Enzymatic Stickies Control In MOW, OCC, and ONP Furnishes

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Abstract

Stickies remain as one of the major obstacles in the manufacture of quality paper using recycled fiber sources such as OCC, MOW, and ONP. A combination of proper water clarification, effective screening and cleaning practices, and low impact repulping will allow for the mechanical removal of a majority of stickies. However, stickie contaminants often remain in the process even after peak mechanical efficiencies for stickies removal are attained. The chemical control of stickies is the next tool for a papermaker's use. Some new effective tools in this arena are enzymes.

Enzymes are gaining wider acceptance in the pulp and paper industry for a variety of applications such as pulp mill and paper machine boilouts, deposit control by dispersion of accumulated slime, pitch control, drainage assistance as well as other uses. A recent area of research involves using enzymes for the control of stickies. This paper describes laboratory work done in the search for an enzyme that will act on stickies. Evidence of action on stickies could be shown if the enzyme reduced either the size or the number of stickies. Laboratory data has provided this evidence. We will discuss work done on a number of different furnishes, and the effect of enzymes in reduction of stickies.

Introduction

Secondary fiber contaminants are a major issue in most recycled mills throughout the U.S., as the amount of recycled fibers such as mixed office waste (MOW), old corrugated containers (OCC), and old newsprint (ONP) used per ton of paper produced increases across the country (1). One driving force for the increased use of these fibers lies in the environmental pressure that the industry is receiving to increase the tons of recycled fiber that they incorporate into their process (2). This pressure often comes from federal or state mandates that require the increase use of recycled fiber in the manufacture of paper. A second factor is that mills are trying to make better paper out of a lower quality, less expensive furnish (3). This trend is fueled by the reduction in fiber costs which should lead to a more profitable final product due to lower raw material costs. Finally, the cost of disposing wastepaper into landfills has increased significantly over the last fifteen years on a national average basis, and the choice to recycle these fibers in paper production has become more economically attractive.

However, using an increased amount of recycled fiber also presents the industry with more challenges. As the use of recycled fiber in mills increases, the amount of contaminants such as adhesives, coatings, glues, and binders that enter the mill furnish also increases. These materials become incorporated into the pulp slurry and are called “stickies” (4). Once these materials are a part of the furnish, they are difficult to remove due to their physical characterisitics. For example, stickies are deformable in nature. Their deformablity reduces the effectiveness of screening systems by allowing these contaminants to be extruded. In addition to this characteristic, the fact that stickies’ specific gravity is so close to that of water and fiber causes them to be accepted by cleaners (5) that are designed to permit water and fiber into the system. The

consequence of these traits is that macrostickies are accepted into the post screening process. These macrostickies, stickies that are rejected by a .10 mm slotted plate (6), often fill felts, plug wires, cause paper defects, and increase machine downtime which reduces machine production efficiency. They have been identified and classified into numerous different categories such as polyvinyl acetate, styrene butadiene, pressure sensative adhesives, and others (4,7). The cost of these impurities to the paper industry has been quantified by various sources (1,8). In 1997 the cost of this problem to the paper and paperboard industry in terms of downtime due to stickies was estimated to have been over $500 million for major recycled paper grades (8). These stickies problems are primarily caused by macrositckies. When screens and cleaners are unable to mechanically remove macrostickies from the process, they remain in the system, and chemical treatment is required. Traditional approaches for chemically controlling stickies include the fixation of stickies to fiber (9,10), the dispersing of stickies using solvent and surfactant blends (11), polymeric stabilization (12) and combinations of each of these programs.

In addition to these traditional approaches, we have developed a unique method for the controlling stickies – stabilized enzymes. Buckman Laboratories has developed stabilized enzymes that have been used to boil out paper machines, control slime, clean starch systems and improve bleaching efficiencies (13). Enzyme technology is also the basis of our new stickies control technology that can be used to reduce the size of stickies and allow for more effective stickies control in recycled paper machine systems. The enzymes of choice are esterases. These enzymes have been evaluated in OCC, ONP, and MOW mill furnishes to examine their effectiveness in reducing macrostickies concentrations. These chemistries will cleave the ester bonds of the macrostickies making them smaller in size as well as reducing their tackiness.

