Cost-effective, common sense approach to stickies control

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ABSTRACT: This overview addresses control methods to manage problems resulting from stickies contamination in recycled fiber. The paper outlines how dispersion, detackification, cationic polymer, wire passivation, and solvents provide flexibility in designing the most cost-effective control programs for stickies. Case histories highlight successful implementation of these strategies.

KEYWORDS: Cationic compounds, cost effectiveness, dispersions, impurities, passivity, problem solving, quality control, reclaimed fibers, solvents, stickies, synthetic polymers, tackifiers, technology.

Regardless of one's educated opinion on the need to use recycled fiber, "the simple fact is that the consumer is the driving force" *(1)*. Because recycled fiber utilization will be the norm into the next decade, papermakers must adapt their operations to embrace this technology.

"Recycled fiber is not inferior to virgin fiber—it's just different" *(2)*. This comment is an appropriate prelude to this paper. Whether one is a "new" user of recycled fiber producing fine paper or a traditional user shifting to lower grades of recycled fiber, a learning curve will exist. The key to beneficial, cost-effective use of recycled fiber is to use the right tools to fix any problems.

Problems with recycled fiber

Problems related to recycled fiber run the gamut from new sources of microbiological contamination, increased fines, and large quantities of ink to serious contamination with stickies resulting from hot-melt adhesives, waxes, and other adhesive ingredients. The problems associated with recycled fiber contaminants fall into two broad categories: deficiencies in sheet quality and difficulties during paper manufacturing.

Product quality problems include sheet spots or holes and decreased sheet strength. This difficulty can adversely affect any subsequent printing and converting operations. High dirt counts, poor sheet appearance, underliner show-through in board grades, stick-downs and pickies in converting, and coating or printing problems are all difficulties leading to deficient quality.

Operational problems appear as sheet breaks resulting from forming fabric deposition as well as deposits in the press or dryer sections. These cause slower machine speeds or excessive downtime for cleaning.

Problem solving approach

Effective use of recycled fiber requires the proper use of biocides, retention aids, drainage aids, and water clarifiers. In addition, it is important to consider felt conditioning and to develop a proper strategy for control of stickies. These topics cover the effective solution for 95% of all problems related to the use of recycled fiber.

The scope of this paper does not encompass a detailed evaluation of the effects of various additives on recycled fiber usage. Rather the focus will be a presentation of a problem solving methodology that has been effective in controlling issues related to stickies. The following problem solving techniques concerning stickies, however, apply equally well to the issues of biological growth, fines and ash management, and felt conditioning on the papermaking machine.

Solving problems with stickies requires an organized, analytical approach. The initial step is a survey of the system to gather all the details concerning the problem. Investigation should concentrate on five basic areas:

- General production information to include the grades manufactured, furnish sources, and equipment used
- Machine and process flow diagrams
- Process information with specific conditions of pulping and other operations

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- Detailed examination of the deposition areas to define the problem as quality or operational related
- Costs attributable to the problem.

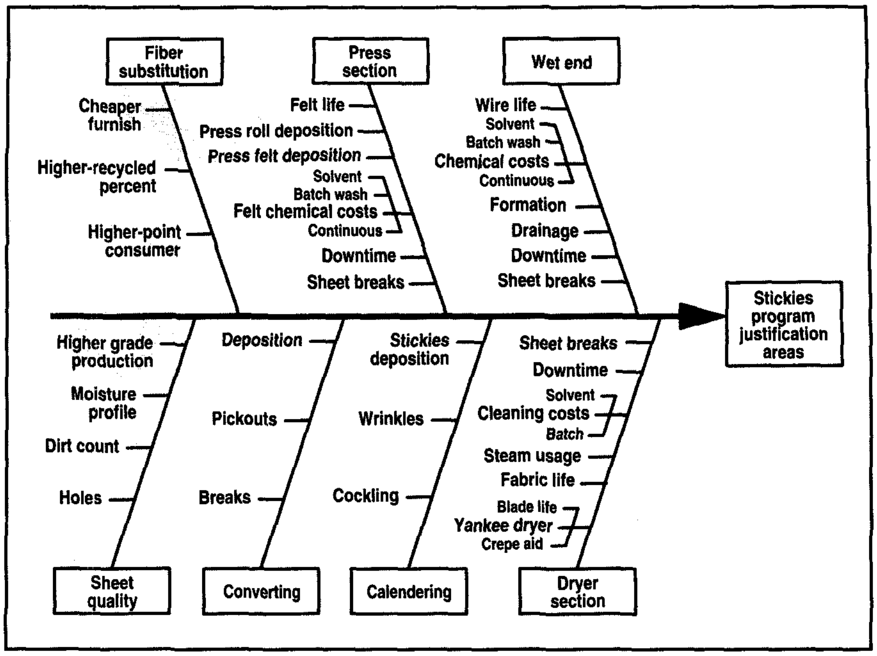
Since the business world is driven by economic factors, one must examine the financial aspects of the problem to assemble the complete story. The priority and resources assigned to solve a particular problem will relate directly to the cost of that problem.

