Online analysis of macrostickies in a sorted office waste recycling plant making tissue

MICHELLE RICARD, GILLES M. DORRIS, NATALIE PAGÉ, AND DENISE FILION

ABSTRACT: An online macrocontaminant analyzer, the FPAutoSpeck, was used for 8000 measurements of deinked pulp to determine the number and area of heavy stickies, light macrocontaminants, and dirt. The analyzer detected a wide range of macrocontaminant levels, during which the three types of macrocontaminants varied independently of each other. "Stickies storm" levels were detected and visualized by the analyzer, with heavy stickies levels exceeding 17000/kg in the final pulp. Different particle size distribution patterns were noted for the light macrocontaminants when compared to those obtained for heavy stickies and dirt. Mill surveys of the fine screens and flotation cell showed different removal efficiencies for heavy stickies and light macrocontaminants. Fine screening was slightly more efficient in the removal of heavy stickies than of light macrocontaminants. Fine screens were more efficient at removing heavy stickies with particle sizes larger than 400 μm in diameter. On the other hand, flotation could remove heavy stickies with particle sizes of 200-300 μm. Furthermore, flotation was able to remove most of the light macrocontaminants independent of their particle size.

Application: The reader will gain insight into how macrocontaminant levels can vary over a year in a recycling mill and learn how to remove different types and sizes of macrocontaminants using recycling unit operations.

We previously reported the development of an image analysis-based online macrocontaminant analyzer that characterizes macrocontaminants larger than 200 μm [1-3]. When compared with other methods [4-6], this analyzer separates macrocontaminants based on their relative buoyancy in water, color, and light reflectance. The three categories of macrocontaminants include heavy stickies, light macrocontaminants, and dirt [2]. The lighter-weight, low density contaminants or light macrocontaminants float on the water surface and are comprised of waxes, stickies, hot melts adhesives, and plastics. The heavier-weight high density macrocontaminants sink onto the settling plate of the analyzer where image analysis further splits the contaminants into two categories: 1) heavy stickies that are shiny and whitish in color and mainly comprised of stickies and 2) dirt that is blackish in color and comprised of black toners and dark wood components such as sclereids [2].

Despite the advent of cleaners and fine pressurized basket screens with slots of 100-400 μm [7], macrostickies are still problematic for mills producing tissue and towel grades from sorted office waste (SOW). Macrostickies and potentially agglomerated microstickies can contribute to operational problems through deposition on paper machine wires, press felts, vacuum boxes, and dryers, which may lead to premature replacement of wires, sheet picking, wet web breaks, and dirt specks and holes in the finished paper [8]. To prevent deposition of troublesome stickies on paper machine wires and components, fixatives, dispersants, and passivation agents are commonly added to pulp suspensions to agglomerate stickies and facilitate their removal by cleaning and screening; to disperse stickies and stabilize them in suspension; and to prevent their deposition by detackifying the stickies [9]. For many mills, control and prevention of stickies deposition is not sufficient. They must also treat paper machine wires, felts, and rolls with chemical agents to prevent deposition. As a last resort, mills often clean the paper machine wire with costly and sometimes dangerous solvents [9].

In this report, we describe the performance of the FPAutoSpeck (Technidyne; New Albany, IN, USA) on the final deinked pulp (DIP) in a recycling plant integrated with tissue and towel making from SOW. At high stickies levels, this SOW mill uses high volumes of costly solvents to clean paper machine wires. Bales made from pulp containing higher stickies levels are either repulped and recycled anew through the recycling plant or sold at an inferior price for linerboard fabrication. Before the trials and installation of the macrocontaminant analyzer, the mill measured stickies contents using TAPPI T 277 om-07 "Macro stickies content in pulp: the "pick-up" method" twice each shift of 8 h. Based on a single laboratory elevated stickies result, the mill would cull pulp bales produced a few hours before and after sampling of the final pulp.

More frequent and reliable results would allow better control of pulp quality. In addition, the mill wished to validate the stickies removal efficiencies of their flotation cells and new pressure screen baskets with smaller slot diameters. Therefore, the first objectives of the macrocontaminant analyzer installation were to increase frequency of stickies analysis, to cull only troublesome bales of pulp, and to learn more about how unit operations reduce concentrations of stickies in their final pulp. In addition to the online data, the performances of primary and secondary fine screens and the primary flotation cell were determined using the manual or survey mode of the instrument. Particle size distributions and removal efficiencies of macrocontaminants are reported for both online and manual sampling modes.

