The effects of coated magazines on deinking of newsprint after pulping and flotation

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ABSTRACT

The authors examined the furnishes of mixed magazine and newsprint to investigate changes in properties of recycled fiber during different stages of deinking. The explanation for these changes is the change in proportion of mechanical and chemical fibers, filler, fines, and ink during flotation. After the pulping stage, detrimental effects of filler from magazines influenced the trends in strength properties. After the flotation stage, enhancement in all strength properties occurred due to loss of most filler and fines. Ink coefficient influenced the brightness and light absorption coefficient when large amounts of filler were present. No evidence supported the idea that ash components from the magazines facilitate removal of ink from newsprint. Extended periods of flotation time did not show a significant effect on properties of recycled fiber.

Application:

Mechanical fiber, fiber derived from chemical pulp, and filler are the important deinking components of paper recycling.

ATTEMPTS TO IMPROVE THE strength and optical properties of recycled fiber quality have received recent attention. Addition of magazines improves the optical and strength properties of recycled paper because of the introduction of fillers and chemical fiber. The literature is divided on the role of magazines in deinking of newsprint *(1, 2)*. Some researchers have reported the effects of deinking on the properties of recycled fiber *(3–6)*. Most studies have focused on comparison of virgin fiber and deinked fiber. The influence of deinking on paper properties primarily comes from ash or filler loss, fractionation of fiber or type of pulps, and the ink. These factors can have different influences on the properties of recycled paper during different stages of deinking. Due to the presence of several such components in the system, different interactions may occur simultaneously. This complicates the entire system.

Some studies reported that the strength properties of deinked pulps depend on the type of deinking process *(4, 5)*. In deinking of different magazines, washing and flotation showed a significant difference in the strength properties *(3–6)*. These differences were the result of the different degrees of extraction of ash or fillers and fines *(4, 5)*. These studies did not investigate the effects occurring at the pulping stage. Most studies have not addressed the role of different types of pulps, the ink, and the fillers and fines in the properties of recycled paper during different stages of deinking.

To gain an improved understanding of the many components involved in the deinking system, this study investigates the role each component has on the properties of recycled paper at different stages of deinking. It also investigates the dominating effect exerted by these components at different stages of deinking and their effect on each property of recycled paper. To our knowledge, no study has been reported that discusses comprehensively the effects of deinking on optical and physical properties of recycled paper after the various stages of deinking such as pulping and flotation.

EXPERIMENTAL

Stock preparation and reagents

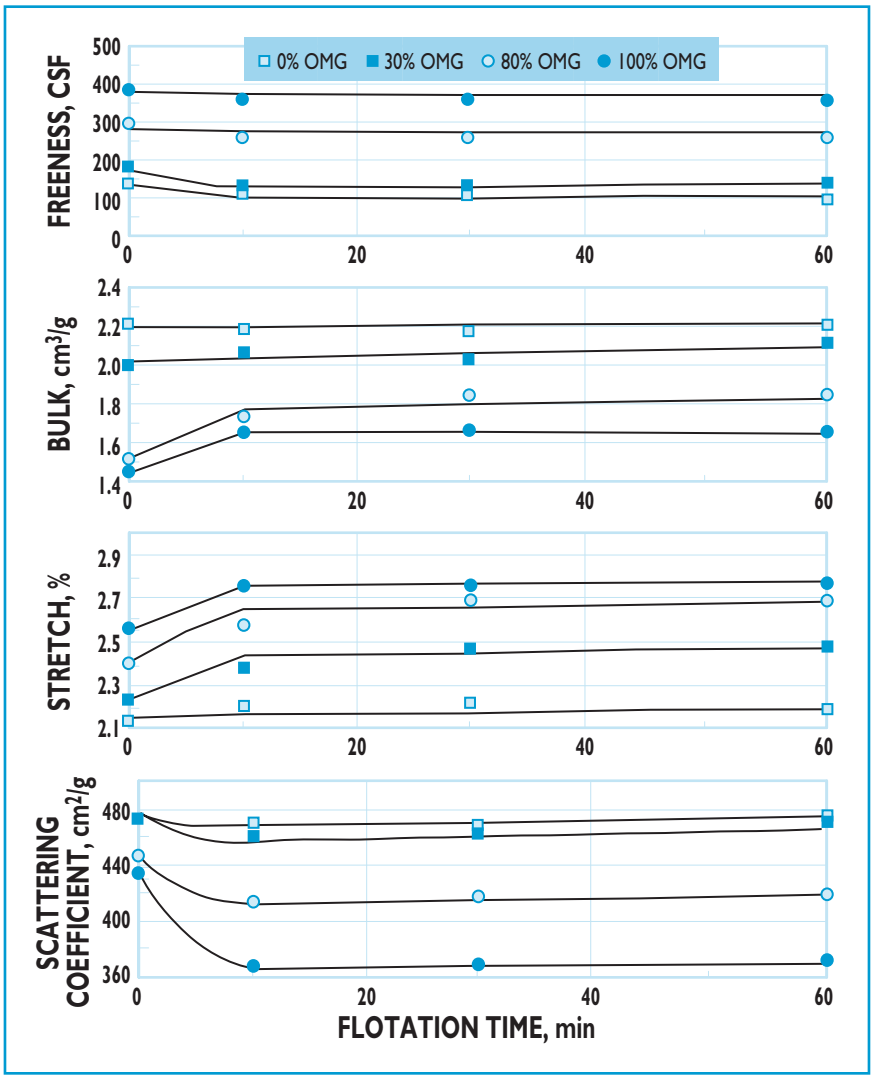
Old newsprint (ONP) came from batches of recently printed offset newspaper that was three months old. A selection of highly coated magazines with high gloss was selected as representative of coated magazines (OMG) with high ash content of 30%. The ash content of glossy magazines used in this study was 49.36% CaO, 17.55% SiO_2, and 14.53% Al_2O_3. The age of the magazines was approximately 2–3 months.