Developing the costs associated with problems related to stickies initially seems like a monumental task. Gathering information from the stock preparation, production, converting, and printing operations, however, will provide the necessary information. **Figure 1** shows many of the difficulties possible in various areas as a result of problems with stickies. Each of these can contribute to the total cost of the problems which result from contamination with stickies. **Table I** offers an example of a calculation of the costs associated with stickies.

An understanding of the true cost of all the problems related to stickies will encourage all levels of mill management as well as the chemical and mechanical suppliers to find a cost-effective solution.

It is imperative to approach the problem of control of stickies contamination from both a mechanical removal and chemical control perspective. One should optimize an operation with mechanical contaminant removal equipment followed by an appropriate specialty chemical control program.

1. Quality approach to stickies "costs" analysis



I. Sample calculation of costs* associated with stickies

Problem:	Machine downtime of 2 h/day due to 3 batch washes/day from excessive stickies deposition
Constants:	Production rate: 8 tons/h Production cost: US$ 350/ton *Cleaning chemicals: US$ 200/machine batch wash*
Evaluation:	Downtime costs: 2 x 8 x 350 = US$ 5,600/day Chemical cleaning costs: 3 x 200 = US$ 600/day Total cost: 5,600 + 600 = US$ 6,200/day

*The total cost does not include many other costs that are often applicable. See Fig. 1.

Mechanical technology

Mechanical contaminant removal is a key step in the control of problems related to stickies. Good screening and cleaning are necessary to remove the largest percentage of contaminants. A state-of-the-art recycled fiber stock preparation system such as shown in **Fig. 2** allows papermakers to control potential problems with recycled fiber more effectively. The high cost for such a system, however, places a constraint on most organizations to use a simpler stock preparation operation.

A properly designed stock preparation system is critical. Improper installation, placement, or operation of contaminant removal equipment will be detrimental to stock preparation system cleaning efficiency. Two major areas where this often occurs are stock screening and overall tailings management.

