ELIMINATING A COMMON OCC "STICKIES" PROBLEM

Matthew A. Blazey, Gordon C. Chen, Christian B. Edmonds and S. Allen Grimsley
Papermaking Effects NAFTA
Ciba Specialty Chemicals
Suffolk, VA USA 23434

Hot melt adhesives, such as ethylene vinyl acetate (EVA), are some of the most troublesome contaminants in paper recycling, particularly in old corrugated container (OCC) furnishes. Problems caused by hot melt adhesives include paper machine deposition, undesirable spots in the sheet, and runnability issues during converting operations. This paper discusses how hot melt "stickies" problems are identified by analytical techniques, how a modified smectite clay used in conjunction with a cationic polymer fixative can be used to treat the problem, and how the sheet properties are impacted by the treatment program. A case history is included in these discussions.

Introduction

Corporate sustainability refers to the business approach by companies to consider not only economical needs in their strategies and practices, but also environmental and social needs.[1] Put another way, it can be defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs.[2] Sustainability efforts are at the forefront of paperboard manufacturers and end-users such as Wal-Mart. At the heart of these efforts is the recovery and recycling of old corrugated containers (OCC). Recent statistics reveal that in 2005, approximately 77 percent of all corrugated containers produced were recovered for recycling, and that the corrugated industry recycles 61 percent of all recovered fiber back into new container board to be converted into corrugated containers.[3] At the same time, the increasing use of recycled fiber can result in increased runnability problems for paperboard manufacturers due to the presence of hot melt "stickies" contaminants present in the OCC.

What Are Hot Melt "Stickies"?

By definition, hot melts are adhesives, which are applied in a molten state in order to form a bond upon cooling.[4] Hot melt adhesives are commonly used in paper and board converting applications such as magazine and bookbinding, bag ending, and case and carton sealing. Chemically, hot melt adhesives typically contain ethylene vinyl acetate (EVA) copolymers and hydrocarbon wax as primary components.[5] When paper containing hot melts is recycled, passing through pulpers and other high shear mechanical processes, the hot melts are sheered and broken down into particles commonly known as stickies. The stickies may be in the visible range (macrostickies) or below visible range (microstickies, colloidal stickies). These stickies, if not effectively handled, can create significant problems at both the wet and dry ends of the paper machine as well as the converting plant. For example, hot melt stickies can form deposits on press felts, rolls, and dryer cans. These deposits can lead to picking, sheet breaks and subsequent machine downtime.

Macrostickies, that elude screening and cleaning or are sometimes formed from agglomeration of microstickies, can also appear as sheet spots in the finished sheet. These spots can negatively impact the printability of the sheet surface or lead to hole defects discovered as the sheet is unwound. Additionally, the presence of high amounts of the wax component from some stickies in the sheet can lead to slip problems with stacked sheets or telescoping problems when the sheet is wound.[6] Digital photomicrographs of machine deposits and sheet spots due to hot melt stickies are displayed below in Figure 1.

Figure 1: Examples of Sheet Spots and Machine Deposits Containing Hot Melt Stickies

