Deposit control: A team effort leading to improvements in a TMP/DIP newsprint mill

By L.H. Allen and S. Ouellet

Abstract: The Stadacona Inc. newsprint mill was troubled for several years with a gradually increasing deposit problem at the calender stack. It caused dirt specks, thin spots and holes in the sheet, and was most severe on paper machine #4, sometimes causing production losses of 5-10 t/d. Steps taken to find a solution are described. Replacement of the first press roll doctor system, reduction of calender stack temperatures and replacement of the screw in one of the screw presses solved the problem.

For several years prior to August 2002, the Stadacona Inc. mill was troubled by a gradually increasing deposit problem which was especially severe on paper machine #4. The problem consisted of calender scabs and holes in the sheet emanating from deposits on calender rolls. It resulted in culling of the off-grade paper rolls and consequent production losses. The losses were highest on paper machine #4 and sometimes amounted to 5-10 t/d.

At the time, Stadacona Inc., in Quebec City, produced 1360 t/d of newsprint and directory grade papers on four paper machines. The furnish to these paper machines consisted, on average, of 40% deinked pulp (DIP) and 60% thermomechanical pulp (TMP). Typically, the paper machines used 50 m³ of fresh process water per tonne of production, so the water systems were not particularly closed.

The objective of this paper is to describe how we determined the causes of the deposit problem at the calender stack and the remedial measures that were taken to eliminate it.

Approach

FTIR analyses of the deposits scraped from the calender rolls consistently showed them to be a mixture of pitch (wood resin and its metal soaps) and stickies from the recycled paper.

Our approach was as follows:
1. Assemble a team consisting of key personnel of the production staffs of the TMP and DIP plants and paper machine #4, as well as the technical department. Also included on the team were members from Paprican and the company supplying the retention aid.
2. Review current deposit control practices in the mill.
3. Conduct visual comparisons of time plots of parameters that are either known to affect or that might possibly affect deposit formation.
4. Identify and apply solutions.

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Observations and Discussion

We began by reviewing and inspecting current pitch control practices in the paper mill, using a checklist published previously [1]. A summary of what we observed and concluded is shown in Table I.

This revealed that most of the parameters for pitch control were in good order. Nevertheless, there were several weaknesses in the operating practices that were likely contributing to the problem:

1. use of relatively fresh wood,
2. elevated bark content of chips,
3. poor efficiency of cleaners, and
4. high pH of shower water.

These factors were not new to the mill and had not been a problem in the past. Although they increased the propensity for deposit problems, it was difficult to understand why deposition would become more of a problem. Regarding the age of the wood, the mill used saw mill chips and they did stay in the mill wood yard for approximately one week (and at the saw mill for some time, too); hence, they were partly seasoned. The bark content of chips may be important and we will come back to this later.

The project team next assembled a list of possible factors for why paper machine #4 was experiencing more difficulties than the other paper machines:

1. lower first pass retention on paper machine #4 than on others (Use of less refiner rejects stock, which gives better retention, was a possible reason. In this mill, the TMP rejects stock is segregated from the main line.)
2. the rolls on paper machines #3 and #4 were smaller in diameter and therefore the operators had less time to patch the holes
3. lack of an automatic hole stop on paper machine #4
4. paper machine #4 typically used 5-10% more DIP than the other paper machines.

Of these factors, lower retention and higher use of DIP were judged to be significant. The other factors were judged by the team to be less so, but important to keep in mind. Paper machine #4 shared a common white water system with the other newsprint machines (#1 and #2).
TIME PLOT ANALYSES
Most of the factors considered so far involve the TMP plant and paper machine areas. In a newsprint mill with an integrated deinking plant, there is also a wide range of possible complications in the deinking plant that could lead to deposits [4, 5]. Consequently, the project team’s next approach was to assemble and brainstorm to produce a list of all possible parameters that might contribute to the problem. This done, we proceeded to conduct a visual comparison of time plots of these parameters (and some of those identified in Table I) with the daily tonnage rejected for holes and calendar scabs. Figs. 1-9 show examples of those where, in most cases, there appears to be some relationship.