Magazines and newsprint were individually cut into 2–3 cm squares. All staples and glue were removed before pulping, and samples were stored in opaque plastic bags. In this study, four samples of 0%–100% OMG were used in the deinking process.

The quantities of the chemicals charged in the deinking formulations were calculated as a percentage of the o.d. weight of paper fed to the pulper. Hydrogen peroxide (30%), sodium hydroxide (98%), and sodium silicate (30%) were corrected for 100% activity. The study used a fatty acid surfactant that GC/MS analysis indicated was predominantly stearic, oleic, and linoleic fatty acids.

Pulping and flotation

A Lamor Deinkit was used for pulping and flotation. In the pulping stage, a Helico pulper was installed in the unit. For flotation, the Lamort helico rotor was replaced by the Lamort Hyperflotation kit



1. The effect of extended flotation time (Pulping conditions: 1% H_2O_2, 1%NaOH, 0.4% surfactant, 0.2% DTPA, 20 min., 50°C, and 8% pulp consistency. Flotation conditions: 1% pulp consistency, 50°C, pH 10.5, 200 ppm hardness as $CaCO_3$.)

incorporating an aeration screen and air suction column on the rotor and an overflow weir for ink sludge collection. Pulping used 750 g o.d. mass (ONP and OMG as such) at 8% pulp consistency. Chemicals [1% hydrogen peroxide, 0.4% surfactant, 0.2% diaminetriethylenepentaacetic acid (DTPA), and 1% sodium hydroxide, 1% sodium silicate on o.d. mass] were added to hot water at 50°C before addition of the waste paper. After reaching a good rolling and mixing action, the pulping stage continued for 20 min.

In the flotation stage, 450 g o.d. of the repulped stock was diluted to 1% pulp consistency, and a constant pH of 8.5 was maintained. An optimum level of hardness at 200 ppm was maintained in the flotation cell. The flotation time was 10 min.

Handsheet formation, physical testing, and optical measurements

Measurements of paper strength, optical properties, and speck count used standard methods. Pulp (26 g o.d.) was acidified to pH 4.5–5.0 before sheet formation to simulate acidic paper making conditions. This pH reflects typical industrial papermaking conditions practiced in Australia. At this pH level, handsheets containing calcium carbonate would form in less than ideal conditions. Significant foaming was visible with repulped OMG stock. This could come from the evolution of carbon dioxide resulting from a carbonate with acid interaction.

From each sample, eleven handsheets were made using a laboratory sheet former according to standard method AS-NZS-1302-203 s (1993). The handsheets were then dried and stored in lightproof bags until testing. Testing used the best eight formed sheets. Handsheets were conditioned before testing according to Appita method p414m-1986 using standard conditions of atmosphere. The o.d. mass of the handsheets was determined by oven drying at 105°C for two hours. Physical testing of handsheets used standard Appita method AS-NZS-1301-208 s (1989).

The ash content of all samples was determined according to TAPPI T413 om-85. ISO brightness, light scattering coefficient, and light absorption coefficient were measured according to ISO method 8791-4 (1992). Each value is the average of eight readings and is reported as o.d. grammage.

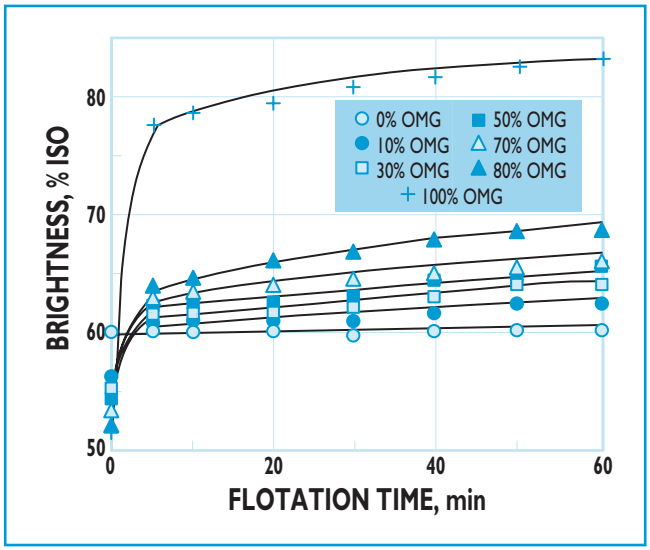
Speck count measurements used image analysis equipped with "Visilog" computer software. Specks were classified as having ISO brightnesses below 40.1. These speck counts are expressed as numbers, and the instrument used for measuring ink size distribution had a minimum detection limit of 65 µm.

X-ray microanalysis

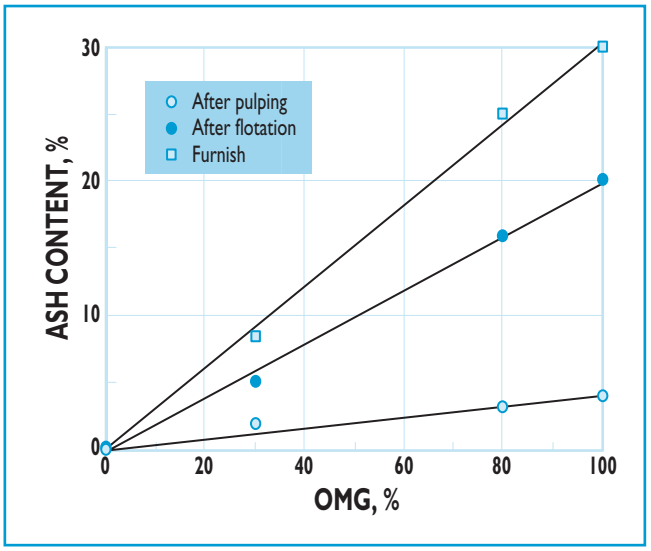
Paper samples were subjected to elemental analysis after ashing at 900°C. Ash samples of 500 mg were compacted in a die press to form discs subsequently coated with 20 nm of ultra pure carbon in a vacuum