MATERIALS AND METHODS

Mill installation of online macrocontaminant analyzer

An industrial prototype of the macrocontaminant analyzer retrofitted to a commercial pulp classifier (Pulmac MasterScreen, Pulmac Systems International; LaSalle, QC, Canada) was installed at the mill for testing. After the successful trial, the mill purchased and installed the first industrial version of the analyzer, the FPAutoSpeck. The analyzer was equipped with an autosampler on the DIP line of the SOW recycling producing tissue and towel grades [1,2]. Autosamplers were calibrated to deliver constant volumes of DIP at constant pressure. Samples were corrected for consistency using mill online consistency sensors. In this mill, DIP is then either transferred to the tissue paper machine or pressed to ~45% consistency for baling, shipment, and sale to mills producing tissue, towel, or board. This report presents the results of manual sampling of the recycling plant's primary and secondary fine screening systems and primary flotation Escher Weiss cells, as well as online data taken during the prototype trial and after installation.

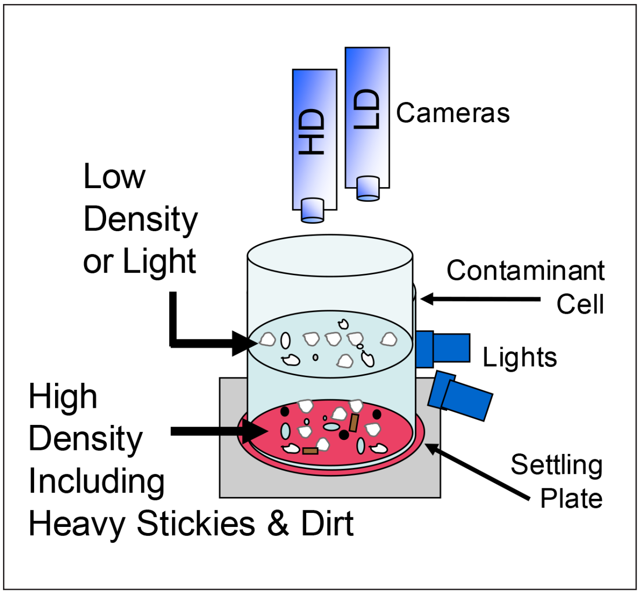
Removal efficiencies (RE) were calculated as follows:

$$RE, \% = (A_f - A_a / A_f) \times 100$$

where A is the amount of macrocontaminants based on number/kg of pulp or mm²/kg of pulp, f is the feed, and a is the accepts of a unit operation. For overall efficiencies, the number and area used for feeds were obtained from survey results obtained during the spring of 2010, whereas the accepts are the means of the online data points collected during the prototype trial (1.5 months, April-June 2010) and since installation (intermittently between December 2010 and June 2011).

Macrocontaminant analysis

The components and mode of operation of the macrocontaminant analyzer were previously described [1,2]. Briefly, pulp or whitewater samples are added manually (survey mode) or automatically via autosamplers (online mode) to the pulp classifier. The pulp classifier screens macrocontaminants larger than 0.006 in. slot width from pulp fiber and concentrates them before their transfer to a specialized chamber that further separates the contaminants primarily based on their relative density to water. **Figure 1** shows the contaminant chamber where contaminants are separated based on their relative density to water [2].



1. Simplified diagram of the macrocontaminant analyzer contaminant cell containing water and macrocontaminants settled on the plate (high density = heavy stickies and dirt) and floating on water surface (low density = light macrocontaminants) [1,2,3].