Stock screening

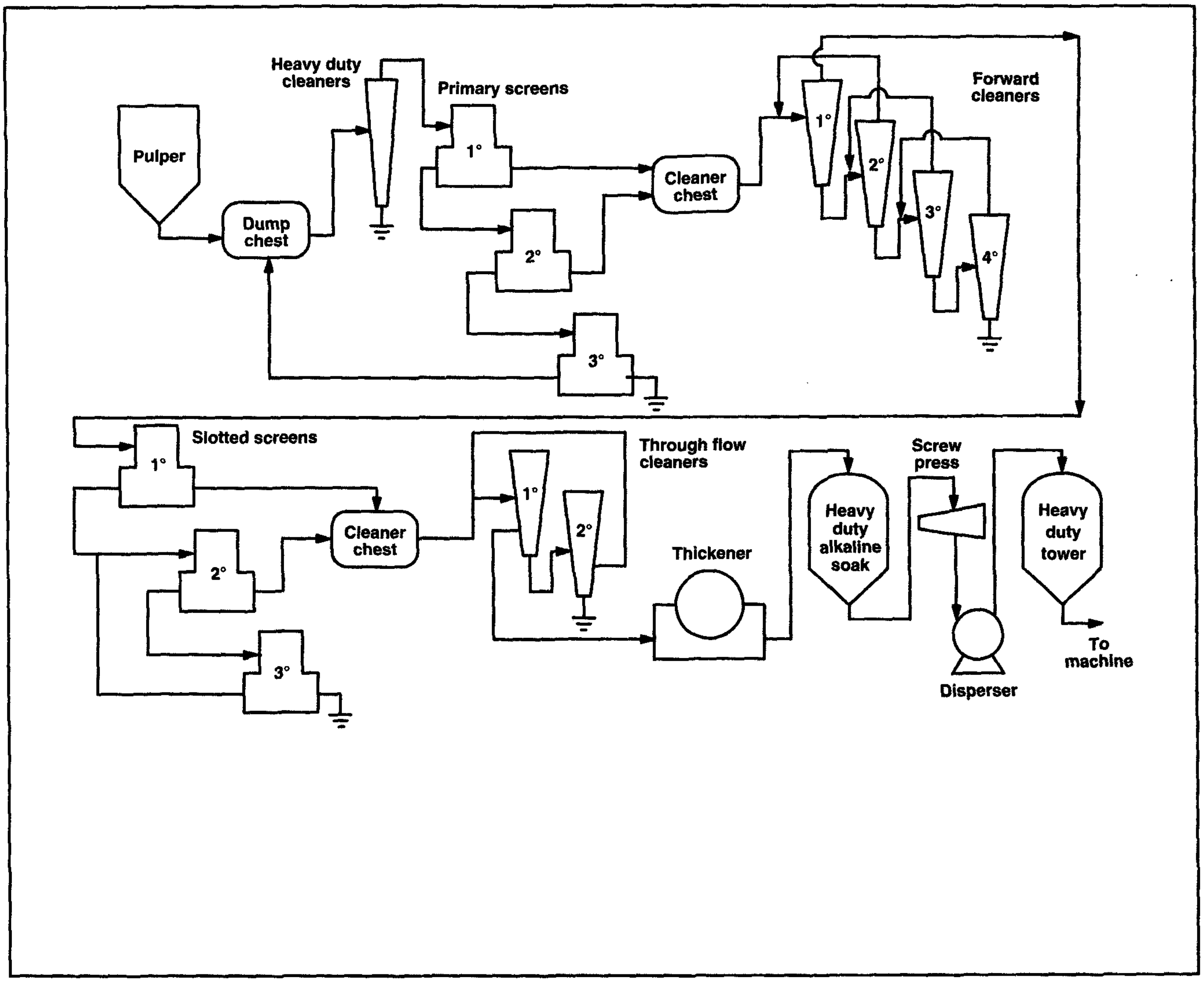
Screening typically employs a feedback loop philosophy directing the secondary and tertiary screen accepts to the primary and secondary screen feed. Because of the traditional practice of regressive screen hole sizes where primary is 1.83 mm, secondary is 1.14 mm, etc., accumulation of stickies within the screening loops often occurs.

Tailings management

Poor tailings management is also a major contributor to the overall stock preparation system accumulation of stickies. This occurs in systems which limit rejects in an attempt to reduce excessive fiber loss. The following are typical examples of systems adversely promoting contamination with stickies:

- Return of rejects from screens and cleaners to repulpers and storage chests

2. State-of-the-art contaminant removal system



- Return of a partial flow to repulpers and storage chests due to limited capacity contaminant removal equipment
- Return of flotation saveall and clarifier sludge to the process.

Process improvements

Today there are many changes which can reduce the accumulation of stickies in a process. One technique recommends screening schemes which use a forward feed of accepts during the secondary as well as the primary stage by using the same screen design and size in both stages *(3)*. This forward feed approach eliminates accumulation between the two stages.

Slotted fine screens ranging from 0.15–0.25 mm are more efficient for removal of recycle related contaminants than traditional hole screens. With this technique, standard equipment operates with a larger capacity *(4–7)*. Mechanical equipment after screening will disperse stickies to reduce their size even further.

There are limitations on the type of recycled fiber furnish which any given mechanical system can handle. The furnish might range from heavily contaminated to clean sorted material. The most important point is to understand the capabilities of the stock preparation system and utilize the proper recycled furnish grades so final product specifications can be met*(8)*.

Chemical technology

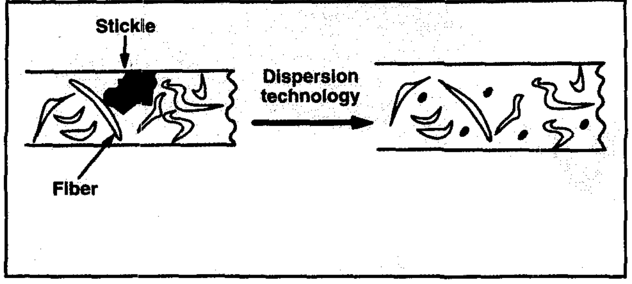
There are five complementary stickies control treatment technologies for solving problems related to stickies which are successfully utilized throughout the industry:

- Dispersion
- Detackification
- Cationic polymer
- Passivation
- Cleaning solvents.