Stickies Measurement Methods

The following method was used with OCC, ONP, and MOW mill furnishes. Mill machine chest stock was diluted to a 1% consistency and was heated to 50°C to 60°C. Several one liter samples of the stock were placed on a hot plate at 50° to 60°C and were stirred at 100 RPM to 150 RPM. The appropriate amount of enzyme was added to the furnish, and the samples mixed for one hour. Each one liter sample was diluted with water to 10 L and was screened through a Pulmac Masterscreen using a 0.1 mm screen. The screened rejects were collected on a filter pad and were dried in an oven at 100°C . A clean piece of filter paper was placed on the top of the collection pad, and both pieces were placed on a press for 3 minutes at 135°C and at 68,900 kPa. Under these conditions, stickies will transfer to the top filter paper leaving the non tacky materials on the original filter paper. The top filter pad was peeled off, and the amount of stickies that transferred from the original collection pad was measured using a flatbed scanner. Size and concentration changes were noted. A lesser amount of macrostickies measured by the scanner when compared to the control was indicative of the enzyme's ability to convert macrostickies into microstickies that will pass through the screen.

Laboratory Results and Field Results

Laboratory results indicate an average reduction of 22% in macrostickies concentration from the control in ONP, and an average reduction of 45% in macrostickies concentration in MOW. OCC results indicate an average macrostickies concentration reduction of 50%. Please refer to the graphs at the end of the text.

To support these laboratory findings, we have run numerous successful mill trials using this enzyme technology.

Example 1: A 100% OCC mill was controlling stickies using a traditional dispersion chemistry added directly to the pulper in combination with a cationic polymer used for stabilization in the machine chest. The organic dispersant was replaced with an esterase, and improvements were seen immediately. The total amount of stickies in the pulp was reduced 50% as compared to no treatment and was reduced 10% from the traditional dispersant treatment. Dryer felt fabric life was increased an additional 10 to 15 days or 15% to 20%, and there was a 50% decrease in downtime from 5% to 2.5%.

Example 2: In a mill manufacturing liner and fluting grades from 100% recycled fiber, enzyme was added to the high density storage chest, and cationic polymer used for stabilization was added to the machine chest. The results were impressive. Deposits on rolls and in the dryer sections were significantly reduced. The lower deposition rate translated into a reduction of total breaks by 47%, and a reduction of 71% in breaks directly attributed to stickies.

Discussion

The lab results and the successful mill trials provide conclusive data that stabilized enzymes are an effective tool for reducing macrostickies deposition. Analyses have shown that stickies are a combination of various tacky materials that will agglomerate during the papermaking process (14). Esterase enzymes will cleave the ester bonds of these stickies, reducing their size as well as reducing their characteristic tackiness. This new technology is an additional tool to be considered when designing a chemical program for stickies control.

Developing a stickies control strategy using enzymes alone or in combination with traditional stickies control methods will depend upon several variables in a mill and will involve using a stepwise process. First, a stickies analysis of the process must be completed. This work will include measuring critical factors such as process temperature and pH variations, process water clarification efficiencies, dilution practices using mill water and fresh water, screening and cleaning equipment efficiency surveys, and furnish mix. All mechanical equipment should be running at peak stickies removal efficiency before chemical treatment is initiated.

The second step is to select a chemical program. Data gathered at the mill using field stickies system analysis techniques will help provide insight to help choose the best application points for chemical programs. Program selection will hinge upon some of the above variables as well as upon the closure of the mill system, the stickies load of the furnish, and the variability of the load in that furnish. If the mill is open, enzyme or dispersant technology can be effective in reducing the number of macrostickies in the process and sending them to the sewer or out with the sheet. However, the esterase enzyme contains no VOC's giving it an advantage over many traditional dispersants. In a more closed mill, the microstickies must be removed from the process with the sheet or stabilized in the system by adding a polymer component to the control program. At lower stickies levels, a polymer will coagulate the smaller stickies with fines, filler and other additives and remove them from the system via fixation or via physical entrapment in the sheet. At higher stickies levels, stabilization of the stickies in the system is required. This stabilization is accomplished by using additional polymer as needed to stabilize the level of smaller stickies in the process. When choosing an enzyme or a dispersant in any situation in combination with a polymer, it is important to remember that the anionic nature of a dispersant and the cationic nature of a polymer may lead to a control system inefficiency.

Conclusion

Laboratory studies and mill trials show that esterases can be effective tools used to control stickies.

This environmentally friendly, stabilized enzymatic macrostickies control approach will be further investigated to optimize dosage rates and application points in other mill systems. The use of different stabilization chemistries will also be explored to study further improvements in the prevention of deposition at higher stickies loads. Finally, investigations of enzymatic effects on stickies in other papermaking process areas of the mill will be continued.

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