Deinking stage	OMG, %	Ash, %	SO_3, %	SiO_2, %	Al_2O_3, %	MgO, %	CaO, %	Na_2O, %	FeO, %	TiO_2, %
Pulping	0	0.290	0.008	0.06-	0.020	0.024	0.0792	0.0912	0.0064	0.0012
Flotation	0	0.180	0.003	0.056	0.101	0.016	0.051	0.0406	0.003	0.0004
Pulping	100	20.00	0.044	8.252	5.852	0.620	4.472	0.230	0.190	0.3400
Flotation	10	3.980	0.006	1.684	1/2746	0.090	0.8246	0.020	0.030	0.0508

I. Elemental analysis of major components in the ash content of magazine and newsprint after pulping and flotation



2. Effect of flotation time on final handsheet brightness for feedstock with various ratios of ONP/OMG (Pulping conditions same as Fig. 1 except with 1% Na_2SiO_3. Flotation conditions same as Fig. 1.)



3. Effect of deinking on ash content with pulping and flotation conditions same as Fig. 1

coater. The X-ray microanalyzer in this study was an electron probe type. The percentages of elements are reported as their corresponding oxides.

Experimental errors and confidence limits

The variations in optical and physical properties measurements were very low when using Lamort Deinkit. The percentage error was less than 0.5% for all optical and physical property measurements. Each reported value is an average of six different measurements.

RESULTS AND DISCUSSION

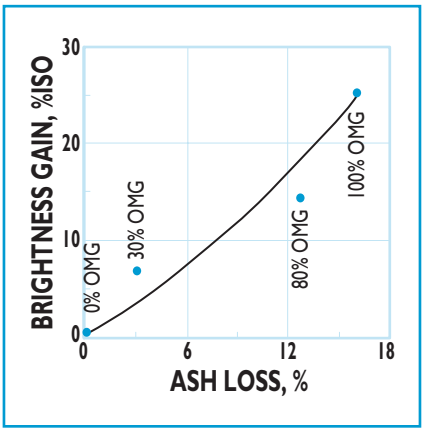
Effect of extended flotation time on properties of recycled paper

The results in this study used 10 min. flotation times. The study showed that longer flotation did not affect the properties investigated as **Fig. 1** indicates. **Figure 2** does show a further improvement in brightness when using extended periods of flotation.

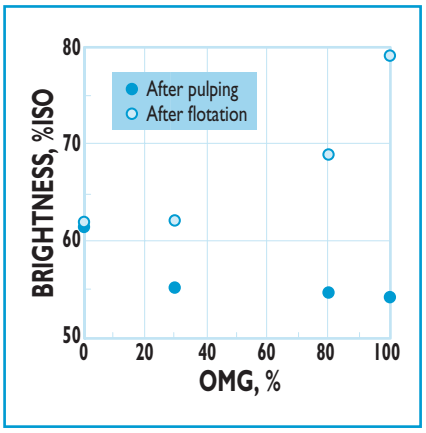
Effect of deinking on ash content

Table I presents results of an elemental analysis of 100% OMG and 100% ONP after pulping and flotation stages. The results of the elemental analysis show that the deinked pulp contains filler from several sources including aluminum silicates (clay), titanium dioxide, and calcium carbonate. A major change in the composition of the pulp occurred during the flotation process. Large amounts of fillers and fines were lost from the pulp during flotation. A decrease in the percentages of CaO, SiO_2, and Al_2O_3 in Table I also showed changes in the ash composition.

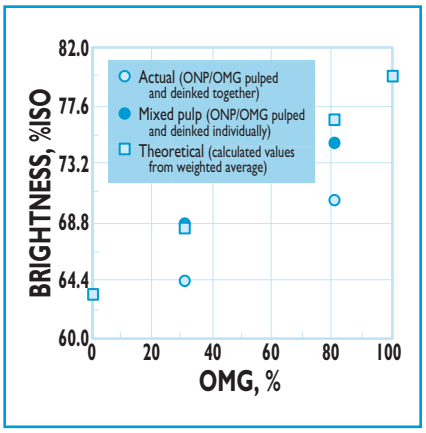
Figure 3 shows that the total amount of filler retained in handsheets prepared after pulping and flotation was proportional to the amount initially present. For comparison, the figure shows the initial ash contents of the furnishes. The linear relationship between the percentage of OMG and the ash content of the pulp is due to the addition of fillers and coating originating from the magazines. The lowest ash level occurred with 0% OMG or 100% ONP. This shows a negligible percentage of fillers are present in the newsprint. A 10% reduction in the ash content of the 100% OMG furnish occurred after the pulping stage in Fig. 3. This result may be due to a loss of fillers and fines during the sheetmaking process. Some loss of calcium carbonate would probably occur under acidic papermaking conditions, since handsheet preparation used pH 4.5.



