O PAPEL vol. 84, N.o 1, pp. 66 - 69 - JAN 2023

POLYMERIC PULP MILL PROCESSING AIDS FOR ENHANCING PULP WASHING APPLICATIONS IN SPECIALTY PAPER MARKETS

Authors: Rafael Bortolan[1], Luciana Bava[2]

[1] *Kemira Chemicals Brazil*

[2] *Kemira Chemicals North America*

ABSTRACT

Recent advances have been made in a new polymeric processing aid technology primarily for pulp mill applications. This polymeric technology leads to improved pulp washing and cleanliness, and overall pulp mill operation. The formulated product contains an acrylate polymer as the primary active ingredient and minimizes or eliminates other traditional defoamer components. The study presented in this paper adopts an integral approach by evaluating the new chemistry as a pulp mill process aid rather than solely a defoamer. This polymer-based technology is proven to have significant advantages, including control of pulp mill foam, reduction in dirt and pitch, facilitation of cold startups, increased washing efficiency, and reduced bleaching costs. Product optimization through systematic laboratory testing, and its validation in field applications for over three years are discussed in this paper. Highlighted field studies illustrate how this new technology can be used to reduce operational costs and improve pulp quality. Examples are drawn from several pulp mills in the Americas and Europe producing market, specialty, and dissolving pulp grades.

Keywords: defoamer; processing aids; eucalyptus; kraft pulping

INTRODUCTION

A growing need for increased pulp cleanliness in specialty paper and dissolving pulp applications has brought greater scrutiny to pulp mill operations. Historically, mills have used mineral oil based defoamers that incorporate a variety of additives such as ethylene bis - stearamide (EBS), hydrophobic silica, trace amounts of silicone, and other additives. These oil-based defoamers were used in order to run a pulp mill with minimal operational strains at the lowest possible cost. Advances in defoamer technology such as silicone-based and water-based silicone defoamers have greatly improved pulp mill operational efficiency.

These advances led to the realization that increased efficiency within the pulp mill can lead to cost savings that far surpass the cost of the defoamer. Such cost benefits result from higher black liquor solids sent to the evaporators, lower downstream costs associated with bleaching, reduction or elimination of deposit control programs costs, etc.

A novel polymeric processing aid, comprising an acrylate polymer, was developed in efforts to improve pulp washing while aiding in defoaming performance. This technology not only targeted improved washing efficiency compared to traditional chemistries, but also eliminated EBS and silicone from its formulation, which decreased the potential for downstream contamination.

Defoaming Mechanisms

The primary concern in foam control on a brown stock washer is the air bubbles adhering to the fibers being washed. These bubbles must coalesce and be released from the fibers. When this occurs, drainage is improved as the path the water must travel through the fibers is reduced (see Figure 1). Improving drainage greatly increases the washing efficiency of the system.

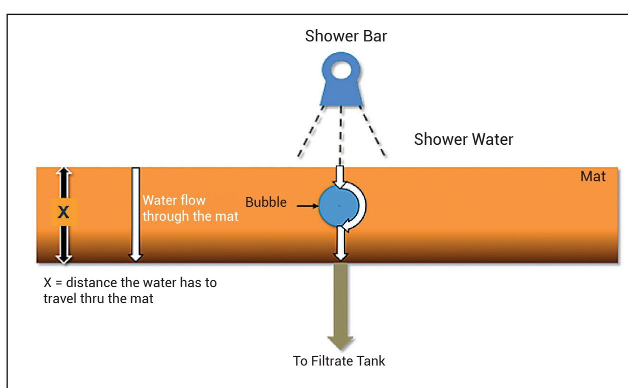

Figure 1. Schematics of washer drainage through the mat

Corresponding author: Rafael Bortolan. São Paulo, SP, Brazil – CEP. 04568 – 010. Phone: +55-11-988669205. rafael.bortolan@kemira.com

A second mechanism for improving pulp washing is by reducing the viscosity of the wash water. Viscosity of the water is reduced by reducing entrained air. Reduced viscosity yields a thinner wash water that moves more quickly through the fiber mat, resulting in improved washing. Both mechanisms require removing air from the system. Improved washing enables pitch or dirt to move counter current to the system in the water phase, and to the evaporator system where it is burned. This results in cleaner pulp with less anionic waste that reduces downstream bleaching or deposit control costs. In addition, improving washing with the same level of shower flow leads to increased black liquor solids, which translates into sizeable savings for all mills and becomes operationally critical in mills that are evaporator limited.