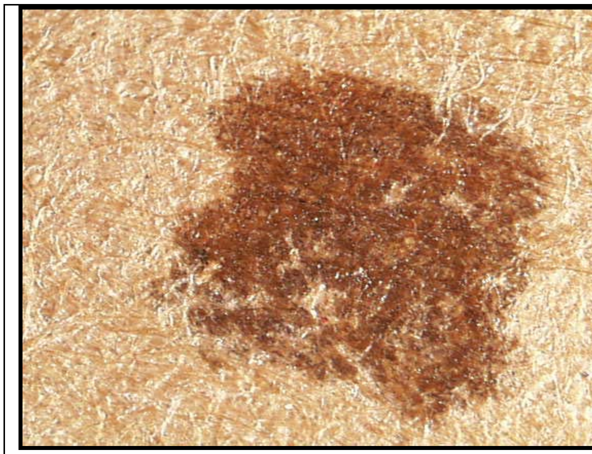


Image 1. Hot Melt Stickies in Linerboard Sheet Spot

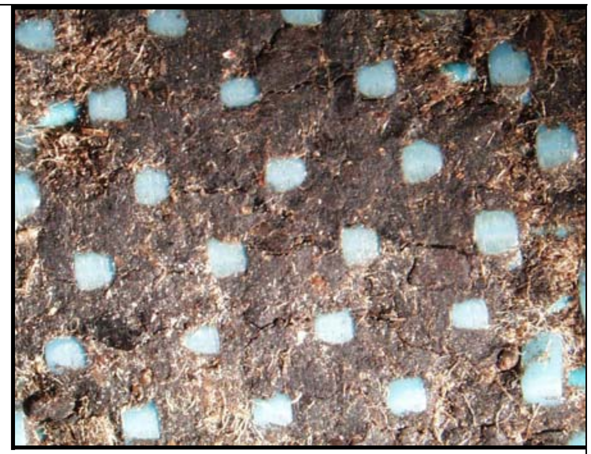
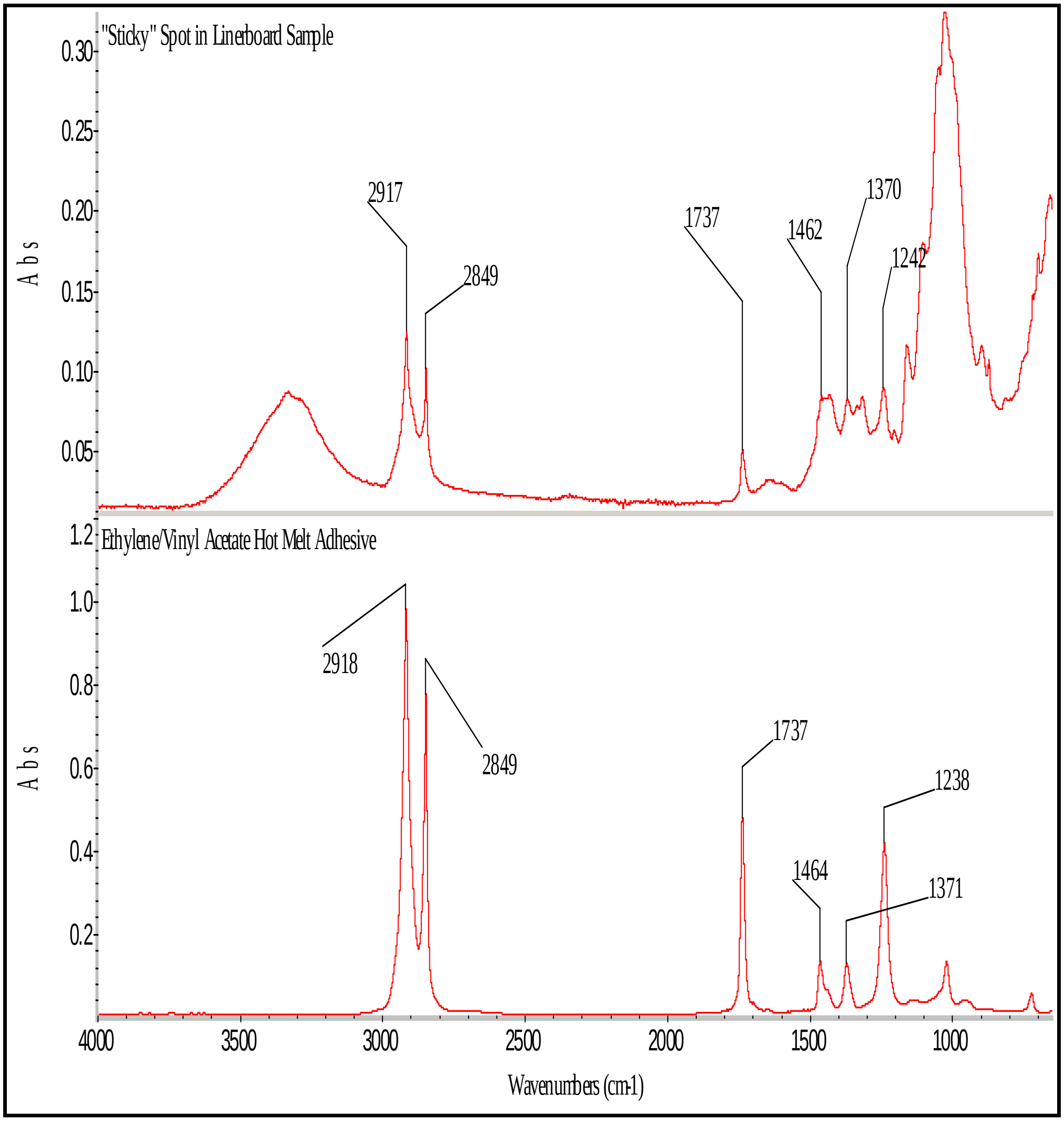