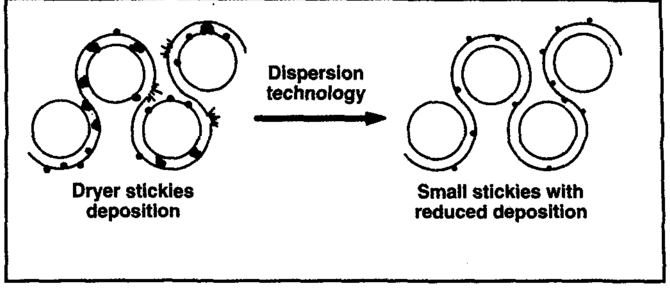
Dispersion

Dispersion technology relies on chemical enhancement of the thermal and

3. Particle size reduction of stickies improves sheet quality



4. Particle size reduction of stickies reduces dryer section deposition



mechanical characteristics of the recycled fiber repulping process *(9)*. These two characteristics collaborate to reduce large stickies to small, discrete particles. Dispersion chemistry then stabilizes small stickies to prevent reagglomeration. The chemical techniques comprise wetting, emulsification, solubilization, and stabilization.

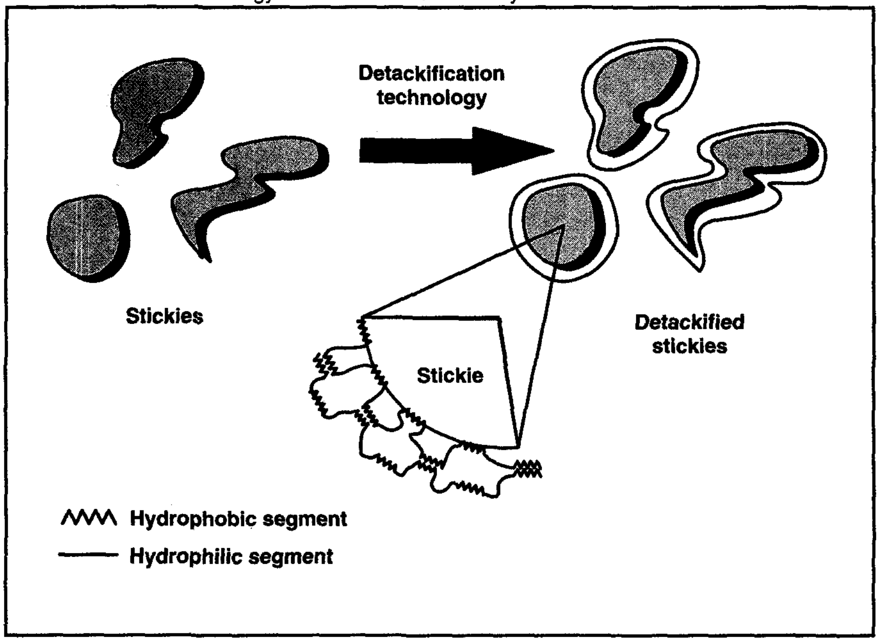
Utilization of dispersion chemistry techniques prevents the following problems:

- Poor sheet quality and appearance
- Dry-end deposition of stickies
- Converting bottlenecks related to stickies.

Reducing the size of the stickies contaminants improves quality by reducing unsightly, large blemishes in the sheet. Smaller, discrete stickies will not cause appearance problems because they blend in with the fiber mat as shown in **Fig. 3**.

Large-sized stickies cause dry-end deposition and converting bottlenecks such as pickouts and breaks. Reducing the individual surface area of stickies by dispersion technology also reduces the bond strength of the stickies to the dryer fabric. Although high dryer temperatures still cause the stickies to become tacky, the smaller size of the stickies and the discrete manner in which their retention occurs results in less deposition as shown in **Fig. 4**.