The new polymeric processing aid works as an antifoam, rather than as a defoamer, assisting with drainage and washing. An antifoam prevents the formation of foam, while a defoamer will reduce foam that is already present in the system. Traditional defoamers have an immediate impact on foam control but become less effective over time (known as system decay). Decay occurs mainly when the carrier oil is pulled away from the particle that is defoaming (i.e., EBS or silica). The polymeric processing aid works through a different mechanism, which relies on disrupting the surfactant formation on the bubble wall and causing the bubble wall to drain and then rupture. Due to this alternate method of foam control and lack of competition for defoaming particles, polymeric technology can stay active in the system much longer than traditional defoamers.

METHODS

In laboratory evaluations, a modified version of the foam cell test is used to determine the decay of each chemistry. The Foam and Entrained Air Test (FEAT) measures the density over time (instead of foam height like traditional foam cell tests) of the medium (i.e., black liquor for pulp mill evaluations or white water for paper machine evaluations) being tested. Air is injected into the system, and the medium is pumped in a continuous loop through a densitometer. Air is injected until the density decreases to a set value, at which point the chemistry is added and the density is tracked for a pre-determined length of time. Increases in density indicate removal of entrained air (foam). The first 30 seconds of the test is the knockdown portion, showing how quickly the chemistry eliminates the air in the system. The system decay is shown by the density for the remainder of the test. The area under the density curve is determined and used to compare the effectiveness of the products tested. Better defoamer performance is characterized by higher area under the density curve.

Figures 2 and 3 summarize the FEAT results of the polymeric process aid as well as traditional water-based silicone and oil-based defoamers.

The FEAT evaluation shows the improved system decay over the water-based silicone and oil-based defoamers. The knockdown is also improved compared to traditional technologies.