Image 2. Felt Sample Plugged with Hot Melt Stickies

Troubleshooting Hot Melt Stickies Problems

The first step in any troubleshooting effort is to identify the problem and its source. For hot melt stickies in sheet spots or machine deposits, the use of Fourier-Transform Infrared (FT-IR) Spectroscopy is a fast, reliable way to confirm the presence of hot melt stickies.[7] FT-IR spectra of sheet spots and deposits produce a characteristic fingerprint that can be compared against the unique fingerprint characteristics of ethylene vinyl acetate-based hot melt adhesives. An infrared spectrum of a stickie spot in a linerboard sample is shown below in Figure 2 along with a reference spectrum of an ethylene vinyl acetate hot melt adhesive.

Figure 2: Example of Infrared Spectrum of Sheet Spot Containing Hot Melt Stickies along with Reference Spectrum of Ethylene Vinyl Acetate Hot Melt Adhesive



Peaks characteristic of ethylene vinyl acetate hot melt adhesives at approximately 2917, 2849, 1737, 1462, 1370, and 1242 cm^{-1} can be observed in spectra of spots and deposits, making identification fairly straightforward.

Treating Hot Melt Stickies Problems

Once a problem has been identified as involving hot melt stickies, the next step is to propose an effective solution to address the problem. The source of the hot melt stickies is usually the recycled fiber component. Removing this component from the furnish would be the ultimate solution but is often not feasible for economic and environmental reasons. For packaging mills using a furnish of 100% old corrugated containers (OCC), a typical source of hot melt stickies, alternative solutions are clearly needed. The current alternative solutions in use, however, present some difficulties.

For example, removal of the stickies through screening is of limited value since a large portion of the stickies is too small to be removed by even the smallest dimensioned microscreens commonly in use. Also, many hot melts are semi-solid at typical stock temperatures, so many hot melt stickies have the ability to extrude through holes and slots. Cleaning also has limited effectiveness since the density of most hot melts is very close to that of water, making centrifugal cleaning inefficient. The optimal way to solve this problem is with a two-phase approach. First, attach the micro and colloidally dispersed stickies to fiber and fines while they're still in the smallest particle dimensions. By retaining the stickies within the sheet structure in a small, dispersed state, the stickies are removed from the system harmlessly *via* the finished sheet. Secondly, render the remaining stickies non-tacky by passivating their surface until they too are removed from the papermaking loop.

One effective way of implementing this proven approach is by using Ciba® Cedesorb®, a modified smectite clay, in conjunction with various cationic polymer fixatives. The smectite clay, with its very high surface area and affinity for organic materials, can absorb the dispersed microstickies particles.[8] These stickies/ smectite complexes are then easily attached to the pulp fibers by the addition of the proper cationic fixative where they are removed from the papermaking system. This retention mechanism is demonstrated below in Figure 3a & 3b.

