Consider this approach before installing expensive facilities

BY J. JOSSINET

Today's market and environmental forces make the recycling of newsprint a necessary reality. In addition to environmental awareness, economic considerations such as the availability and cost of landfill must be dealt with.

Locally, landfill costs have escalated threefold in the last two years. U.S. legislation is in place, or has been proposed, to cover recycled old newspapers (ONP) content in newsprint, and Toronto city councillors legislated 50% recycled content in newsprint for July 1991 [1].

In secondary fibre and tissue mills, fibre substitution programs with cheaper furnish are already available which maintain the same finished product quality. This is achieved with the use of a chemical de-inking formulation along with an appropriately elevated temperature and pH in the pulper. No mechanical changes are required in the system. This technology is applicable to such grades as printed bleached board, cup stock, ledger and computer printout paper (CPO).

ONP repulping has been practised only to a limited extent as a direct entry process in newsprint mills, due to the operational problems it presents. Substitution of 5 to 7% recycled news, while yielding an acceptable end product, will cause wire darkening, felt filling and deposition in both screening and machine areas. The inclusion of coated inserts with old newsprint also leads to additional “stickies” problems. It thus becomes impractical to use higher amounts of ONP with the direct re-entry approach unless these side effects can be remedied.

A custom de-inking formulation has been developed to address the requirements of those mills which want to process ONP without the high capital outlay required to install a de-inking facility. Secondary fibre mills and news mills using minor amounts (≤20%) of ONP are the most likely to benefit from this approach.

PRODUCT DEVELOPMENT

The original development work was

<table>
<thead>
<tr>
<th>TABLE I. CHEMICAL REMOVAL MECHANISMS.</th>
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<tbody>
<tr>
<td>Step</td>
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<tr>
<td>Required action</td>
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<tr>
<td></td>
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<tr>
<td>Emulsifying binder/vehicle or sheet sizing</td>
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<tr>
<td>Type of chemical needed</td>
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<td>Important considerations</td>
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FIG. 1. DETERMINATION OF SURFACTANT CMC.

<table>
<thead>
<tr>
<th>SURFACANT 1</th>
<th>SURFACANT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE TENSION</td>
<td>58</td>
</tr>
<tr>
<td>DYNES/CM</td>
<td>50</td>
</tr>
<tr>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>LOG [CONCENTRATION (g/ml)]</td>
<td>0.001</td>
</tr>
<tr>
<td>0.010</td>
<td>0.100</td>
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<td>1.000</td>
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done with ONP containing coated inserts. The treatment of ink from reprographic processes requires a different approach and is not addressed here.

Custom de-inking chemistry centres on a surfactant/dispersant blend designed to achieve two functions. The first is to complete the wetting action required to release the ink particles from the fibre during pulping, as well as the emulsification of the ink vehicle. The vehicle is usually oil, due to the prevalence of offset and letterpress printing. Simultaneously with this wetting action, the dispersion of the ink particles in the water phase is accomplished with a highly anionic dispersant. Table I summarizes these reaction mechanisms, along with selection criteria for the surfactant and dispersant.

In order to better evaluate a chemical, its effect on total reflectance, rather than brightness at a single wavelength, was considered more appropriate. The reflectance of handsheets is measured from 500 nm to 650 nm at 10 nm intervals and totalled to give "total reflectance". This range was chosen because the eye sees light in the yellow-green portion of the spectrum around these values more easily than in other portions. The differences in the totals thus indicate how much treated sheets differ in color from the control and each other. A higher total reflectance value indicates a better result.

When selecting a surfactant on the basis of critical micelle formation, the surfactant reaching this stage at the lowest concentration is the product of choice, Fig. 1. The oil or oil-like vehicles in the ink formulation can thus be emulsified at low surfactant concentration. This allows for economy of use and also assists in minimizing foaming tendencies in the system.

The hydrophilic-lipophilic balance (HLB number) of a surfactant, will also affect its de-inking performance. In order to significantly improve total reflectance, the HLB ratio must be in the region of 12 or more, i.e., on the higher end of the oil-in-water emulsifier category, Fig. 2.

In selecting the proper dispersant, its effect on the stability of the ink particles in the water phase is determined by measuring the zeta potential of the carbon black particles. Figure 3 shows that an increasingly negative zeta potential corresponds to a higher total reflectance of the treated handsheet samples. This results in better de-inking capability, since the ink particles are no longer prone to agglomerate and to redeposit in the sheet.

The ratio of surfactant to dispersant is also important, as it has an effect on the total reflectance. As can be seen in Fig. 4, a surfactant to dispersant ratio of 3:1 or higher is required to give the highest total reflectance, with the specific molecules under study at that time.

The use of the selection criteria listed above helped in the screening process to arrive at the desired end product — a solvent-free blend of surfactants, dispersants, and stabilizers capable of de-inking ONP at normal pulper operating conditions.

