA project with great expectations," E. Krauthauf of Haindl Papier in Schongau, Germany, will mention the active efforts of INGEDE which is using the same approach as the USPS by working in Europe with other members of the paper chain to improve total recyclability of printed products. Their goal is to integrate product recyclability into the product specifications of every printed product. Screenable PSA materials are a step toward achieving that goal.

OTHER SYMPOSIUM FEATURES

The keynote speaker at the TAPPI 2000 Recycling Symposium will be Fran McPoland, the Federal



Environmental Executive. In her Environmental Protection Agency position, she reports to the White House Office on Environmental Policy and oversees the implementation of President Clinton's Executive Order 12873. This requires purchase and use of recycled and environmentally preferable products in all federal procurements. In 1998, McPoland became a member of the Steering Committee to make policy for Executive Order 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition.

To celebrate the unique role that postage stamps play in the TAPPI 2000 Recycling Symposium, the USPS will provide a philatelic booth operating from 11 a.m. to 7 p.m. on March 6–8. Each day will feature a specific postmark and pictorial cancellation design. Conference atten-

dees will receive three cachet envelopes and information on purchasing the stamps and obtaining the postmarks.

Additional information and registration material for the TAPPI 2000 Recycling Symposium is available from the TAPPI Service Line at 1 800 332-8686 (United States), 1 800 446-9431 (Canada), and +1 770 446-1400 (International). The fax number is +1 770 446-6947, and the web site is <http://www.tappi.org/public/events.asp>. Mailing address is TAPPI Registration Department, Technology Park/Atlanta, P. O. Box 102062, Atlanta, GA 30368-0062.TJ

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RECYCLABILITY AS A NEW MATERIAL REQUIREMENT

The USPS program to develop "Environmentally Benign Pressure Sensitive Adhesives for Postal Applications" placed new requirements on pressure sensitive adhesive formulations. The highly engineered solution that resulted from the cooperative efforts of many team members ensures that PSA stamps do not cause problems during recycling because of stickies.

PSA materials used for stamps are emulsified acrylic copolymers or formulated styrene-butadiene rubber products supplied in solvent. They are coated on silicone release paper, dried, and transferred to the paper substrate that is then printed. The resulting permanent PSA must provide a balance of adhesive and cohesive characteristics that influence the final tack, peel strength, and shear strength of the product. In this sense, the adhesive for stamps is similar to any PSA application.

Stamp use requires additional PSA properties for recycling operations. During the pulping operation, the PSA should not fracture into small particles. Large particles of PSA remaining after the pulping are easier to remove during screening. Any remaining adhesive requires removal by flotation.

Screening

During pulping and subsequent screening, PSA particle size distribution and temperature strongly influ-

ence removal efficiency. The strength of the PSA polymers and the particle surface chemistry that controls the agglomeration are the important factors that determine the particle size distribution.

Higher temperature decreases screening efficiency probably due to deformation of particles through the screen. Modulus of the PSA polymer therefore determines its response in the screening operation. In addition, experimental work shows that many PSA materials are less tacky in water at higher temperatures. Optimum temperature must be a balance. Best screening efficiency in pilot work occurred at 45°C.

Flotation

Although screening initially removes PSA, flotation is the other important unit operation for removal of particles that can form stickies. PSA removal efficiency depends on particle size and surface chemistry.

A particle must be sufficiently small and tightly bound to remain adhered to a bubble as it rises through the water. Any surface active agents used to prepare the adhesives that enter the process must not interfere with the water chemistry during flotation. As an example, defoamers added to an aqueous PSA to allow coating on a silicone release paper can diminish foaming characteristics of a flotation aid and depress flotation removal efficiency.