Figure 3a: The Use of a Smectite Clay for Adsorbing the Colloidal Stickies

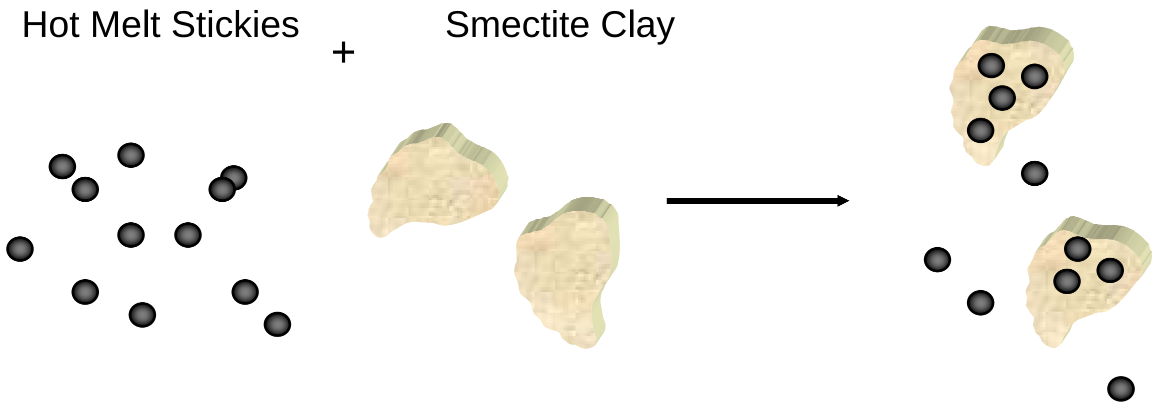
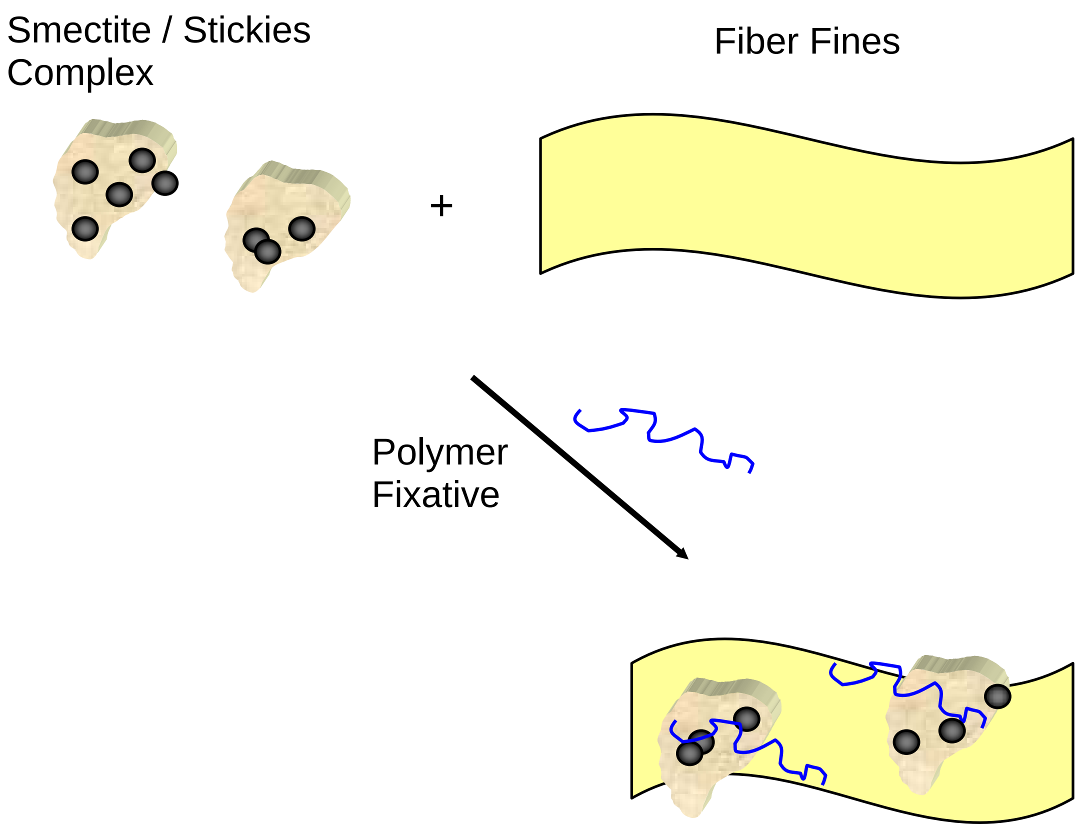