Custom de-inking of newsprint differs from that of woodfree pulper de-inking grades. An alkaline pH, while effective for de-inking purposes, leads to mechanical pulp fibre darkening, so that ONP de-inking is undertaken at or around neutral conditions. Also, there is considerably more ink to be removed, approximately 2.5% vs. 0.5% by weight, based on fibre. Some provision must be made to remove the ink particles once released from the fibre and stabilized in the water phase. This necessitates a washing step and can be accomplished
most economically through the use of a sidehill screen. The grey water must subsequently be treated to remove the ink particles (eg. flotation saveall) before being recycled back into the system at the pulper.

**LAB EVALUATIONS**

An initial de-inking study was undertaken with a furnish of post consumer news under the following conditions:

- Repulping: lab hydropulper at pH 7, temperature 38°C (100°F), time 1 hour, 5% consistency;
- Dilution: to 2% consistency;
- Washing: two passes over laboratory sidehill screen.

Control and treated samples were prepared under identical conditions. Bleaching was done on half of the treated washed stock (thickened to 3.6% consistency and adjusted to pH 4.5). Sodium hydrosulphite (4.5 kg/t or 10 lb/t) was the bleaching chemical used, along with a chelating agent.

Figure 5 illustrates the optical results of the study.

Conclusions from this study were:

- A simple washing improved the GE brightness of the control handsheets;
- Stock treated with the custom de-inking chemical produced handsheets with a brightness equivalent to the control with washing;
- Treated and washed samples had a brightness of 48 — higher than any control;
- Treated, washed and bleached samples produced the highest brightness at 55;
- Handsheets treated with custom de-inking chemical, washed and bleached had a 13 point brightness improvement (ie. 24%) versus a washed control.

Subsequent laboratory evaluations have addressed the effect of fibre substitution on strength and optical properties of virgin fibre. These properties naturally decreased with the increasing percentage of ONP added. Note also that the age of ONP is an added factor since optical and strength properties are decreased with time [3].

Future work will study the effect of ONP content in newsprint on lint and printing properties. It is expected that, like recycled ONP de-inked by flotation systems, linting and/or dusting will become a problem with increasing recycled content. While reduced bonding ability is a known occurrence, surface properties have not been extensively studied [4].

**INDUSTRIAL EXPERIENCE**

To date, actual industrial experience has been in a recycled mill in the southeastern U.S. The standard furnish of 20% blank news, 70% TV Guide, and 10% unprinted yellow trim was changed to 100% post consumer news. Repulping conditions were: pH 5.5, 6% consistency, 48°C (110°F), with the custom de-inking chemical, and 22 minutes repulping time. Post pulping dilution to 2% consistency was followed with a washing stage consisting of one pass over a sidehill washer. The grey water was then sent to a Krofta clarifier.

Comparisons were made with a second machine running the standard furnish. Conclusions following this evaluation were that:

- Machine runnability remained consistent with pretrial conditions;
-Brightness with the custom de-inking formulation averaged within two points of the standard furnish;
- Sizing was unaffected;
- Foaming was not experienced on the machine;
- The mill reduced their production costs.

It is hoped that an evaluation in a newspaper mill will be undertaken in the near future to fully assess the performance of the custom de-inking chemical in that segment of the industry. Laboratory scale experiments with ONP and industrial experience with ONP in a secondary fibre mill certainly indicate the validity of the concept to date.

**CONCLUSION**

A non-solvent chemical approach has been developed to de-ink ONP in a paper and some magazine grades. A washing step is required, but the de-inking takes place at operating process temperatures and pH conditions. Mills most likely to benefit from this approach are secondary fibre mills and news mills using minor amounts of ONP. Those mills which are experimenting with the use of recycled newspaper should consider this approach before installing capital-intensive de-inking facilities.

**REFERENCES**


**Résumé**: Un traitement chimique sans solvant a été mis au point pour le désencrage du vieux papier journal et des revues directement au trifurateur. Un stade de lavage est nécessaire, mais la procédure de désencrage se fait aux températures et pH conventionnels des opérations reliées au procédé. Les avantages des traitements conventionnels sont ainsi éliminés. Cette méthode est applicable dans les usines de fibres recyclées pour remplacer les fibres plus dispendieuses ou pour remplacer partiellement les fibres vierges dans le papier journal.

**Abstract**: A non-solvent chemical approach has been developed to pulper de-ink old newspaper (ONP) and some magazine grades. A washing step is required, but the de-inking takes place at operating process temperatures and pH conditions. This eliminates disadvantages presented by conventional treatments. The treatment is applicable to secondary fibre mills as replacement for higher grade fibre or for partial replacement of virgin fibre in newspaper.


**Keywords**: DE-INKING, NEWSPRINT, MAGAZINE PAPERS, SURFACTANTS, DISPERSANTS, WASHING, EQUIPMENT, OPERATIONS, PARAMETERS.