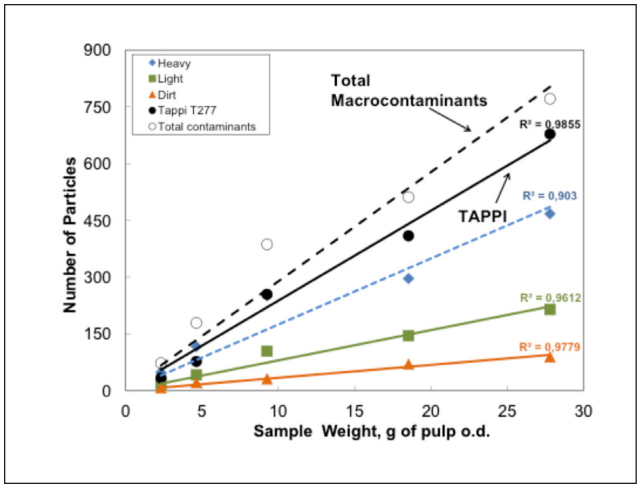
The low density macrocontaminants or light macrocontaminants float on the water surface, and the high density macrocontaminants, heavy stickies and dirt sink onto the settling plate where images of both contaminant types are then captured and analyzed. As the cameras image a section of the chamber area, large air bubbles are sparged to redistribute the macrocontaminants between repeat imaging and analysis. In addition to relative density to water, factors such as particle shape, chemical composition, hydrophobicity, and propensity to stick to air bubbles may also influence a contaminant's ability to float or sink within the contaminant cell. Only contaminants that float and are whitish in color or reflect light are classified as light macrocontaminants, with no further distinction as to their nature. This category can be comprised of waxes, stickies, hot melt adhesives, and plastics. Through image analysis, the heavier higher density contaminants are further split into two categories: contaminants that are reflective and whitish in color and mainly comprised of stickies are named heavy stickies, and contaminants that are blackish in color and comprised of black toners and dark wood components such as sclereids are named dirt. Dirt measurement was added to the macrocontaminant analyzer after the prototype trial.

Chemical and microscopic analysis

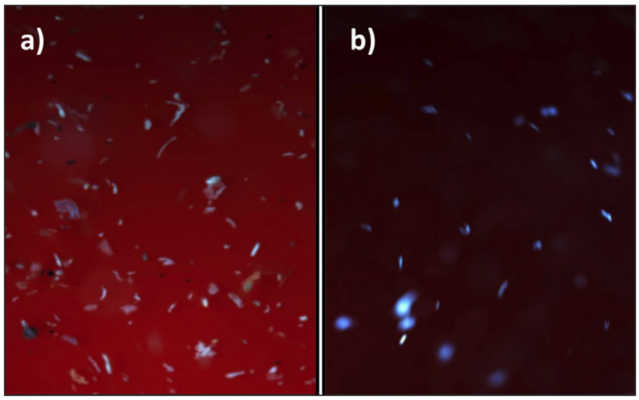
To characterize the contaminants, individual macrocontaminants were isolated from the top and bottom phase of the contaminant chamber water fractions. These contaminants were then analyzed by microscopy, malleability testing, and Fourier transform infrared spectroscopy (FTIR) to determine the type and chemical composition of the isolated macrocontaminants [2].

Calibration and method validation

Before measurement, for each sample type and mill stream, the appropriate sample volume capable of giving repeatable measurement was determined by preparing a calibration curve of sample volume size against macrocontaminant concentration (**Fig. 2**). For example, ovendry (o.d.) sample sizes of ~ 25 g gave sufficient area of heavy stickies, light macrocontaminants, and dirt when surveying fine screen accepts and flotation cell feed, whereas for the lower contaminant levels in the DIP, sample size was increased to ~ 60 g o.d. for adequate online measurement. At 60 g o.d., the limit of the pulp classifier for this pulp was almost attained. With the advent of cleaner pulps, a larger classifier will be required. Figure 2 also compares the analyzer calibration curves to those obtained by TAPPI T 277 om-07 for a composite sample of primary screen accepts. Similarly, as previously reported for OCC [2], the sum of the number of the three types of contaminants measured by the macrocontaminant analyzer approaches that obtained by the TAPPI method, except that the number of contaminants measured by the analyzer is slightly higher to those measured by the TAPPI method. On the other hand, the area of the total contaminants is slightly lower to the calibration curve as measured by the TAPPI method. Contrary to the analyzer calibration curves measured in old corrugated containers (OCC), where light macrocontaminants and dirt were the major components of OCC pulp, the major components of the secondary screen accepts are heavy stickies and light macrocontaminants. If different sampling points were taken within the recycling plant or from one recycling plant to the other, the proportions of heavy stickies, light macrocontaminants, and dirt would vary [3], as would their comparison to values obtained using TAPPI T 277 om-07.



2. Calibration and determination of sample size for secondary screen accepts needed for macrocontaminant analyzer measurement and validation against TAPPI T 277 om-07 "Macro stickies content in pulp: the 'pick-up' method." Total macrocontaminants represent the sum of counts for heavy stickies, light macrocontaminants, and dirt.



3. Portions of macrocontaminant analyzer images of secondary fine screen feed containing heavy stickies and dirt (a) and light macrocontaminants (b).

