Conference review: Recycling sessions at TAPPI PEERS

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This special feature provides a review of recycling-related papers presented at the TAPPI PEERS Conference, held October 2-5, 2011, in Portland, OR. The intent of this feature is to present a synopsis of the significant research results and industry ideas reported at the conference.

The 12 papers referenced in this review were part of recycling sessions at PEERS. These sessions, listed below, were organized by the TAPPI Fiber Recycling Committee:

- Water – Daniel Haynes, Chair
- Stickies and Pitch – Neale W. Fetterly, Chair
- Deinking – Carl Houtman, Chair
- Unit Operations – Joel Kendrick (substituting for Joe Cable), Chair
- Green Deinking – Garnet Bremner, Chair
- Process Control of Stickies: Panel Discussion – Mahendra Doshi, Moderator

Water reuse and treatment

The paper industry uses a considerable amount of water, as **Table I** shows [1]. The effluent discharged by pulp and paper mills is considerably less, due to significant reuse of water. Savings in energy and chemicals along with reduced fresh water demand and effluent generation are strong incentives for the reuse of water.

Rutz [2] presented the use of Microfilter for paper mill applications. Microfilter is a rotating drum with a 10 µm to 1000 µm opening filter cloth that is selected depending on the application. The filter can potentially replace or complement existing savealls. Water to be cleaned is introduced inside the drum, clean filtrate is collected outside, and solid cake is removed from the top of the drum, which rotates slowly – 0.6 to 1 rpm. Speed can be controlled to accommodate surges in flow rate or suspended solids load entering the drum. Examples of applications at a specialty paper mill in Norway, a newsprint mill in Sweden, and a tissue mill in Germany were presented.

Mill Type	Number of Mills	Water Use* (m^3/a.d.mt)
Bleached chemical	77	82.9
Unbleached chemical	38	44.1
Semichemical	10	32.5
Mechanical	20	59.2
Recycle – deinked	35	57.5
Recycle – non-deinked	110	7.3
Non-integrated paper	113	58.0
Total	**403**	

* 2006

I. Water use in US pulp and paper mills [1].

Stickies and pitch

An online macrostickies measurement unit developed by Ricard et al. [3] was installed in an old corrugated containers (OCC) mill. (The unit is described in detail in a peer-reviewed paper in this issue of *TAPPI Journal*.) The unit is able to provide a snapshot of high density and low density stickies/contaminants levels at various points in the system. It is specifically useful in evaluating the efficiency of screens, cleaners, flotation, and other unit operations. The online measurement data, collected every 15 minutes, may be applied to control the addition of passivating additives like talc, zirconium chemicals, etc.

Rissanen et al. [4] use flow cytometry (FCM) to measure size and shape of colloidal pitch particles in pretreated groundwood pulp samples. Two pretreatment methods were compared – centrifuge and dynamic drainage jar (DDJ). Centrifuge removed most of the fines, and turbidity of supernatant was less than 20 NTU. On the other hand, DDJ filtrate contained proportionally more fines, resulting in turbidity greater than 180 NTU. If presence of fines is desired, DDJ pretreatment should be preferred. Centrifuge pretreatment is recommended when FCM measurement of pitch particles needs to be conducted in the absence of fines.

Paper mills making printing and writing grades try to include 10% to 20% recycled fiber by purchasing deinked market pulp (DMP). However, most mills experience increased problems with this furnish from stickies that affect paper machine runnability. As a result, mills cut down on their use of DMP. Haynes proposed measurement of colloidal stickies and treatment to avoid stickies-related problems on paper machines [5]. He measured colloidal stickies with a previously

developed total organic carbon (TOC) method, as well as tackiness of filtrate from a 25 µm filter paper. The treatment included the addition of cyclodextrin solution. Cyclodextrin is a torus shaped sugar-based molecule with a hydrophobic cavity and hydrophilic outer surface. The treatment with cyclodextrin could potentially reduce stickies-related problems and allow mills to use a greater amount of DMP [5].

Measurement

Korkko et al. [6] measured ink content of deinked pulps using a spectrophotometer at wavelengths of 700 nm and 950 nm. Undeinked pulp, nine deinked pulps with varying material loss, and hyperwash pulps were considered for the study. The starting point was a 50:50 mixture of old newspapers (ONP) and old magazines (OMG). Results indicated that ink contents measured at 700 nm and 950 nm correlate well. However, residual ink content values measured at 700 nm were 1.57 times the corresponding ERIC values measured at 950 nm, primarily due to differences in absorption values of black and colored inks (blue, green and cyan) at these wavelengths. Colored inks absorb light at 700 nm, while at 950 nm, the contribution of colored inks to ERIC is negligible.

As deinking mills reuse process water, there is an increase in the amount of ink, other contaminants, and dissolved solids in the water. Eventually, the quality of deinked pulp may suffer due to the extensive reuse of water. Haapala et al. [7] evaluated different methods for measuring optical properties of process water. They recommend capturing all suspended and colloidal solids from process water on a 0.45 µm membrane foil. The resulting opaque pad may be used to monitor brightness, reflectance, or luminance.