In Fig. 1, where the percent DIP fed to paper machine #4 is plotted with tonnes of production lost to holes and calender spots, we find that the losses in production increase as the percent DIP increases from about 30% in July 2000 to 50% in December 2002. The machine operated at pH 4.8-5.8, with a target of 5.2. Machine crew knew from past experience that excursions to values above 6 gave problems. Machine operated at pH 4.8-5.8, with a target of 5.2. Machine crew knew from past experience that excursions to values above 6 gave problems. Machine operated at pH 4.8-5.8, with a target of 5.2. Machine crew knew from past experience that excursions to values above 6 gave problems.

In Fig. 2, while production of DIP increased considerably during the winter of 2001, the DIP contaminants possible. Clay not used on this machine. Because of some cross-over of white water with a directory grade machine, we clarified that TSPP was not used with the filler clay. It is evident from Fig. 2 that the production of DIP increased considerably during the winter of 2001. This increase put more pressure on the thickening equipment at the end of the deinking plant, resulting in greater carryover of deinking plant filtrates. Lost production on the paper machine did not increase dramatically at the point that DIP production did. Nevertheless, it remains a factor to be kept in mind.

Figure 3 shows a corresponding plot for hardness in the paper machine white water (in mg/L, as CaCO₃). It is evident that over the period from July 2000 to December 2002, while production losses increased, the paper machine white water hardness also increased. This hardness of the paper machine white water did not correlate especially well with hardness of the fresh river water used in the mill, as shown in Fig. 4. Consequently, the increased hardness is probably a reflection of the increased percentage of DIP, and much of that hardness probably comes from dissolution of calcium carbonate fillers used in recycled OMG (old magazine grade). Calcium carbonate dissolves at pH values below 8.2 to give calcium ion.

Figure 5 shows time plots for conductivity of the paper machine white water.