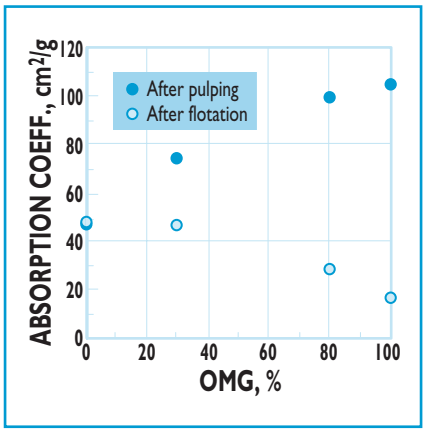
4. Effect of deinking on ash loss and brightness with pulping and flotation conditions same as Fig. 1



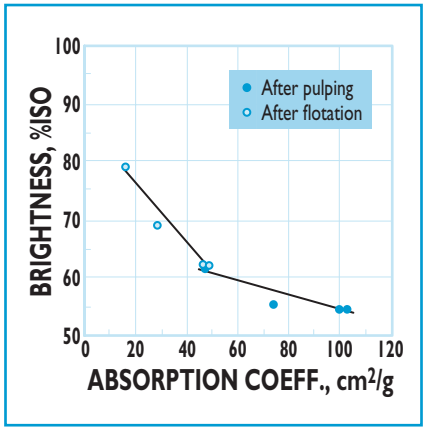
6. Effects of deinking on brightness with pulping and flotation conditions same as Fig. 1



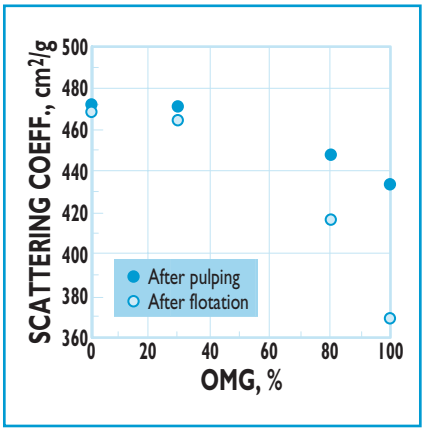
5. Final pulp brightness as a function of furnish composition plotted with corresponding brightness for pulp blends prepared from individually deninked OMG and ONP (also showing calculated values of brightness for blended pulps)



7. Effect of deinking on absorption coefficient with pulping and flotation conditions same as Fig. 1



8. Relationship between brightness and light absorption coefficient



9. Effect of deinking on scattering coefficient with pulping and flotation conditions same as Fig. 1

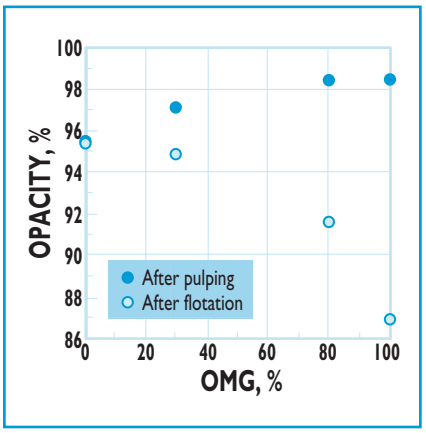
Significant foaming occurred with repulped stock of 100% OMG. This was probably due to the evolution of carbon dioxide resulting from a carbonate with acid interaction. Although these acidic pH conditions were not ideal for samples containing calcium carbonate, we used this pH because it reflects the typical industrial papermaking conditions practiced in Australia. **Figure 4** shows the correlation between brightness gain in pulping and flotation stages and the ash lost between these two stages. An increase in brightness occurred with increasing ash or percentage of OMG. This does not mean that removal of the clay from a magazine coating causes high ink removal efficiencies.

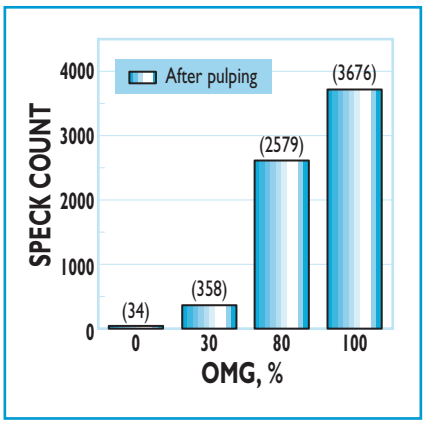
In Fig. 4, the observed increase in brightness with increasing ash or % OMG could be due to the combined effect of several factors:

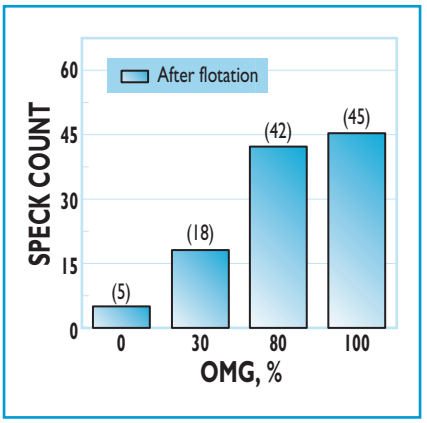
- Despite the ash losses, significant ash or filler retention in deinked pulp adds to the brightness of the deinked pulp due to white fillers like titanium dioxide and calcium carbonates (2).
- Although the pulping conditions are not ideal for bleaching, chromophore removal due to a bleaching effect occurring in the pulping stage could be possible (3, 7).
- Retention of brighter chemical pulp could originate from the magazine material (2).

Effect of deinking on optical properties

Figure 5 shows the effect of deinking on brightness. After the pulping stage, a significant decrease in brightness occurs as the percentage of OMG in the furnish increases. With the high proportion of filler originating from







OMG in the furnish, one would expect repulped stock to have higher brightness. The observed decrease in brightness is due to the increased ink content originating from magazines. The decrease also suggests that the effect exerted by the ink predominates over that of the filler.