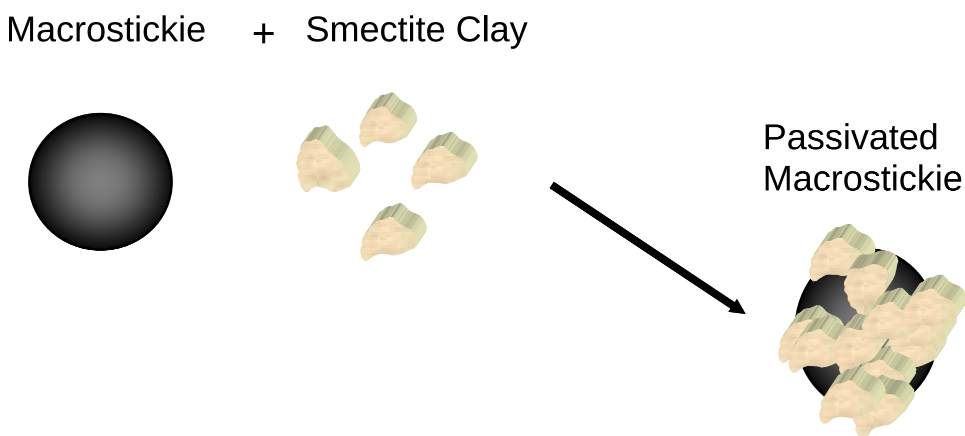
Figure 3b: The Addition of Polymer Fixative for Retaining the Smectite / Colloidal Stickies Complexes onto Fiber Fines



By retaining the stickies particles in their smallest particle dimensions, the particles will not be able to agglomerate and cause machine deposits or

subsequent sheet spots. Addition point, dosage, as well as conditions such as shear, time, temperature, etc., are important parameters in optimizing this ability.
The second objective is to passivate any remaining stickies, especially the macrostickies which are prohibitive in size for effective fixation, to prevent their agglomeration or deposition. This passivation mechanism is shown below in Figure 4.

Figure 4. The use of a Smectite Clay for Passivation of Macrostickies.



Furthermore, the use of a smectite clay to passivate the surface of the stickies particles also minimizes defects and runnability problems during subsequent printing and converting operations.

The following case study demonstrates how a deposit control retention system of a smectite clay followed by a cationic polymer fixative can effectively solve a hot melt stickies problem.

Case Study: Hot Melt Stickies in Envelope Grades

A mill producing various packaging envelope grades was experiencing severe sheet spot problems in its finished product, resulting in rejected rolls and lost production. The mill was using a furnish of 100% recycled OCC fiber, running at a production rate of about 100 tons per day, and using a combination of diatomaceous earth and poly aluminum chloride (PAC) to treat stickies in the recycled fiber. Due to the sheet spot problems, the mill was very limited in its capacity to utilize its lowest cost, lowest quality waste paper as a fiber source as it was known to contain considerable amounts of hot melt glue. When previously attempting to run this wastepaper, they were forced to shut down and clean up once the spots occurred.

The sheet spot problems being experienced by the mill typically appeared as translucent flecks of material as shown in Figure 5 below.