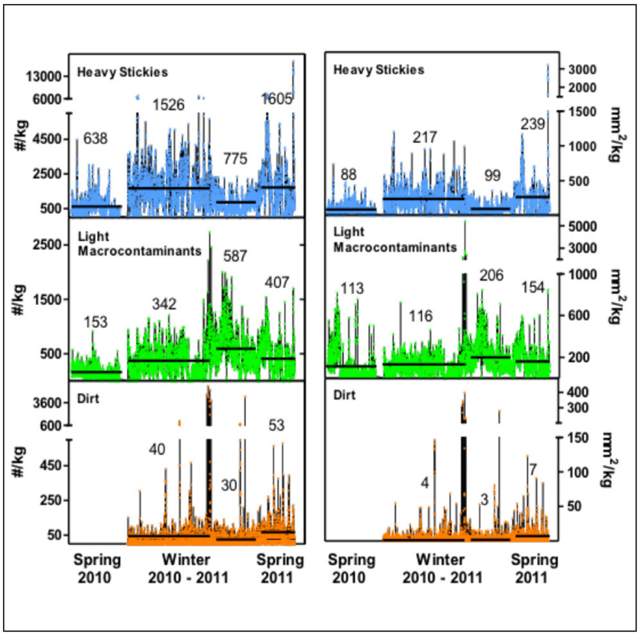
RESULTS AND DISCUSSION

Images of macrocontaminants

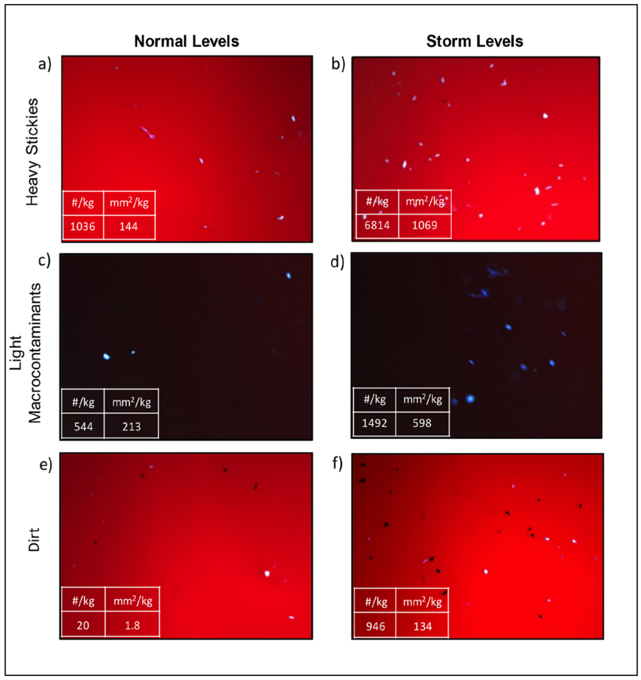
Figure 3 shows portions of images of heavy stickies and dirt (a) and light macrocontaminants (b) taken with the macrocontaminant analyzer from samples of secondary fine screen feed. Although not yet measured in early 2010, several large and small particles of dirt are clearly seen. Using different image analysis parameters, 73870/kg and 23552 mm²/kg of heavy stickies were also measured from this same image. Some of the heavy stickies are small and roundish, like a ball, while portions of other stickies are elongated like a cigar or rolled-up film. Two-dimensional or film-like stickies have been reported [10,11]. In this particular mill, many of the heavy stickies are filiform in nature, almost as if the stickies or films had been rolled. This filiform shape was not seen as frequently in the OCC pulps [3]. A more in-depth study of the macrocontaminants before and after each unit operation of the recycling plant might reveal whether the shape of stickies is modified as they travel through the recycling plant. Galland et al. [11] even suggest using kneaders to manipulate stickies shape and size, thereby facilitating their removal by unit operations. Figure 3b shows images of lighter density contaminants with 10010/kg and 9157 mm²/kg of light macrocontaminants.

Online analysis of macrocontaminants

Figure 4 shows six graphs with variations in the number and area of online macrocontaminants during the prototype



4. Online macrocontaminant analyzer results of deinked pulp showing variations in number (left, y axis) and area (right, y axis) of heavy stickies, light macrocontaminants, and dirt. The macrocontaminant trends represent 8158 data points. Average is indicated by bar "___".



