

# LESSONS LEARNED FROM THE PROCESS OF DEVELOPING AND EVALUATING THE NEW GENERATION PRESSURE SENSITIVE ADHESIVES<sup>1</sup>

**Said AbuBakr**

Research Project Leader  
USDA Forest Service, Forest Products Laboratory  
Madison, Wisconsin 53705-2398

## ABSTRACT

Stickie contaminants in recycled recovered paper have been and continue to be one of the main technical barriers for paper recycling. The methods for solving this problem have not been clear. This paper describes lessons learned from the long process of initiating, developing, and evaluating the new generation pressure sensitive adhesives (PSAs). We started with a problem, which included finger pointing and blaming, and ended up with a solution and a useful product. And, all participating parties came away with a feeling of ownership in the process. The reasons for choosing maximum removal efficiency and the strategy used in developing universal standard testing methods for measurements are fully explained in this paper. All parties involved fulfilled their responsibilities, which made this a very successful project.

## INTRODUCTION

The use of PSAs in a wide array of paper and paperboard products has grown dramatically in the last decade. During the same time period, postconsumer paper and paperboard recovery and recycling rates have also greatly increased. In 1995, the demand for recovered paper exceeded the supply, making it difficult for recycling mills to compete with the price of virgin pulp. During that time, many paper mills started to close the water loop and microstickies in process water became an even more significant problem. And, at about the same time, the convenience and popularity of PSA stamps caused demand for these stamps to increase dramatically. Because of all these elements, debate started and with it came some counterproductive finger pointing. The United States Postal Service (USPS) took the initiative and put in the resources to address the problems associated with PSA during recycling of recovered paper. The problem is simply that if PSAs are not removed, then stickies derived from PSAs deposit on equipment and cause paper production and quality problems. In the past, the major focus in recycling was to remove the ink (deinking); now it has changed to removing the contaminants.

## TASKS AND RESPONSIBILITIES

The USPS took the initiative, provided the resources, and formed vertical teams to represent and address all aspects of the issue of recycling postage materials containing PSA. Members of the vertical teams included representatives from the following industries: adhesives, converters, stamp printers, face stock, testing laboratories, recyclers, and academic and environmental policy support. The end users of recovered paper containing PSA, which are the papermakers (recyclers), selected "screenability" as the highest priority for the PSA reformulation, and they agreed to have their mills available for field testing and monitoring the impact on operations. Screenability was selected as the preferred removal strategy because the earlier the PSAs are removed in the recycling process, the lower the total cost and the less likely it is that PSAs will be deposited throughout mill water system. The adhesive industry took on the task of formulating their new generation PSA to be removable as well as meeting the PSA functionality criteria. The USDA Forest Service, Forest Products Laboratory (FPL), as a USPS partner, took the responsibility of working with all concerned parties to come up with a widely accepted standard method for evaluating the recyclability of

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<sup>1</sup> The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

paper containing PSA. Two protocols were developed with the review and concurrence of the USPS and the vertical teams. The first one is a pilot testing protocol to evaluate removal efficiency after each unit operation, and the second is an image analysis (IA) protocol to evaluate the handsheets for PSA content. The pilot testing includes feeding 100 kg of copy-envelope paper with a controlled amount of PSA to semicontinuous unit operations that include high consistency pulping, coarse and fine screening, forward and reverse cleaning, and flotation and washing. Samples are taken at 16 sample points, handsheets are made, and IA is used to measure contaminant level and to evaluate the removal efficiency of each unit operation and the cleanliness of the final products.

Three other pilot testing facilities were selected to confirm FPL protocols. Specialized Technology Resources (STR) was assigned the responsibility of conducting the initial screening of new PSAs for both functionality and recyclability using a lab-scale protocol. National and international universities took on the tasks of investigating the mechanism of PSA breakdown during pulping, the interactions between ink and PSA, and the testing of final products. Printers, converters, and chemical suppliers committed to conducting whole stamp construction trials to be used for lab, pilot, and mill testing of recyclability.

The final objective of this project is to have clean, PSA-free final pulp in a typical recycling operation from paper containing PSAs and to establish universal test methods and protocols that can be confirmed and accepted by the industry. The users of recovered paper (the recyclers), however, preferred the mostly screenable adhesive approach because of the ease of removal by size at the start of unit operations and the efficient removal of the residual PSAs by the rest of the unit operations including flotation. Even though paper mills are at different stages of technology for deinking and stickies removal, they all have pressure screens. Pressure screening is also independent of density, which is important because other contaminants may modify the PSA density and nullify the centrifugal cleaning stage. Screening does not require new or intensive capital investment, and the operation can be optimized to increase the removal efficiency. Temperature, consistency, and velocity are among the operating conditions-parameters to examine for optimization. Higher consistency pulping creates gentle fiber-to-fiber actions and causes the adhesive to stay large and easily removed by screening. Lower temperature during high consistency pulping, lower consistency through the screens, and lower velocity through the screens has shown to increase the efficiency of the screening process. The mostly screenable adhesive approach was also preferred and accepted by the adhesive industry for reformulating their adhesive to be mostly removed in the pressure screening stage. An additional benefit is that removing stickies in the early stage of screening minimizes the amount of microstickies in the process water.

## **HOW TO MEASURE SCREENABILITY AND REMOVAL EFFICIENCY**

After lengthy discussions with papermakers, adhesive producers, research institutions, equipment manufacturers, and other concerned parties, it was decided to develop three protocols to measure the recyclability of paper containing PSAs. The first protocol includes a lab-scale recycling test, the second is a pilot recycling test, and the third is an image analysis technique to measure contaminants. All these methods will be fully presented and explained at this symposium. In addition, confirmations of these test methods by actual mill and other pilot trials will be also presented. A data bank from using those protocols at various mill, pilot, and laboratory trials is available for the industry to use.

## **LESSONS LEARNED**

Some of the key lessons learned through the course of this work were

- As one of the largest PSA label users but not producer, the USPS was the best convener for vertical teams to address the problems associated with recycling of paper that contains PSA products.
- All industry involved and all interested parties were invited to contribute to alternative solutions (vertical team concepts).
- Existing recycling mills are at various stages of deinking--contaminant removal technology and removing contaminants by screening and flotation would fit better than by dispersion.
- Consumer preference for PSAs outweighed environmental concerns.
- Public research institutions, such as FPL, and academic institutions can play a significant role in providing unbiased scientific solutions and fundamental research capabilities when solving a problem.

- Organizing and developing consensus within the vertical team concept in problem solving takes time but, in this case, it appears to be resulting in a process and outcome that has greater support among all interested and affected organizations.
- Universal test methods were developed and accepted by the affected industries.
- Along with private sector, academia, and special interest groups, government agencies need to be involved in the process to make significant progress.
- Technical societies, such as TAPPI, are very useful in providing a neutral forum to present technical data and results on an industry-wide scale.

## **CONCLUSIONS**

It is hoped and expected that this multitask cooperative approach will help minimize the problems associated with recycling paper that contains PSAs. A collective approach in defining the problem, providing solutions, and developing standard methods of testing proved to be very successful. It is also hoped and expected that lessons learned from this experience can be extended to include all PSAs, preconsumer and postconsumer, including those used in labels, tapes, and stickers. Future plans also include the involvement of vendors and users of office products. Users of office products may include Federal, State, and City governments.

2000 PROCEEDINGS

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