Environmental Friendliness: Zero Effluent Spun Yarn Slashing

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If you were asked to name the most environmentally troublesome process in the greige plant, what would you say? For most operations, the answer should be the slasher, or more specifically the various liquid wastes that come from the typical spun yarn slasher. This answer can be derived by considering the frequency in which greige plants are fined for exceeding discharge permit levels. These permit infringements can be traced directly to the biological and chemical oxygen demands inherent with the starch and polyvinyl alcohol film formers that are so commonly used today. Dumping any size, or even simple cleaning of the slashing area can release more than enough starch and PVA to cause a discharge permit violation in the typical plant.

Survey of Plant Practices

Approximately five years ago, the Institute of Textile Technology (ITT) and its members surveyed a number of plants to determine just how much wastewater is generated by the typical sizing operation. The survey also noted any practices that were different between mills. The central findings were:

- Most plants occasionally dump concentrated batches of cooked size, thinking that solids are too high or too low to use.
- A typical spun yarn slasher will produce 3000 to 5000 gallons of effluent per week. This comes mainly from cleaning the size cooking area, the slasher frame and the size boxes. This wastewater is not highly concentrated, on the order of 3% solids or less.
- The wastewater usually contains lint, pepper trash, strings and traces of the sizing agents used.
- Some plants trickle discharge their effluent at a continuous rate, while others discharge wastewater in bulk as it is produced. Permit levels can be easily violated in either case.

ABSTRACT

If a spun yarn slashing operation within a greige mill discharges liquid wastes that contain starch and polyvinyl alcohol film formers, the plant could be exceeding its discharge permit limits. A cooperative study undertaken by ITT at Spartan Mills showed that alternative practices offered the possibility of zero effluent spun sizing.

KEY TERMS

Biological Oxygen Demand
Chemical Oxygen Demand
Discharge Permits
Sizing
Slashing
Total Suspended Solids
Wastewater

Discussion

Some 25 years ago, the Spartan Mills John H. Montgomery Plant, one of the plants surveyed, was forced to find discharge alternatives and they began to reuse part of their effluent to prepare new batches of cooked size. The heart of this idea was the realization that the typical slasher wastewater does not contain anything that has not already been intentionally applied to the warp yarn other than contaminants such as lint and pepper trash. After visually inspecting a slasher wastewater sample, it was easy to project that these contaminants might be filtered out and the resulting water reused for size cooking. This was precisely the principle in use at the plant. The challenge was to find improvements that might be made in filtration of the normal wastewater as well as methods to rework potentially unusable full size cooks so that the sizing operation could be considered a true zero effluent operation.

Wastewater Recycling System

Fig. 1 shows an overall view of the wastewater recycling system that resulted as a joint venture of Spartan Mills, ITT and the Ira L. Griffin Co. All wastewater, except a very small amount from periodic floor scrubbing, is collected into holding tanks. From the holding tanks, the wastewater is pumped into a Sweco filter for separation of water and solids. The ejected solids are packaged for transport to a local landfill. The filtered water gravity feeds into a second holding tank to await usage in size preparation. When ready to cook size, the operator draws a set number of reclaimed water gallons, a set amount of virgin water and set amount of warp size. The reclaimed water leaves the slasher room as steam from the drying cylinders. More wastewater is generated for recycling as the slasher and cooking area are cleaned during set changes. (Experience has since shown that a normal spun slashing operation can reuse all available wastewater if each batch of prepared size contains 25% reclaimed water and 75% virgin water.)

Prototype System

In January and February 1992, a prototype system was installed at the Spartan Mills Spartan Plant. This prototype (as shown in Fig. 1) was intended to take the Montgomery Plant concept and make refinements in filtration and metering so that there would be no disadvantage or ill effects of using the reclaimed water for size cooking. The ultimate goal of the project was to develop the system to a point where complete elimination of discharge was met. That is, the slasher room would be completely self contained and incapable of making an environmentally objectionable discharge.

The Spartan Plant system was operated on several occasions in early March 1992 for the purposes of determining if there would be any undesirable effect on weaving stop levels and/or finishing. After processing sample warps made with 25% reclaimed water, it was decided that there were in fact no ill effects. Because the Sweco filter was highly effective at removing solids, it was also found to be unnecessary to make any adjustments in size formulations. (That is percent solids in the cooked size were unaffected by using the set portion of reclaimed wa-