<table>
<thead>
<tr>
<th>Location</th>
<th>Parameter</th>
<th>Guideline</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire System</td>
<td>Temperatures on paper machine</td>
<td>Maintain as high as practical</td>
<td>No problems observed. Paper machine headbox stock temperature: 55 - 60 °C. No cold fresh water showers used on the paper machine.</td>
</tr>
<tr>
<td></td>
<td>Foam</td>
<td>Eliminate stagnant foam</td>
<td>Stagnant foam not an issue. Furthermore, no defoamer (which might deposit) used.</td>
</tr>
<tr>
<td></td>
<td>Microbiological growth</td>
<td>Eliminate</td>
<td>Well under control. Temperatures high. Sodium hypochlorite used in fresh water showers of paper machine.</td>
</tr>
<tr>
<td></td>
<td>Lubricating oils, greases and hydraulic fluid</td>
<td>Avoid leaks into stock</td>
<td>Inspection revealed this not to be an issue.</td>
</tr>
<tr>
<td></td>
<td>Cleaning of stock system</td>
<td>As often as necessary</td>
<td>There were no excessive deposits visible in the paper machine system.</td>
</tr>
<tr>
<td>Wood and Pulp</td>
<td>Pulps free of depositables material</td>
<td>Good debarking; seasoned chips; &lt; 10% Jack pine use; good DIP plant operation</td>
<td>Mill used relatively fresh wood with higher bark in winter. 2-6% Jack pine</td>
</tr>
<tr>
<td>Preparation</td>
<td>TSPP (tetrasodium) pyrophosphate</td>
<td>Avoid as a dispersant for filler clay [3]</td>
<td>DIP contaminants possible. Clay not used on this machine. Because of some cross-over of white water with a directory grade machine, we clarified that TSPP was not used with the filler clay.</td>
</tr>
<tr>
<td>Screens and</td>
<td>Removal of plastics and stickies</td>
<td>Operate for maximum efficiency</td>
<td>Occasionally DIP screening was poor. Paper machine cleaning poor (operating beyond design capacity).</td>
</tr>
<tr>
<td>Cleaners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forming Fabrics</td>
<td>Flows to showers</td>
<td>Maintain adequate</td>
<td>Judged satisfactory</td>
</tr>
<tr>
<td></td>
<td>Even distribution of shower water across the machine</td>
<td>Maintain</td>
<td>Judged satisfactory</td>
</tr>
<tr>
<td></td>
<td>Shower water temperature</td>
<td>Match that of headbox stock</td>
<td>Judged satisfactory</td>
</tr>
<tr>
<td></td>
<td>Shower water pH</td>
<td>Match that of headbox stock</td>
<td>Judged satisfactory</td>
</tr>
<tr>
<td>Press Section</td>
<td>Lube shower flows</td>
<td>Adequate</td>
<td>No problem</td>
</tr>
<tr>
<td></td>
<td>Shower water temperature</td>
<td>Match headbox stock</td>
<td>No problem</td>
</tr>
<tr>
<td></td>
<td>pH of shower water</td>
<td>Adequate</td>
<td>A little high, at pH 7.5.</td>
</tr>
<tr>
<td></td>
<td>Uhle box vacuums</td>
<td>Adequate</td>
<td>No problem</td>
</tr>
<tr>
<td></td>
<td>High pressure needle showers</td>
<td>Use as required</td>
<td>A little high, at pH 7.5.</td>
</tr>
<tr>
<td></td>
<td>Press-roll doctor condition</td>
<td>Maintain well</td>
<td>Appear satisfaction at first, but later discovered problem in pneumatic system that delivers pressure to hold one of the doctors against the roll.</td>
</tr>
<tr>
<td></td>
<td>Felt cleaning</td>
<td>Use detergent as necessary</td>
<td>Detergent used continuously. Judged satisfactory.</td>
</tr>
<tr>
<td></td>
<td>Uhle box strips</td>
<td>Use ceramic surfaces</td>
<td>Judged satisfactory</td>
</tr>
</tbody>
</table>
and lost production. It would appear that there is some correlation. The conductivity of the paper machine white water is greatly influenced by carryover of deinking plant filtrate. This would be a reflection of the condition and operation of the twin-wire and screw presses used at the end of the deinking plant to thicken the pulp after deinking and before it proceeds to the paper machine. The screw presses were immediately implicated, as the exit consistencies of the twin-wire presses were always over 25%.

Shown in Fig. 6 are plots of the percent bark in the incoming wood and lost production on paper machine #4. It is normal to have more bark in the wood chips during the winter months, as logs are less readily debarked under freezing conditions. It is interesting that in Fig. 6, during the winter of 2001/2002, there is a reasonably good correlation between bark content and production losses. However, the previous winter showed no relationship.
ship, which suggests that there was something different in the mill during the second winter. High bark content introduces more extractives into the process.

Figure 7 shows a time plot of white water consistency along with that of lost production. There is an increase in white water consistency over the period under review which, in a loose way, correlates with the increase in production losses. An increase in white water consistency might be caused by less effective retention aid performance or a reduction in its feed rate. The mill was using a dual cationic polymer retention aid system. Other possible causes include: a reduction of the percent TMP reject pulp in the furnish, an increase in the percent broke diluted with rich white water on this paper machine, an increase in the percent DIP in the furnish or a change in another parameter (such as TMP refining) that might change the natural retention of the stock.

The first pass retention on paper machine #4 is plotted against time in Fig. 8. One would expect an inverse relationship between retention and lost production, since better retention aids in the removal of dispersed wood resin and stickies from the paper machine system. There does not appear to be much inverse correlation. Since April 2001, first pass retention had decreased, perhaps a reflection of the increased DIP production and carryover of DIP filtrate.