5. Detackification technology renders stickies nontacky



Detackification

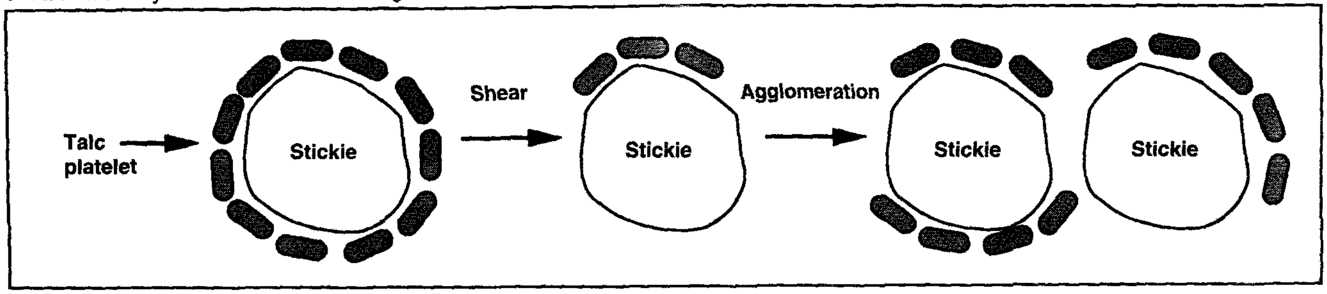
Detackification is the elimination of the contact adhesion properties often associated with the high tack surfaces of stickies. Detackification stabilizes stickies preventing agglomeration *(10)*. The process of detackification will stabilize and detackify stickies but not reduce their physical size. Additions of nonionic polymer, zirconium, or talc are three detackification treatment techniques.

In the case of the nonionic polymer, a patented, high molecular weight polymer encapsulates the stickies and forms a multilayer shield that effectively covers the surface, rendering them nontacky *(11–13)*. The hydrophobic stickies attract and subsequently attach themselves to the hydrophobic segments of the nonionic polymer. The hydrophilic segments of the nonionic polymer then extend into the water phase as shown in **Fig. 5**. Eliminating the contact adhesion properties of the stickies' surface stabilizes them and reduces their hydrophobic characteristics. This dramatically reduces deposition on the paper machine.

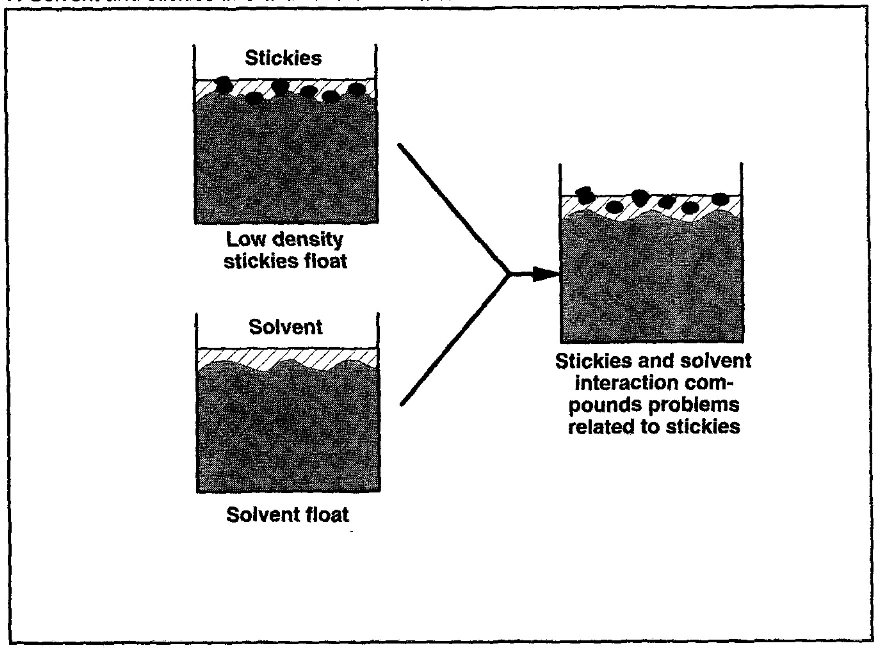
Adding the nonionic polymer chemistry detackification process to the recycled portion of the furnish has been very successful for solving wet-end and press section deposition of stickies. Mechanical dispersion or pulper dispersion is the suggested technique for elimination of stickies in the dryer section, however.

For the addition of zirconium, there are a number of chemicals available for use as control agents for stickies that will coat them with either a hydrophobic or hydrophilic layer to reduce their tackiness *(14)*. Ammonium zirconium carbonate has had some commercial success in this use over the last 10 years.