Figure 5: Examples of Sheet Spots in Envelope Grade

Image 1. Sheet Spot in Envelope Grade

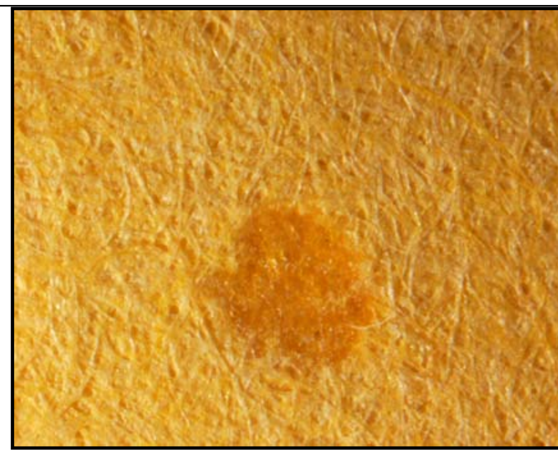
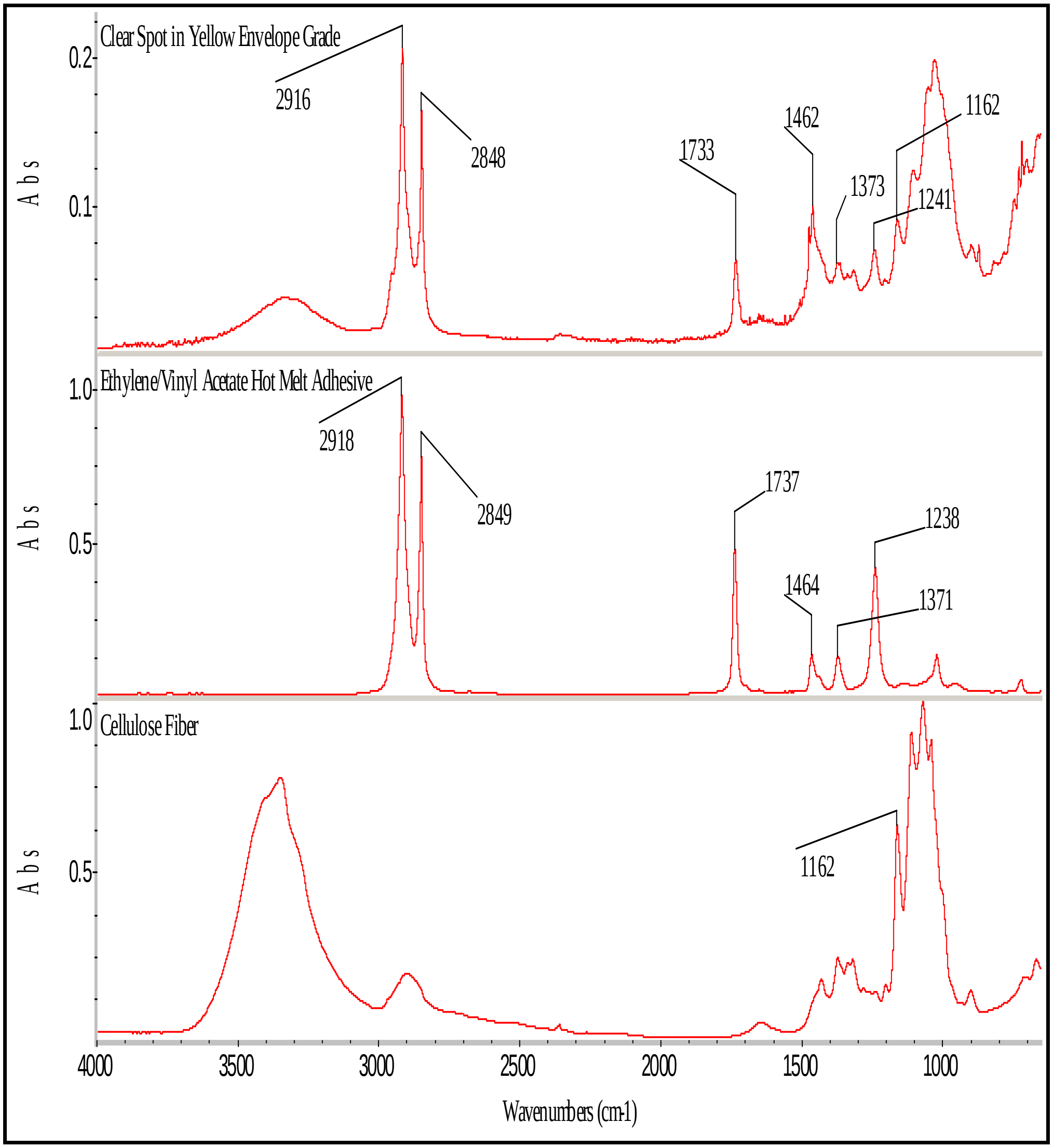