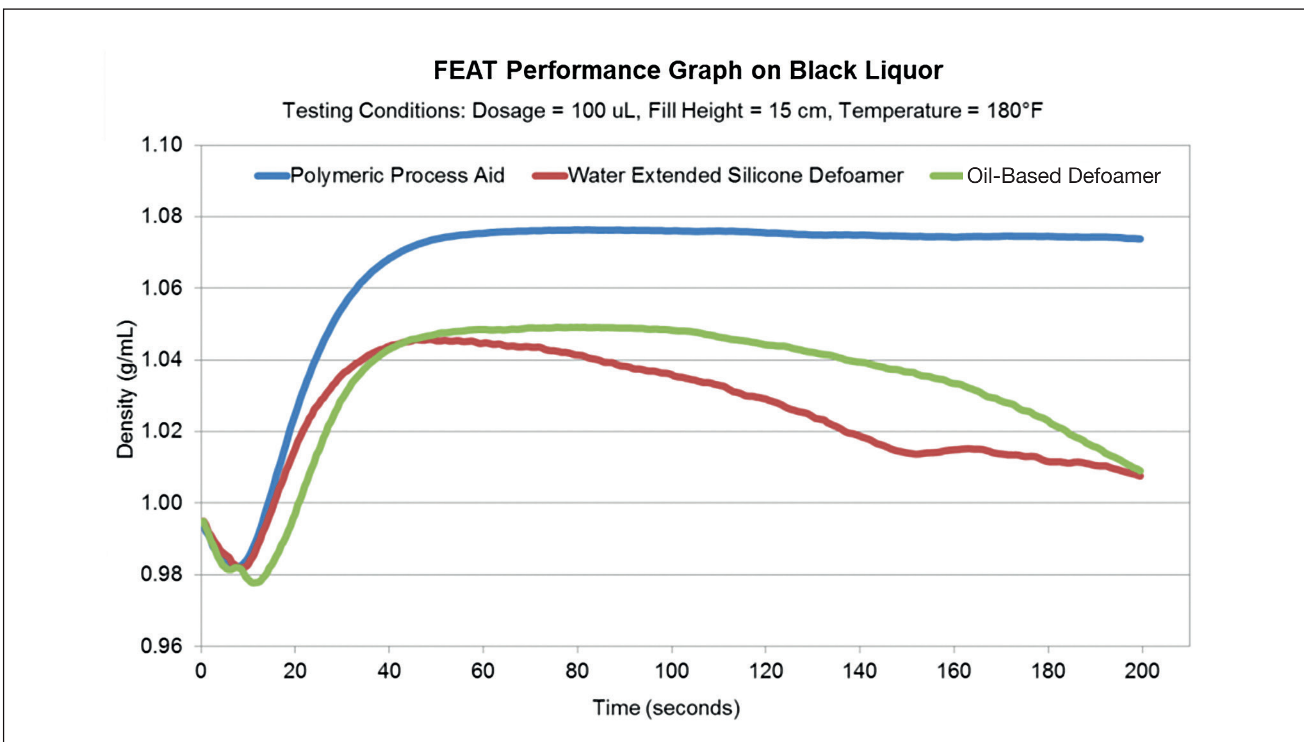

Figure 2. Summary of FEAT performance, density (g/mL) over time (sec)

O PAPEL vol. 84, N.o 1, pp. 66 - 69 - JAN 2023

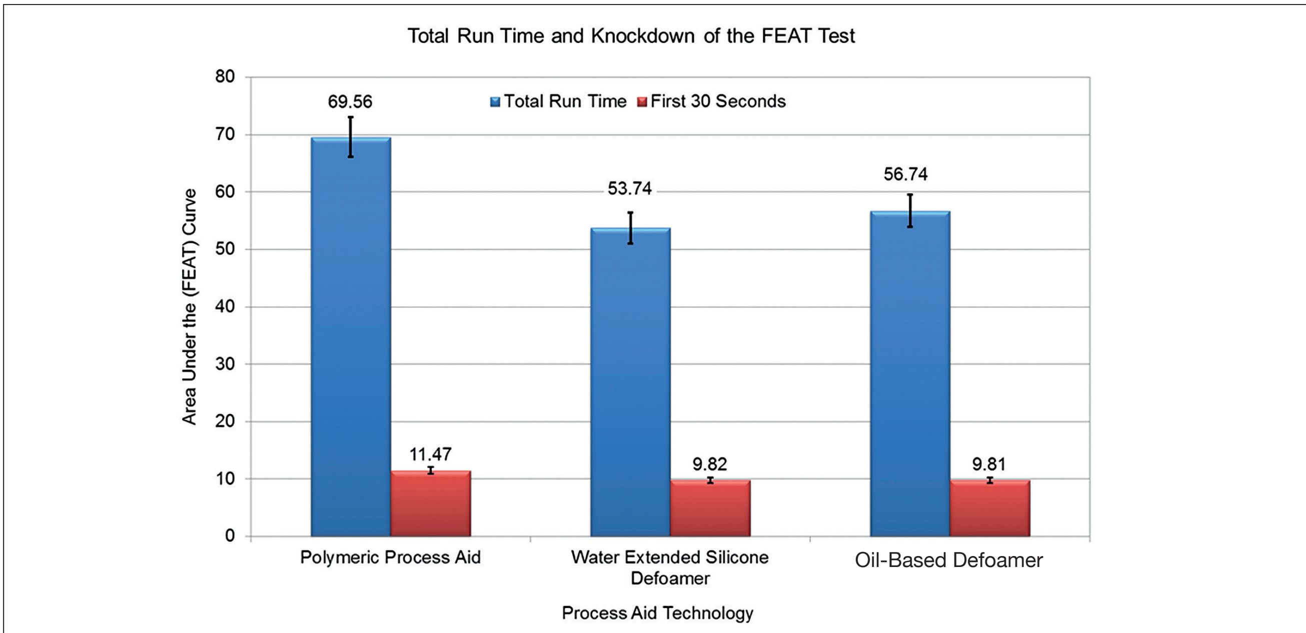

Figure 3. Area under the (FEAT) curve for Figure 2

RESULTS AND DISCUSSION

In this section, trial results from five different mills are highlighted to show the benefits of this novel technology.