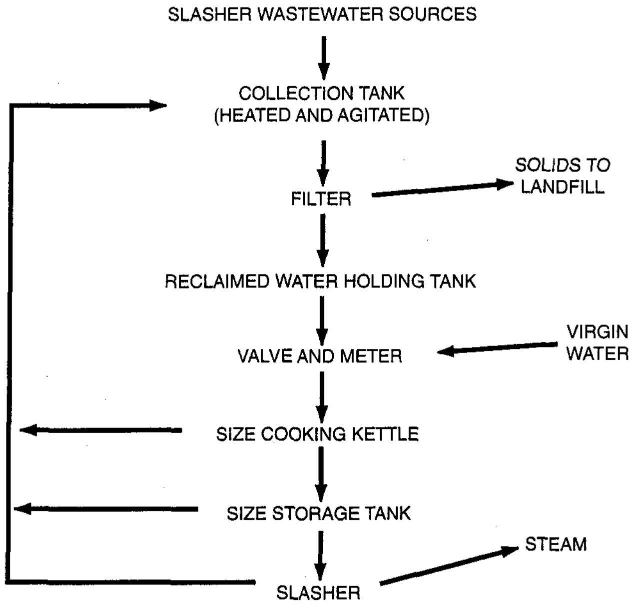

Fig. 1. Schematic of spun slasher wastewater recycling system

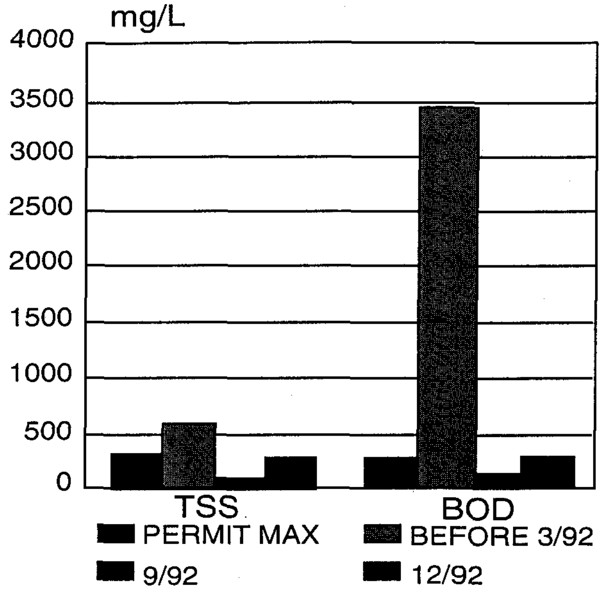

Fig. 2. Effect of slasher wastewater recycling.

ter compared to when no recycled water was used.)

On March 25, 1992, the slasher wastewater recycling system went into full time use at the Spartan Plant. Since that time, there has been no effluent from the slasher area. After approximately six months of continuous service without problem, confidence in the system was such that the former drainage line to the city sewer was removed entirely. Wastewater testing with and without the system activated showed that there was a profound effect on the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) levels in the plant waste stream. With the water reclamation system in operation, BOD and COD levels were reduced to the point where permit violations were no longer a problem. In fact, present plant discharge minus slashing effluent is so low, a total cancellation of the discharge permit is the goal of the plant and is under consideration by the local authorities. (This means that the plant would be considered as a normal household sewage discharge point.)

Fig. 2 shows the actual effect of using the slasher wastewater recycling system at the Spartan Plant. Note that in the primary categories of Total Suspended Solids (TSS) and BOD the plant was routinely violating discharge permit levels prior to March 1992. After initialization of the system in March, two sets of test data (September and December 1992) confirmed that removal of the slasher wastewater component from the plant effluent stream did allow permit levels to be met.

The local landfill authority was consulted concerning the long term effects of burying the ejected solids from the recycling system. After reviewing the quantity and contents involved, landfilling was categorized as a good low-risk disposal method.

Handling Shut Downs

The only apparent remaining problem was how to deal with water held in the system during an extended plant shutdown such as July Fourth vacation. With the assistance from Seydel-Woolley, a workable nonformaldehyde preservative was located and tested. Results showed that the wastewater shelf life was 72 hours without the preservative. With the preservative added, wastewater could remain in the system for at least seven days without turning rancid. The use of the preservative did not result in any sizing, weaving or finishing problems.

Attention now focused on how to handle the occasional bad batch of cooked size that was deemed unusable. A look into the causes of these off quality batches revealed that most were created by mixing errors of size and water. With concentration (solids) either high or low, the normal course of action was to discharge to the sewer. Naturally, this caused huge violations of discharge permit levels. The problem was addressed in two ways.

Training/Education

Slasher operators and size preparation personnel were briefed on the impact and cost of making and dumping "bad cooks." Communicating this alone practically eliminated off quality size batches.

Contingency Plan

With education, the likelihood of making unusable size was greatly decreased. On those occasions where error does occur, three options were outlined, to be used at the choice of management.

- A: If solids too high, add water until target level reached.
- B: If solids too low, cook small batch at high solids and mix with low solids batch.
- C: If totally unusable, dilute with fresh water and pump into wastewater recycling system.

Plant experience over the last four years has shown that bad cooks can be managed if the will to do so is present from management and operators. Spartan has not wasted a size batch in more than four years.

Conclusion

The experimentation at the Spartan Plant clearly shows that zero effluent spun yarn sizing is viable. The components are wastewater filtration/reuse and more conscientious attention to preventing cooking errors as well as correcting size batches as opposed to the quick fix of dumping.

We must all remember that our industry needs to be a leader in the environmental arena. This means to attack problem areas such as slashing on our own initiative, not waiting for the government to force change. The cooperative effort outlined in this study is a good example of how major problems can be resolved.

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