Shown in Fig. 9 is the percent TMP refiner rejects used on paper machine #4 versus time, along with the corresponding time plot of lost production. The TMP rejects have been re-refined to give a material which usually results in better first pass retention on the paper machine wire. Under ordinary circumstances, this would result in greater retention of pitch and stickies. There does not appear to be much correlation, perhaps because of the low percentages used.

Table II summarizes the observations to this point. It also indicates the connection between each parameter and the deposit problem. It must be kept in mind that a good correlation is not necessarily a sign of cause and effect. In Figs. 1-9, a good correlation indicates only where the problem might be, or a contributing factor, but not necessarily the cause of the problem.

The observations in Table II suggest that the percent DIP in the furnish to paper machine #4 and carryover from DIP thickening (higher paper machine white water hardness and conductivity) may be important contributors to the problem. These factors would contribute calcium ion to the paper machine white water which, with pH > 6, would lead to calcium soap formation and deposition. TMP dispersed pitch would then accelerate the deposition rate [4]. (It is worth noting that in this mill, to avoid pH > 6 and pH shock, the pH values of the DIP and TMP are adjusted to 6.2 and 5.1, respectively, before they are mixed.) Table II also suggests that improvements in retention would be beneficial.

One aspect of the problem that intrigued the project team was the predominance of holes in the center of the sheet. Figure 10 shows the cumulative hole count during the period from September 28 to November 5, 2002 plotted against position across the paper machine. Logically, this hole distribution might be due to poor mixing of contaminants and stock (judged highly unlikely).
an edge temperature effect, or a mechanical phenomenon. The latter possibilities led us to carefully examine calender roll temperature and the operation of the press section roll doctors.

There was no correlation between lost production and high amounts of macro-stickies, as measured by the Pulmac test, Fig. 11. This contradicts the general wisdom that macro-stickies are the usual cause of deposits in mills using recycled paper [6]. It is also different from the observations reported in the literature for another newsprint mill, where coating latex appeared to be the source of calender scabs [7]. The flotation and screening of stickies may be more efficient at Stadacona than in the mill where this occurred.

At Stadacona, mill personnel measure and try to minimize macro-stickies because they may cause sheet breaks during printing.

We also conducted time plot analyses for a large number of other parameters and saw no correlation with lost production. These parameters are listed in Table III.
IDENTIFICATION OF IMPORTANT CAUSES

Based on the hole profile across the machine in Fig. 10, we tried lowering the temperature of the calender rolls. Eventually we stopped heating the calender rolls altogether, except for profiling, which eliminated almost all rejects related to calender scabs. Paper machines producing SC grades, where the calender rolls are often heated to high temperatures, are equipped with doctors on the calender rolls [8]. Paper machine #4 did not have calender doctors.

Toward the end of the time plot study, the team became aware that a frequent cause of calender scabs and holes is poor doctoring of rolls, especially in the press section. Deficiencies of press doctors can result in dirt on the surface of the sheet, which is carried to the calender section, where it may stick to the heated rolls. Further inspection of the press section doctor blades showed that, although the blades themselves were in good condition, the pneumatic system for applying pressure in the middle and on the edge of the blade against the roll was leaking. As a consequence, the blade was being applied with only half the force it required.

In addition, the thickening of the DIP with one of the screw presses was inferior, especially after the increase in production of the DIP plant. Although the mill target was >15%, consistencies were sometimes in the 5-10% range, and occasionally as low as 4%, which resulted in large amounts of carryover of deinking plant process liquid.

The retention aid system consisted of a split feed of coagulant (polyDADM/CAPM) to: the latency chest (350 g/t), the main line TMD dilution box (400 g/t), and the mixed stock chest (400 g/t). This was followed by addition of 125 g/t of cationic polyacrylamide (CPAM) after the pressure screen. Recent research at Paprican [9], observation at other mills, and published literature [10] suggest that the polyDADM/CAPM retention aid system in use is, indeed, the most efficient one for TMP/DIP pulps. To further tune it up, we tried changing the point of addition of the coagulant from the inlet to the outlet of the mixed stock chest, where it would get better mixing at the pump. We also tried increasing the feed rate of coagulant. These changes were made in stages, on a trial and error basis. In the end, we concluded they made no noticeable difference in the rejects rate, and went back to the original feed rate and point of addition.