Image 2. Sheet Spot in Envelope Grade

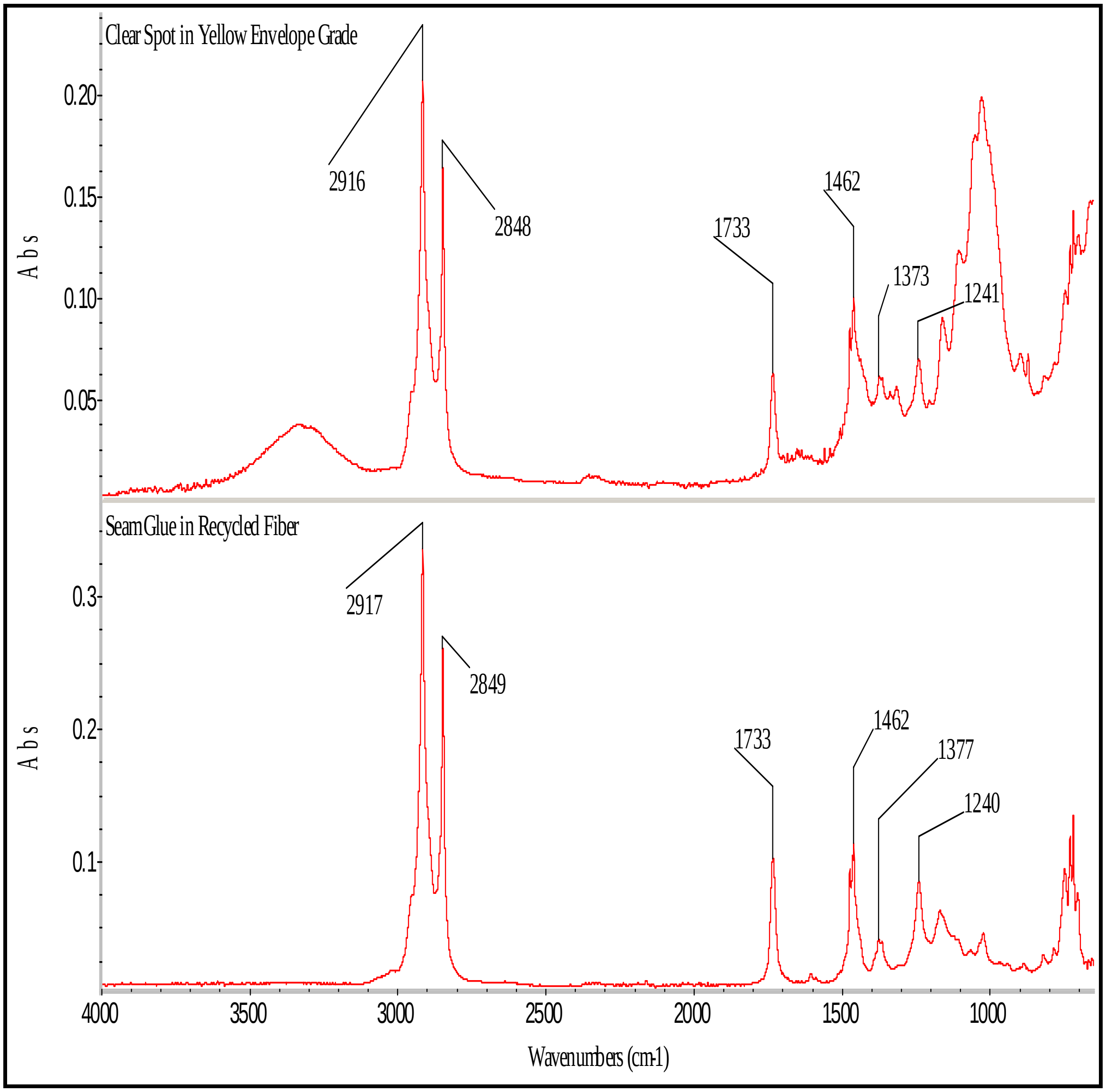
The sheet spots displayed above in Figure 4 were analyzed at the mill using a unique portable FT-IR spectrometer. Infrared spectra of the sheet spots were acquired and are shown below in Figure 6 along with reference spectra of ethylene vinyl acetate hot melt adhesive and cellulose fiber.