After flotation, the observed increase in brightness can be due to removal of ink, filler retention and chromophore removal, and retention of brighter chemical pulp originating from OMG in deinked pulp. The 100% ONP and 0% OMG showed very little change in brightness. This suggests almost no ink removal or that the alkaline darkening process occurring at high pH in mechanical pulp may offset the brightness gains that occur with ink removal and any bleaching that may occur.

To differentiate between increased brightness due to addition of higher brightness materials from the magazines such as fibers or coating components and the results of the effectiveness of ink removal from the ONP, one can use the comparison in **Fig. 6**. This figure shows the results for deinking of ONP and OMG feedstock using similar experimental conditions. The figure also shows calculated results for the blended samples obtained by tanking a weighted average of the brightness of pulps from independently deinked ONP and OMG.

Figure 6 shows a close correspondence between the actual brightness values of the blended samples and the calculated values derived from the weighted average. The observed brightness values of sheets prepared after deinking ONP and OMG together are much lower than the corresponding values from blended samples. This confirms the results of previous studies that report no positive effect of OMG on deinking of ONP. A negative influence for this system occurred.

Light absorption coefficient

Figure 7 shows the effect of deinking on light absorption coefficient. After the pulping stage, the observed increase in the light absorption coefficient with the addition of OMG is due to the magazine component carrying a higher ink load than ONP. Any bleaching that occurs during this stage removes chromophores and should therefore decrease the light absorption coefficient. White fillers such as calcium carbonate and titanium dioxide often increase the brightness of paper *(2, 4)* due to light absorption coefficient decreases. Despite the presence of such fillers in the furnish in Table I, the effect of higher ink content appears to predominate over the filler effect. This results in an increased light absorption coefficient as the paper becomes darker.

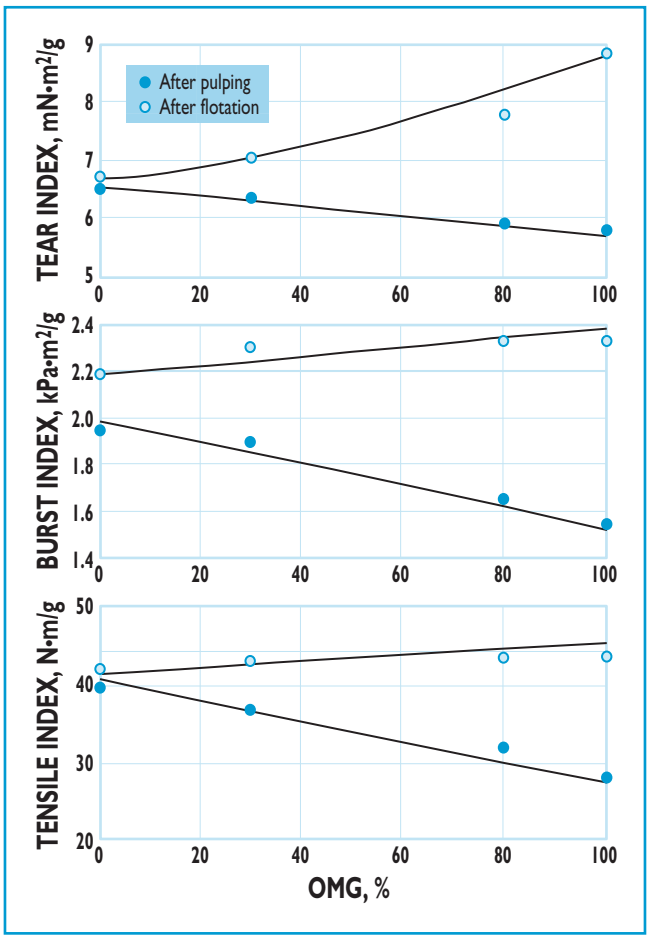
After flotation, reductions occurred in the light absorption coefficient because of the removal of the ink. The furnish with 0% OMG and 100% ONP showed very little change in light absorption coefficient and in brightness as Fig. 5 shows. **Figure 8** shows that the trend showing decreasing brightness with increasing light absorption did not change in both stages of deinking, although the slopes of the relationship are different for the two stages.

Light scattering coefficient

Figure 9 shows the effect of deinking on light scattering. After the pulping stage, the light scattering coefficient of the pulped OMG was less than that of ONP even with the large amounts of clay in the OMG. This is probably due to the fiber in the OMG being primarily chemical pulp in origin and having a lower light scattering coefficient than mechanical type pulp present in ONP. A greater decrease in scattering coefficient occurred after the flotation stage with the addition of OMG. This is due to the change in the proportions of chemical fiber and filler present in the system. Loss of filler that occurs in the flotation stage enhances the effect of chemical pulp originating from OMG.

Opacity

Figure 10 shows the effect of deinking on opacity. The observed increase in the opacity with the addition of OMG after pulping is due to the increasing amount of fillers originating from OMG. In the papermaking



13. The effect of deinking on strength properties

process, a common practice is addition of fillers for the improvement of the optical properties of paper *(8, 9)*. This occurs because the pigment particles occupy voids between the fibers leading to more fiber to air and pigment to air interfaces. As a result, opacity increases *(8, 9)*. After flotation, reductions occurred in opacity due to the loss of filler and retention of lower opacity chemical pulp originating from OMG in the deinked pulp.

According to the Kubelka-Munk theory *(8, 9)*, the light scattering coefficient and the light absorption coefficient determine opacity. Opacity increases with an increase in either factor. This effect occurred after the flotation stage. After the pulping stage, the increase in light absorption coefficient of Fig. 7 contributed to the increase in opacity of Fig. 10 despite the decrease in light scattering coefficient of Fig. 9 with increasing percentage of OMG.