6. Talc efficiency is limited due to shearing effects



7. Solvent and stickies interaction in white water



The actual mechanism of this technique is the reaction of hydrolyzed zirconium with functional groups such as the carboxyl groups on the surface of the stickies *(15)*. A covalent bond forms between the stickies and the zirconium which prevents the tacky surface from depositing on the machine.

Talc is a soft mineral having a layered structure with a magnesium sheet sandwiched between two silica sheets. Talc platelets have large hydrophobic surfaces and hydrophilic edges *(16)*. In stickies applications talc platelets (based on hydrophobic interaction with stickies) align to shield the stickies tacky surface.

Proper utilization of talc will significantly improve overall process control of stickies. Benefits include reduced forming fabric and press section deposition of stickies.

One point that may limit talc use is its poor resistance to shear forces. Places in a paper machine process such as pumps, refiners, and other shear-sensitive spots often result in platelet removal. This in turn may cause agglomeration of stickies and result in machine deposition as depicted in **Fig. 6**.

Cationic polymer

There is a wide use of stock addition of low molecular weight (LMW), high-charge density, cationic polymers for charge neutralization and control of stickies. This technology uses the simple mechanism that such a polymer can "fix" anionic particles of stickies to an anionic fiber.

The most successful utilization of cationic polymer technology addition occurs at the machine chest in those systems utilizing various percentages of recycled fiber. Recycled fiber systems have a high percentage of fines, fillers, and various anionic particles in them *(17)*. Cationic polymer addition to treat the stickies works as a retention aid when fed close to the machine. High cationic polymer feed rates result in retention of the fines, fillers, and anionic particles on the fibers. The improvement in retention cleans the white water system *(18)*. As with all papermaking systems, if the white water fines and ash are low, the process will run more effectively.

More information is necessary to address the concerns about the treatment and retention of large stickies in the 50–100 μm range, the affinity of a cationic polymer to stickies rather than fines and fillers, and the effect of feed rates on sheet formation.

Passivation

Passivation is the use of a product to create a soluble barrier to keep an area free of stickies. Forming fabric and roll neutralization occur when passivation products stabilize contact surfaces. Numerous products using cationic, low molecular weight, high-charge density polymers to inhibit deposition of stickies on forming fabrics are available. Wire return roll, lump breaker, and press roll passivation technology involve both the cationic polymer and the surfactant and dispersant treatment approach.

Proper application of passivation chemistry is critical to avoid detrimental effects such as streaking or filling of the forming fabric. A properly designed passivation program will not cause any adverse effects.

Passivation technology inhibits deposition of stickies and does not remove existing deposits of stickies. This type of localized inhibition treatment for stickies is very effective, but it is not a substitute for a comprehensive stickies control program.

Solvent

Solvent technology is an attempt to dissolve stickies. Stock addition of solvents often causes the surface of stickies to become tackier and thus exacerbate the problem of stickies deposition. The interaction of a solvent with stickies in the stock and white water frequently results in an aggregation of stickies as seen in **Fig. 7**.

This concept of solvent use will apply to applications on the paper machine and to batch washes. One should not return any solvents used to clean machine fabrics to the papermaking system. Discharging box effluent to a sewer using proper disposal techniques and purging white water chests are two ways to reduce the adverse effects of solvents.

Solvents are necessary to clean machine fabrics after a machine disruption caused by stickies or after scheduled downtimes. One must limit their use, however, to avoid developing a vicious solvent cleaning cycle. More efficient utilization of solvents will also reduce the amount of volatile organic compounds (VOC) released to the environment *(19)*.

Conclusion

The appendix to this article presents three case histories covering tissue, corrugated board, and fine paper production. Each demonstrates how a comprehensive approach to stickies control can provide successful and cost-effective results.

Although there are no easy answers to the many problems associated with the use of recycled furnish, an organized approach to identifying and solving these problems will provide rewards. The appropriate technology (dispersion, detackification, cationic polymer, passivation, solvent) must be coordinated into a comprehensive stickies control treatment program specifically designed to correspond to an individual mill's recycled fiber use.

Stickies and other problems that are inherent with the use of recycled fiber are manageable. For all paper grades, the proper utilization of retention aids, clarification technology, fines management, biocides, and control programs for stickies will allow mills to control recycled fiber-related problems in a cost-effective manner. Contaminant control is the key to making recycled fiber an economical raw material.