HOW WE SOLVED THE PROBLEM

1. Minimize Heating of the Calender Rolls

Except as required for profiling of the sheet, the calender rolls were no longer heated. This gave the single largest improvement in elimination of off-grade paper.

2. Doctor Improvement

The first press roll doctor system was replaced with a new one. This resulted in another large improvement.

3. Improved DIP Dewatering

The screw was changed in one of the screw presses, which resulted in exit consistency from the DIP plant that were always higher than 15%.

CONCLUSIONS

By making the preceding improvements, as is evident in Fig. 12, we were able to reduce production losses on paper machine #4 from 5-10 t/d to < 1.5 t/d. Losses due to calender scabs and holes were entirely eliminated. The doctors on several of the other paper machines in the mill have since been replaced, with noticeable improvements in paper quality. We are contemplating installation of a second doctor and shower on the first press roll of paper machine #4.

Perhaps as important as solving the problem, the task force approach also had the positive effect of sensitizing and educating key members of the production and technical departments to the important parameters to watch for in the future for good deposit control.

After our team’s work was completed, a second team was formed to improve maintenance and operation of the doctor blades on all the paper machines. At this point, this second team has taken action along three lines: preparation of a list of all doctor blades in use on the paper machines, an audit of the operation and maintenance of the blades, and the formation of operation and maintenance crews.

PRACTICAL IMPLICATIONS

Our work demonstrated the importance of carefully and carefully carry out operation and press section doctoring, and good dewatering of stock at the end of the deinking plant. Hopefully, the knowledge we gained and the approach that we used may be helpful to others faced with similar problems in TMP/DIP newsprint mills.

ACKNOWLEDGEMENTS

We thank Eric Boulianne for preparation of the time plots and Alain Gagné for technical assistance. We also acknowledge with gratitude the other members of the project team (Dave Fontaine of Buckman, Alain Fortier and Pierre Leblanc) and the mill personnel who participated in the project and carried out our recommendations.

LITERATURE


Résumé: L’usine de papier journal Stadacona Inc. à Québec subissait depuis plusieurs années un problème de dépôt de plus en plus important dans les lisses. Cela entrainait des impuretés, des plages minces, et des trous dans la feuille, et le problème était plus grave sur la machine à papier n° 4. Dans les pires périodes, le problème a entrainé des pertes de production de 5 à 10 t sur cette machine, la production quotidienne moyenne étant de 400 tonnes. Notre travail visait à déterminer la cause du problème et à mettre en œuvre des mesures pour le corriger. Dans le présent rapport, nous décrivons les étapes parallèles, notamment la formation d’une équipe de projet, l’examen des pratiques actuelles en matière de contrôle des dépôts, les analyses de corrélation temporelle, et l’identification des problèmes et des solutions. Il n’y avait aucune corrélation entre les épisodes où le problème était le plus important et le cédex du papier placé sur la matière, cédex du papier placé sur la pâte, mesure à l’aide des essais Pulmac. Nous avons découvert que la principale source du problème était un docteur ne fonctionnant pas de manière appropriée au premier rouleau de presse. La réduction de la température de la lisse a donné de bons résultats. Un mauvais épaississement de la pâte provenant de l’atelier de désencrage faisait aussi partie du problème. Nous avons remplacé le docteur du rouleau de la première presse, abaissé la température de la lisse, et remis la pression à vis en état, et ainsi résolu le problème.


Keywords: NEWSPRINT, NEWSPRINT MACHINES, CALENDERS, DEPOSITS, DEFECTS, UPGRADE.