Ink speck count measurements

Figures 11 and 12 show ink speck counts after the pulping and flotation stages, respectively. After the pulping stage, the ink speck count showed increasing values with increasing percentage of OMG added as the system contained more ink. After flotation, 100% OMG still showed the highest ink speck count despite the highest value of brightness. This suggests that the values of brightness do not necessarily represent the true extent of ink removal *(3, 10, 11)*. Higher ink content in the deinking system seems to give greater final ink speck count. In summary, increased OMG content leads to increased brightness, increased ink speck counts, and reduced opacity and light scattering ability after the flotation stage.

The lowest percentage of ink removal at 85% occurred with 0% OMG and 100% ONP. This showed the poor ink removal from the newsprint. Ink removal at 99% was possible with 100% OMG. Addition of 30% OMG in newsprint was optimum. Interestingly, further addition of OMG could yield only 3% higher ink removal efficiency. This could be a reason for selecting 70:30 ratio of newsprint to magazines in commercial deinking processes.

Figure 12 shows that the values of ink speck count calculated from a weighted average lie below that actually observed, and the observed brightness values are below the values calculated from the weighted average of Fig. 6. These suggest that addition of magazines from this system do not enhance the efficiency of deinking of newsprint.

Effect of deinking on strength properties

Retulainen *(12)* reported that blending two pulps rarely gave a linear change in properties with the blend ratio especially for mechanical and chemical pulps. The same study showed that the system was complex with several mechanisms functioning simultaneously. Some had a positive effect and others had a negative effect on strength properties of the blend making a conclusion difficult. The predictability of resulting paper properties depends on the component properties and nature of the system. The properties of paper made from a blend do not usually follow the weighted mean of the components *(12)*.

In this work, the system chosen for deinking has two different pulps complicated by the additional major factors of fillers and coating material present in the magazines and the ink and chemicals or alkalis. Some studies showed that the use of different alkalis in the bleaching and deinking process can influence the strength properties such as tensile index *(3, 13)*. A recent study *(3)* concluded that the change in strength properties was due to the hydrolyzing effect of individual alkalis used in the deinking process that can affect the bridge forming property of the fiber.

Tear index, burst index, and tensile index

The graphs in **Fig. 13** show the effect of the deinking process upon tear index, burst index, and tensile index. After the pulping stage, each strength property decreased

with increased percentage of OMG. This effect is due to the presence of filler and coating materials originating from OMG in the repulped stock. After the flotation stage, an enhancement in all strength properties occurred.

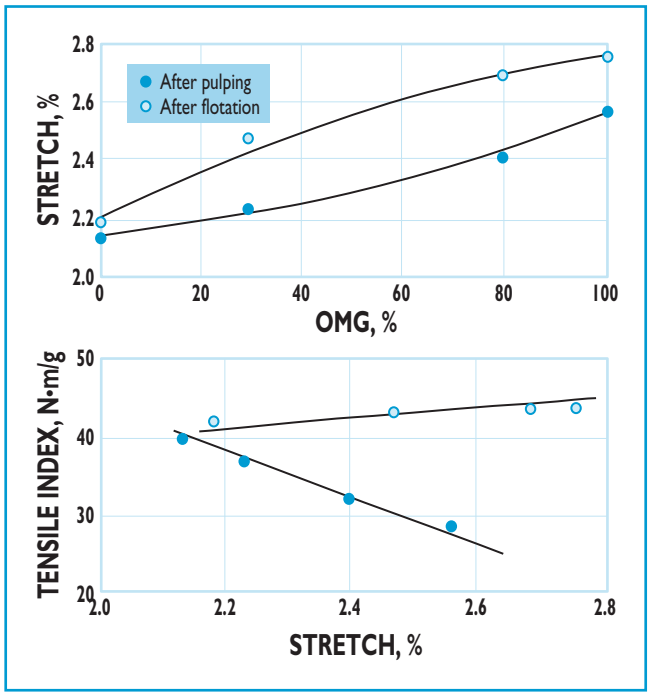
The addition of chemical pulp to mechanical pulp causes an increase in strength *(12)*, since chemical pulp is inherently stronger than mechanical pulp. This is primarily due to increased bonding and an increase in load bearing capacity of the fibrous component *(12)*. Addition of filler reduces strength *(8, 9)*. The strength of paper is mainly due to fiber with fiber bonds. Pigments or filler particles occupy space between fibers and interfere with fiber bonding to give a significant reduction in strength *(8, 9)*. Crawford *(14)* and Riddell *et al. (15)* found that 10% filler gave a 20%–25% reduction of tensile and burst. This strength reduction relates to the reduction in fiber bonding potential *(16, 17)*.

At the pulping stage for the graphs in Fig. 13, a continuous reduction in all strength properties occurred despite the addition of chemical pulp from magazines. This suggests that the filler component caused an overriding negative influence and suppressed the effect exerted by chemical pulp. After the pulping stage, the 100% OMG furnish showed the lowest values of burst, tear, and tensile because of the high percentage of ash or fillers. The 0% OMG and 100% ONP showed the highest values. This suggests that a negligible amount of filler was present in the newsprint.

After flotation in the graphs of Fig. 13, the beneficial effect of the chemical fiber in OMG predominated over the detrimental effect of the filler component due to the loss of most filler in the flotation stage. The observed enhancement in all strength properties occurring after flotation is due to the change in the proportions of chemical fiber, mechanical fiber, and filler and fines in the two stages.

The improvement in tear, tensile, and burst indices occurring after flotation may be mainly due to loss of fillers and fines. The improvement can also depend on the combined effect exerted by mechanical fiber, chemical fiber, and fillers and fines retained in deinked pulp. Due to the complexity of the system, the effect of the loss of fillers on the total improvement of strength properties was difficult to quantify.