Mill A: North American Specialty Pulp Mill

Mill A had been experiencing issues with cold startups and downgrades due to dirt counts. Cold startups could take several minutes to several hours, and foam control during this time was very difficult. The mill had millions of dollars in downgrades annually due to high dirt counts of the pulp dryer. This mill was using a traditional oil-based defoamer, as well as a pitch dispersant to assist with the dirt count issue.

Once the polymeric process aid was introduced into the system, the dispersant program was able to be reduced almost immediately. This is a direct result of the improved cleanliness of the pulp on the pulp dryer. Figure 4 shows the dosage of the pitch dispersant before and after the addition of the polymeric aid, and dosage of the polymeric antifoam began in April 2012.

The polymeric program delivers several benefits for the mill. Downgrades due to dirt counts decreased significantly, which

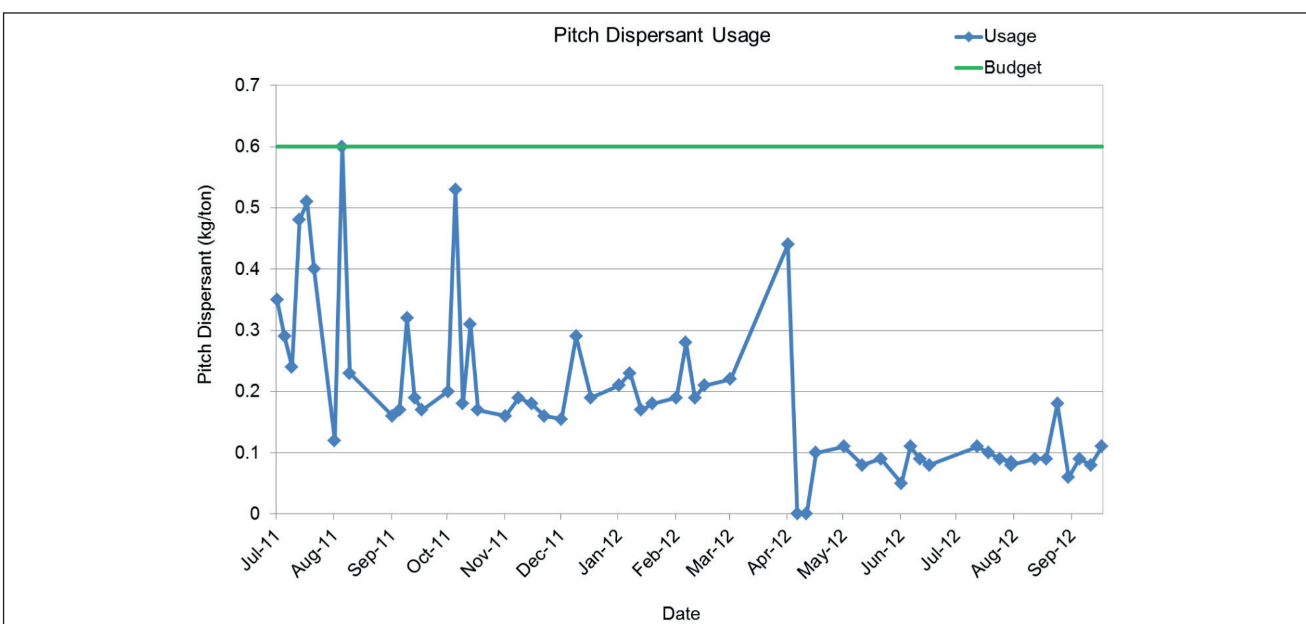

Figure 4. Dosage of pitch dispersant

also had a positive impact on the mill's operations. Cold startups also improved, with the washers lining out immediately. The black liquor solids increased by 0.4%; however, this mill was not evaporator limited. Therefore, the mill was able to speed up its process, increasing the production rate by 7%.