Figure 6: Infrared Spectrum of Sheet Spot in Envelope Grade Confirming Presence of Ethylene Vinyl Acetate Hot Melt Adhesive



Based upon the FT-IR spectral match, the translucent spots in the envelope grade were positively identified as ethylene vinyl acetate hot melt adhesive. To confirm the source of the hot melt glue, a sample of the seam glue found in the mill's recycled OCC was also analyzed and compared with the sheet spot sticky identified as EVA hot melt. The spectral comparison is shown below in Figure 7.

Figure 7: Infrared Spectral Comparison of Sheet Spots with Hot Melt Glue from Mill's Recycled Fiber



In the above spectral comparison, the material in the sheet spot, identified as an EVA hot melt, is a solid match with that of the seam glue observed in the mill's recycled fiber.

Once the presence and source of the EVA hot melt was determined, a trial of the smectite clay / cationic polymer fixative combination was initiated with some operational modifications. Dry bags of smectite clay were added directly to the pulper at a dosage of 10.6 #/T, and Ciba® Alcofix® 159, a high charge density cationic polyamine, was added to the suction side of the machine chest at a dosage of 2 to 4 #/T.

As a result of this program, the previously observed sheet spots were no longer apparent in the sheet, resulting in the production of reels that passed quality inspections. Machine cleanliness also increased sharply as the press and fly rolls, an area of deposition buildup on the machine, were observed to be cleaner than ever. At the same time, the mill was now able to accommodate increased amounts of the glue-containing waste paper, thus leading to dramatically decreased furnish costs.

In addition, the properties of the sheet can be positively impacted through the application of this program. For example, the addition of a microparticle such as the smectite clay can produce tighter flocs, thereby improving the formation of the sheet and drainage.

Conclusions

Hot melt stickies, a commonly observed contaminant in recycled fiber, frequently cause sheet spots and machine deposits. Treating pulp rich in hot melts can be challenging, and problems such as rejected reels, decreased production, extended shutdowns, and costly transitions to cleaner fiber sources are commonly experienced.

However, the use of a modified smectite clay and a cationic polymer fixative has been found effective in handling these stickies. This can help mills to meet quality and production requirements, while actually allowing them to increase the usage of hot melt-laden pulp, thereby improving the cost mix of their furnish.

The use of the smectite clay, with its very high surface area, can effectively absorb and passivate stickies, while the cationic polymer fixative ensures retention and removal of the smectite/stickies complex. In addition, this system can also positively impact sheet properties such as formation.

The effective control of these hot melt stickies will further enhance the efforts of paper and paperboard manufacturers to embrace and extend their sustainability efforts.

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