As anticipated, 0% OMG and 100% ONP did now show a significant change in tear and tensile. Some increase in burst index after flotation did occur. The 100% OMG showed the highest tear, tensile, and burst as expected, since chemical pulps usually have higher tear, tensile, and burst indices compared with mechanical pulps (8, 18). This is a reason the deinking process includes magazines with newspapers.



14. The effects of deinking on stretch and the relationship between stretch and tensile index

Stretch

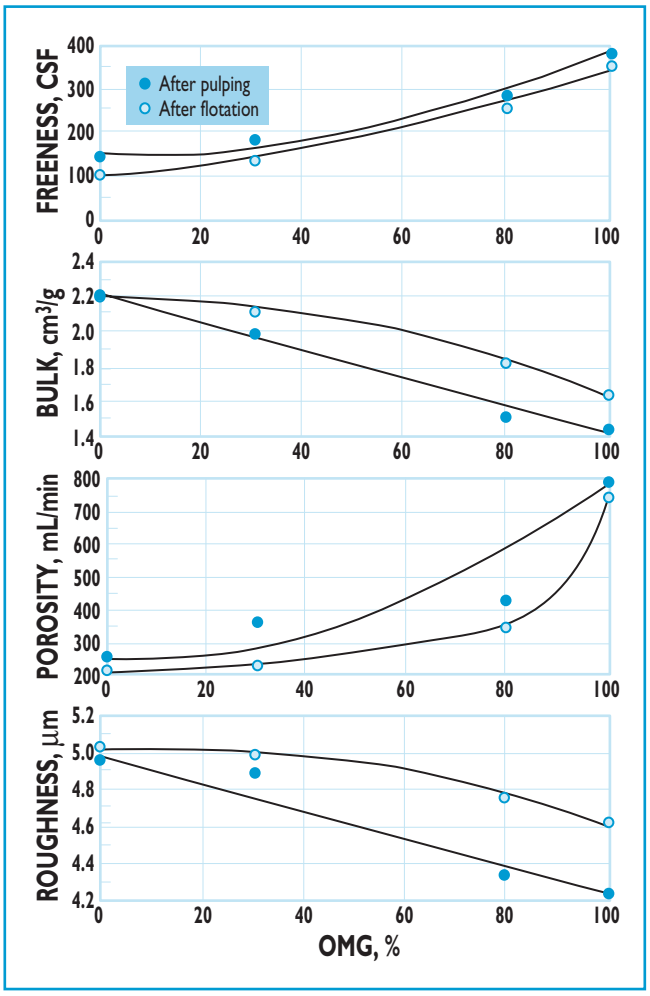
Figure 14 shows the effect of deinking on stretch. Stretch usually follows trends in the tensile index *(9)* as observed here after flotation in Fig. 14. After the pulping stage, the reverse trend to tensile index occurred—increasing stretch with increasing OMG. This behavior was unexpected and is difficult to explain.

Effect of deinking on other properties

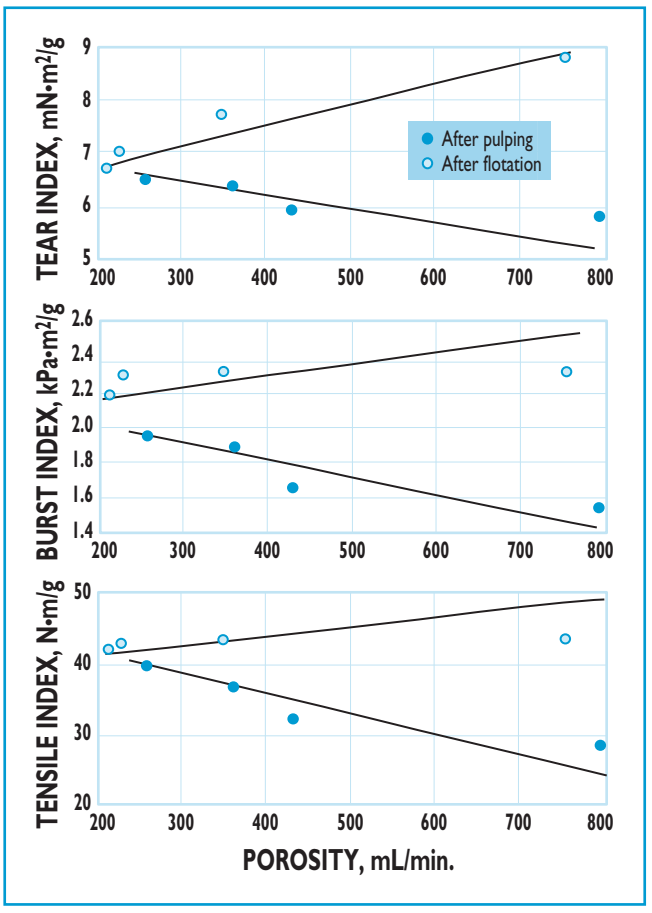
Freeness. Monitoring and controlling freeness is important in paper mills because freeness directly affects basis weight, caliper, moisture, and strength *(19)*. Freeness provides a measure of the speed for running a paper machine *(19)*. To make a consistent, high quality product, freeness must be monitored and controlled before and after refining *(19)*.

Figure 15 shows the effect of deinking on freeness. In the pulping and flotation stages, freeness increased with increasing percentage of OMG. This shows the presence of higher freeness chemical pulp *(18)*. After flotation, freeness was lower than at the pulping stage for a given percentage of OMG. This decrease in freeness is not due to the loss of fines or filler.

If loss of fillers was a key factor in the freeness difference between pulped and flotated pulp for a given percentage of OMG, then one might expect to see a significant difference in freeness between pulped and floated pulp as the percentage of OMG increases. Figure 15 shows an almost constant drop in freeness at a given percentage of OMG. This suggests that the fillers do not influence freeness.