Deinking chemistry

Basilio and Sheppard [8] studied deinking of inkjet printed papers using a deinking reagent that is a mixture of modified kaolin clay and a surfactant. When 100% inkjet printed papers were deinked using this reagent, brightness after flotation increased from 30.3 to 31.1 at pH 10 and from 30.8 to 34.7 at pH 8.2 for a brightness gain of 0.8 and 3.9, respectively. At pH 8.2, the addition of 0.5 kg/ton and 1.5 kg/ton quaternary polyamine increased the brightness gain to 6.0 and 14.2, respectively. However, polyamine did not help when a mixture of ONP and inkjet printed papers was deinked. When a mixture of 90% ONP and 10% inkjet printed papers was deinked at pH 8.2 without polyamine, brightness after flotation increased from 36.1 to 48.5. Brightness of pulp after flotation steadily decreased as the amount of inkjet papers increased, reaching 46.9 at a 50% level. Respective ERIC values were also presented.

Most deinking mills use fatty acid soap and synthetic surfactant for removing inks by flotation. Some mills, particularly in Europe, require that deinking chemicals are biodegradable. Jones [9] discussed the formulation of surfactant from naturally occurring oil, rather than petroleum based oil. Careful alkoxylation of the natural oil resulted in a readily biodegradable surfactant. Mill trials in India and UK showed that green deinking chemistry performed as well if not better than conventional chemistry.

Alkaline deinking of recovered papers containing groundwood fibers, as in ONP for example, poses problems due to yellowing of fibers. Peroxide and chelating agents are added to overcome this alkaline yellowing. Some of the problems with this approach include higher chemical costs, paper machine deposits, and runnability issues due to stickies released under alkaline conditions. Some researchers tried alkaline-free deinking using sodium sulfite. However, Haynes [10] went one step further and explored alkaline-free and sulfite-free deinking by using nonionic surfactant, soap, and sodium silicate in a very high consistency pulping (~30% pulping consistency) operation. Mill trial results show that brightness is reduced by about two points compared to conventional alkaline chemistry, but that this is offset by lower chemical costs, less deposits, and better paper machine runnability. Laboratory testing indicated that with more typical drum or vat pulpers, it is possible to get a final brightness level closer to that for alkaline deinking (depending on oxidative and reductive bleaching performance), with equal ink removal.

Fiber recovery

Rejects from fine paper deinking mills may amount to 25% to 35% of incoming furnish. Mills are always searching for ways to reduce reject rates and increase yield, without sacrificing product quality.

Makinen et al. [11] explored fiber recovery from screen rejects by use of froth flotation. Dispersion of screen rejects was necessary for the effective removal of dirt and stickies by flotation, as results in **Table II** show. For example, macrostickies removal efficiency without dispersion was 35% and increased to 83% and 91% after moderate and heavy dispersion, respectively.

Treatment	Macrostickies	Dirt Specks	Extractives	Reject Rate
Untreated	35	42	15	18
Moderate dispersion	83	67	61	20
Heavy dispersion	91	64	93	18

II. Flotation efficiency.

Process design

Pescantin [12] discussed three examples of modifications to existing tissue products DIP lines to improve product quality, increase production rate and reduce energy consumption. Most of the changes involved modification of the pulper and screening system and introduction of flotation deinking cells. Based on extensive experience in working with many mills, Pescantin [12] proposed three specific deinking lines based on raw material grade and product quality requirements.

Additional topics and acknowledgements

Other recycling topics covered during TAPPI PEERS included a mill optimization session by Neale Fetterly, which provided general approaches and case histories. There was also the stickies process control panel discussion, which is covered as a guest feature in this issue of *TAPPI Journal*.

In addition, special thanks go to Danny Haynes and Robert de Jong for their comments regarding this summary of recycling topics at PEERS.

REFERENCES

The papers here are free to TAPPI members or may be purchased as part of the 2011 PEERS and International Pulp Bleaching Conference Proceedings in the TAPPI Bookstore at www.tappi.org. **TJ**

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5. Haynes, R.D., "Treatment of lap pulp colloidal stickies to improve paper machine runnability."
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10. Haynes, R.D. and Nicodimos, E., "Introduction of sodium sulfite free neutral deinking."
11. Makinen, L.F., Ammala, A.J., Haapala, A.T., et al., "New approach to clean and recover fibers from fine screening rejects by floatation."
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ABOUT THE AUTHOR

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Doshi is a member of the *TAPPI Journal* editorial board and is founder and executive editor of *Progress in Paper Recycling*. He served as moderator of the stickies panel described in this special feature. He has been President of Doshi & Associates Inc. in Appleton, WI, USA, since 1987. Email Doshi at MAHEN@aol.com.

Editor's Note: *Doshi recently contributed a new TAPPI TIP regarding stickies. The Stickies Classification TIP (TIP 0603-02) can help mills differentiate between various types of stickies, including macrostickies, microstickies, dispersed stickies, colloidal stickies, mini-stickies, and DISCO (dissolved and colloidal) stickies. To subscribe to all of TAPPI's Standards,TIPs, and Useful Methods, visit http://www.tappi.org/Bookstore/Standards–TIPs/TIPs/Pulp-Manufacture/Stickies-definition-andclassification.aspx.*