Mill B: North American Market Pulp Mill

Mill B produced a specialty grade of pulp for a particular customer, which dictated to the mill that no residual silicone or defects could be tolerated in the process. One ppm of residual silicone in the mill's final product would result in rejection of the pulp by the customer. Sixteen percent of the pulp being made was above the current target dirt count of 2 ppm. Any pulp made above this limit was rejected and stored. It was then repulped and put back through the system, which equated to 19,000 metric tons year of pulp with defects. A pitch dispersant program was used to help with the dirt count requirements.

Following the addition of the polymeric process aid, the pitch dispersant program was able to be reduced by 40%. This reduction occurred alongside a reduction in off grade pulp from 19,000 to 15,000 metric tons/year, with none of the defects being due to dirt. The processing aid improved the washing significantly, resulting in a 1% increase in black liquor solids, with an estimated annual saving of USD 1MM. In addition, due to the polymeric chemistry and its advantages over traditional water-based silicone emulsions, the residual silicone levels in the final product were decreased, and the mill did not lose its customer.

Mill C: North American Dissolving Pulp Mill

Mill C needed to increase production rates from 455 tons per day to 500 tons per day. However, in their current process, any increase over 455 tons per day resulted in dirt outbreaks and the need to slow back production. This mill was also evaporator limited and needed to have 20% weak liquor solids entering the evaporator system as a minimum. The current process only maintained a level of 18% weak liquor solids. The mill was using a traditional oil-based defoamer.

Once the polymeric process aid was added to Mill C's system, the improved washing enabled the pulp mill to increase production from 455 to 525 tons per day with no dirt outbreaks. This increase in production also aided the evaporator system throughput, the weak liquor solids were increased from 18% to 20.5% in the first 24 hours of the process aid being in the system. After 72 hours of being in the system, the liquor solids amounted to 24%. This improvement is a direct result of the enhanced washing in all washers of the system. The traditional oil defoamer that was previously used was being fed at an addition rate of 1.3 kg per ton, while the polymeric processing aid was able to achieve these results with an addition rate of 0.7 kg per ton.

Mill D: European Eucalyptus Mill

Mill D is a eucalyptus mill processing more than 1,500 tpd. The mill did not use silicone and was open to trying out a new silicone-free process aid. Prior to the trial the mill used an oil-based defoamer. A short trial was conducted with the polymeric aid and several benefits were recognized; an extended trial of 50 days was performed which quantified several benefits:

- Consumption rate of the polymeric processing aid was ¼ of the oil-based defoamer's consumption
- The decker speed decreased 25-30%; this was very important for the mill, as the deckers were a bottleneck for production
- Pulp quality was maintained

Mill E: North American Market Pulp Mill

Mill E is a hardwood and softwood pulp plant producing board, including a silicone coated grade. The mill was currently running an oil-based defoamer with silicone, Kemira was asked to improve drainage while eliminating silicone. The new processing aid was fed to the chemi-washer head box feed and vacuum chimneys to increase drainage. The benefits of the technology were directly observed in the pulp cleanliness and production rate:

- HW and SW dirt reduced by 49% and 11%, respectively
- Off grade product due to silicone was eliminated
- Chemi-washer production rate increased by 16%

CONCLUSIONS

The novel polymeric technology presented in this paper has proven several benefits in the lab and in mill trial evaluations. By preventing pulp mill foam and improving drainage, it reduces dirt and pitch, facilitates cold startups, increases liquor solids to the evaporators, reduces bleaching costs and can potentially improve production rates.

These benefits are direct results of the increased drainage and improved washing seen with this new technology. In the five mills presented herein, this new technology led to more efficient pulp mill operations, with significant savings and satisfied needs for cleaner pulp and lower dirt counts for specialty grades of pulp and paper.

ACKNOWLEDGEMENTS

The authors of this paper wish to thank the management of Kemira R&D for its support and permission to publish this paper. ■