5. Portions of macrocontaminant analyzer images of final deinked pulp showing heavy stickies (a and b), light macrocontaminants (c and d) and dirt (e and f) during normal levels (a, c, and e) and "stickies storm" levels of macrocontaminants.

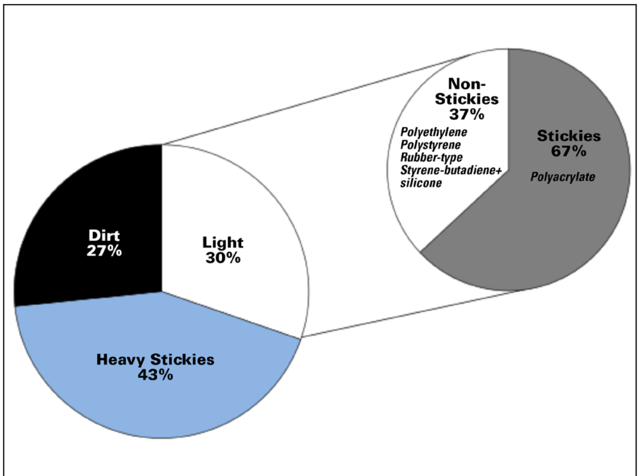
trial and since installation. Two striking conclusions immediately arise from a quick overview of the six graphs: the macrocontaminant analyzer can handle measurement of a wide range of macrocontaminant levels and the three types of macrocontaminants vary independently of each other.

Heavy stickies levels ranged from 0-17646/kg and from 0-3209 mm²/kg. The means of heavy stickies numbers and areas are shown for four different periods. During the winter months, 2.5 times more heavy stickies were noted before dropping back to lower levels. This was followed by a second increase in heavy stickies in the late spring of 2011. Mill personnel noted more complaints from purchasers of baled deinked pulp and heavier dosage of solvents to clean paper machine wires during periods of high stickies content. The mill is now recording cleaning solvent addition in order to establish a correlation between heavy stickies concentration and solvent usage. Such a correlation may lead to a better solvent addition control system and improved paper machine runnability.

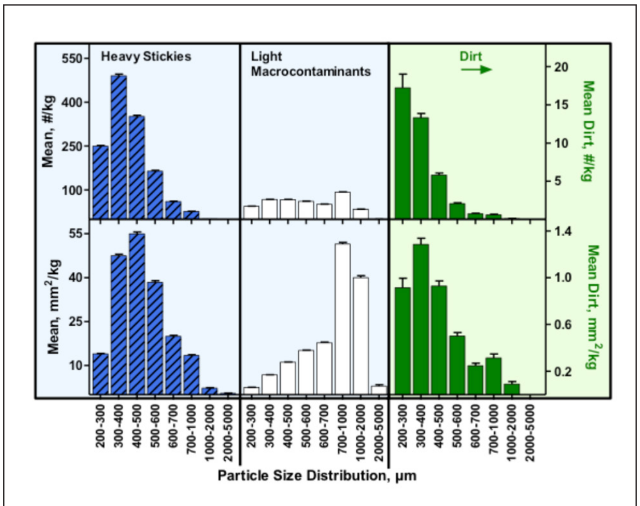
Macrocontaminant images corresponding to sharp peaks of macrocontaminant levels were examined. **Figure 5** compares portions of images taken by the analyzer during "normal" and "storm" levels of macrocontaminants where 6.6 and 7.4 times the number of heavy stickies were measured in number and area during the storm period. Mills have often reported periods of high stickies numbers that appear suddenly as "stickies storms." If we average the number of contaminants during the 20 top storms, mean values of 9034, 2646, and 1861 are obtained for heavy stickies, light macrocontaminants, and dirt, respectively. These spikes confirm mill observations. Although not yet elucidated, the origin of these storms may be the result of furnish swings, microstickies agglomeration, problems with water and pulp circulation, or due to poor control of unit operations.

At levels ranging from 0-2734/kg, the numbers of light macrocontaminants were much lower than those of the heavy stickies (Figure 4). On the other hand, based on area, the spread of data from 0-5432 mm²/kg was similar to values obtained for the heavy stickies. From this we surmise that the density, shape, and surface properties of the light macrocontaminants give them a greater propensity to be retained at the air-water interface. Because number and area of light macrocontaminants varied independently to that of heavy stickies, the sources of each contaminant may be different.