15. The effect of deinking on other properties



16. The relationship between porosity and strength properties using different mixtures of ONP and OMG

Howard and Bichard *(18)* showed that pulps recycled with fines retained showed a drop in freeness—pulps with high fines often have low freeness. The loss of fines would increase freeness so floated stock would be higher than pulped stock. Figure 15 shows an opposite effect. The floated stock has lower freeness than pulped stock. This suggests that factors other than fines and fillers—the possible effects of chemical used in the deinking process—influence freeness.

The concentration of chemicals decreases in the flotation stage due to dilution by a factor of eight compared with the pulping stage. Some recent studies showed that despite the presence of fines and filler in the deinked pulp, the effects of chemicals such as alkalis or enzymes employed in the deinking process influenced the freeness *(3, 20)*.

Bulk. Figure 15 shows the effect of deinking on bulk. The pulped and floated stocks show a decrease in bulk with increasing % OMG. This is consistent with the introduction of lower bulk chemical pulp and fillers through the OMG furnish. For any given furnish, an increase in bulk usually occurs after flotation. This increase is due to loss of filler in the flotation stage. Increased use of chemical pulp resulted in decreased bulk—the trend observed in the flotation stage. The scanning electron image of a floated sample of 0% OMG and 100% ONP appeared bulkier than the floated sample of 100% OMG *(21)*.

Porosity. Figure 15 shows the effect of deinking on porosity. Porosity increased with an increasing percentage of OMG at the pulping and flotation stages. This is due to incorporation of chemical pulp into the system. In Fig. 15 at a given OMG percentage, the observed drop in porosity between pulped and floated samples is not due to the loss of filler or fines.

If a loss of filler or fines was a key factor in the porosity drop between pulped and floated pulp, one might then expect to see the increase in porosity drop between the pulping and flotation stages at a given percentage of OMG with an increase of OMG percentage. Figure 15 shows that porosity drop at a given OMG percentage

does not show an increasing trend. This suggests that other factors such as effects exerted by chemicals used in the deinking process rather than loss of fillers or fines have influenced porosity. A recent study *(3)* showed that the effects exerted by chemicals used in the deinking process rather than filler or fines can influence the porosity of deinked pulp more strongly.

Air resistance measurements are a common control test for paper manufacture because of the indirect correlation between porosity, formation, and strength of the paper *(8, 9)*. Normally, strength relates directly to porosity *(8, 9)*. The literature does report a few exceptions *(22)*. In our study, a trend showing high porosity and low strength was predominant in the pulping stage. The same trend did not occur after flotation. **Figure 16** shows this effect.

Roughness. Figure 15 shows the effect of deinking on surface roughness of the handsheets. In the pulping stage, roughness decreased linearly as the percentage of OMG increased, since chemical pulps originating from OMG usually have a smoother surface than mechanical pulps *(8, 9)*. Addition of fillers improves the printing properties of a sheet *(8, 9)*. Most pigments have a greater affinity for printing inks than the fiber surface *(8, 9, 23)*. Filler often improves the smoothness of paper after calendaring *(8, 9, 23)*.

Shaw and Simmons *(23)* found that incorporation of clay and calcium carbonate into the sheet resulted in a distinct reduction of roughness. The observed reduction in roughness with increasing quantity of OMG at the pulping stage is due to the fillers originating from OMG. Roughness values for a given OMG content were higher after flotation than after pulping. This increase could be due to a loss of fillers in the flotation stage.

CONCLUSIONS

Our studies show that during the process of deinking the trends observed in strength properties like burst, tear, and tensile are explainable by viewing the system as having three main components—mechanical fiber, fiber derived from chemical pulp, and filler. After the pulping stage, the detrimental effects exerted by filler influenced the trends obtained in the strength properties. After the flotation stage, an enhancement in all strength properties occurred. This can be due to the change in the proportions of chemical fiber, mechanical fiber, filler, and fines in the pulping and flotation stages. Loss of most filler enabled the beneficial effect of the chemical fiber to predominate over the detrimental effect of the filler component.

Because of the complexity of the system, the effect of loss of fillers and fines on the overall improvement of strength properties was difficult to quantify. Stretch typically increases with tensile in the flotation stage, but it decreased in the pulping stage.

Despite a significant amount of filler in the system, ink content had a greater influence on optical properties such as brightness and light absorption coefficients. Fiber type dominated the light scattering coefficient. Despite having the highest brightness, 100% OMG had the highest ink speck count.

Increasing the proportion of glossy magazines in the furnish resulted in a deinked pulp with higher brightness. No evidence existed to support the idea that ash components from the magazines facilitate the removal of ink from newsprint. With use of glossy magazines in newsprint furnish, the observed enhancement in final brightness of deinked pulp was due to the combined effects exerted by ink removal, retention of brighter chemical pulp, white pigments such as titanium dioxide and calcium carbonate, and removal of chromophores in the pulping stage.

The effects exerted by chemicals used in the system rather than fines and fillers influenced porosity and freeness. After 10 min of flotation, no advantage existed to continue the deinking process longer. No significant effect on the properties of recycled fiber occurred. The sequence of brightness values at very short flotation times did not reflect the final sequence after extended flotation times. **TJ**

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Received for review May 21, 1997.
Accepted Nov. 20, 1997

Presented at the TAPPI 1997 Recycling Symposium.

Acknowledgement: Australian Newsprint Mills Ltd.; the Department of Industry, Technology, Regional Development; and the University of Tasmania, Australia, provided financial support for this work. The authors thank members of Australian Newsprint Mills Ltd. Research and development center for their support and help.

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