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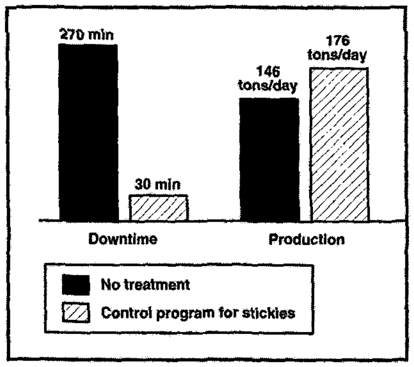
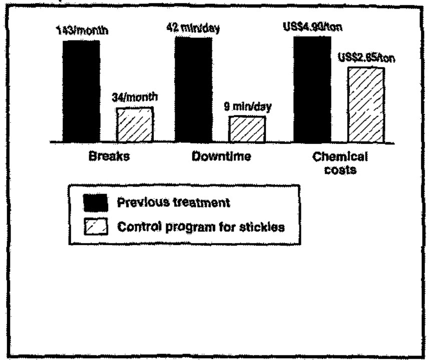
Appendix

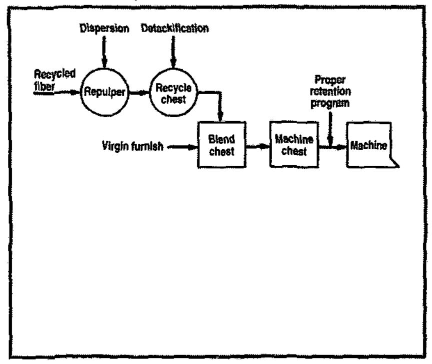
8. Benefits in tissue operation



9.Stickies control benefits in corrugated medium production



10. Comprehensive control program design for fine paper production



Case history for tissue

Machine: Twin wire at 4900 ft/min

Problem: Major machine downtime due to stickies deposition on fabrics

Mill objectives: Run 100% recycled "office waste" furnish without mineral spirits solvent batch washes every 4 h.

Solution: Used nonionic polymer detackification technology to eliminate the stickies in the recycled furnish. In addition there was a low molecular weight cationic polymer fed for wire passivation.

Results: The combination program allowed the machine to run at design speeds while reducing downtime by 85%. Using recycled office waste the production rate increased 17% as shown in **Fig. 8.** Additional benefits included reduced doctor blade changes, reduced crepe aid cost, and reduced solvent use.

Return on investment: 18:1

Case history for corrugated board

Machine: Fourdrinier at 2000 ft/min using 65% recycled OCC and 35% virgin kraft

Problem: Extensive machine downtime due to stickies deposition. High-cost treatments using stock dispersant, solvent, and cationic polymer conditioning chemicals, and mineral spirits and caustic wire cleaners had only limited benefits.

Mill objectives: Control deposition of stickies on paper machine forming fabric and improve general machine operation. Control mill VOC emission by reducing solvent use.

Solution: Used nonionic polymer detackification technology to treat the OCC. This cost-effective approach treated the stickies at the source, in the recycled fiber. Also used cationic polymer wire passivation technology.

Results: Program benefits were extensive. Solvent and caustic wire cleaning chemical use decreased 99%. Sheet breaks and downtime related to stickies decreased by over 75% as shown in **Fig. 9**. Average daily production increased from 434 tons/day to 485 tons/day. Overall, mill chemical costs decreased by over 40%.

Return on investment: 14:1

Case history for fine paper

Machine: Fourdrinier at 900 ft/min

Problem: While using recycled fiber market pulp to produce 10–15% post-consumer recycled grades, the mill experienced excessive operational and sheet quality problems due to stickies contamination. Trials using cationic polymer, in stock addition application, for control of stickies failed.

Mill objective: Efficiently produce post consumer content recycle fine paper grades with minimal adverse effects from stickies contamination.

Solution: Used dispersion and detackification technology to treat the recycled fiber market pulp as shown in **Fig. 10.** Pulper dispersion chemistry effectively reduced size of individual stickies while detackification technology eliminated the tack and adhesion properties of the stickies.

Results: Sheet holes, downtime and solvent batch washes decreased significantly. The mill successfully achieved its objectives. The machine ran to design specifications without the adverse effects experienced before the comprehensive chemical program was implemented. Downtime decreased from 3 h/day to 30 min/day.

Return on investment: 30:1