During the winter of 2010-11, there were 2.2 times more light macrocontaminants than measured in 2010. By early spring of 2011, the light macrocontaminants increased by 3.8 times and then dropped to a mean value of 407/kg, a value 2.7 times higher than measured in 2010. The tendency was very different when we compared the area of the light macrocontaminants. In 2010 and part of 2011, the levels of light macrocontaminants were low at 113-116 mm²/kg. Contrary to the heavy stickies, the levels of light macrocontaminants rose in the early spring by a factor of 1.8 then dropped to 154 mm²/kg. Like the heavy stickies, there were "storm" peaks containing 2.8 times more concentrations of light macrocontaminants, as shown in the online data results of Figs. 4 and 5.



6. Distribution of macrocontaminants from the primary screen feed pulp, including description and chemical composition of light macrocontaminants.



7. Online macrocontaminant analyzer results of deinked pulp showing mean number (top) and area (bottom) values of particles of heavy stickies (left, y axis), light macrocontaminants (left, y axis), and dirt (right, y axis) in a given particle size range. Each column represents the mean of 5778 online data points (± standard error of the mean). Note that the particle size range is repeated on the x axis three times, once for each type of macrocontaminant.

Figure 6 shows the relative composition of heavy stickies, light macrocontaminants, and dirt for a single composite sample of primary fine screen feed. The light macrocontaminants are further subdivided into stickies or nonstickies, based on malleability testing and chemical characterization by FTIR. Light macrocontaminants accounted for 30% of the total macrocontaminants. Of this 30%, 63% were polyacrylate-based materials. Microscopic examination revealed that the majority of the sticky-like material, 44%, was globular in nature, with the remainder being either hairy stickies (globular with fiber), 28%, or film-like, 28%, in nature. The remaining contaminants were nonstickies in nature; chemical composition includes in decreasing order of content, polyethylene, polystyrene, styrene butadiene, and silicone. Under the microscope, these components were all films of different thicknesses. Polyethylene and styrene butadiene are often part of the composition of adhesives, hot melt adhesives, and latexes used in coating formulations [4,8,12].

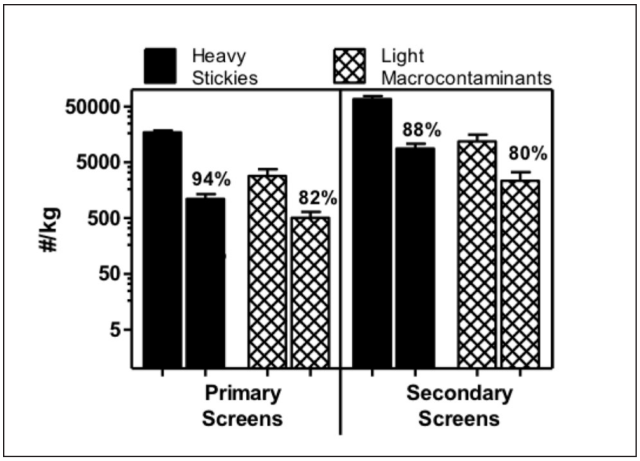
Figure 2 shows that dirt increased linearly with increasing sample size. Figure 4 shows that unlike the heavy stickies and light macrocontaminants, no period of high dirt counts or area occurred over a sustained period. Probably because of a better furnish control or a dispersion step that is more effective for breaking up dirt than stickies, the mill was very effective in maintaining low levels of dirt. Occasionally, high numbers and area of dirt were measured where levels increased from zero to 5806/kg or 398 mm²/kg. Peak levels of high dirt counts sometimes coincided with high peaks of heavy stickies or light macrocontaminants but at other times no correlation was seen. The mill related these "storm" dirt levels to the use of a particular furnish. Contrary to the OCC furnish [3], where dirt was mainly wood particles such as sclereids, the dirt from SOW was mostly toner particles, as proven by FTIR.

Figure 7 shows the frequency distribution according to particle size for the three classes of contaminants of DIP. On a numbers basis, more than 90% of the heavy stickies and dirt were in the size range of 200-600 μm. The distribution pattern was very different for the light macrocontaminants, where most contaminants, based on number, were evenly distributed across the particle size range. Furthermore, the distribution pattern of the light macrocontaminants shows an opposite trend to the heavy stickies and dirt, with more than 84% of the light macrocontaminants, based on area, belonging to larger particle size ranges. Clearly, larger diameter light macrocontaminants are not being fully removed by the mill's screening system.

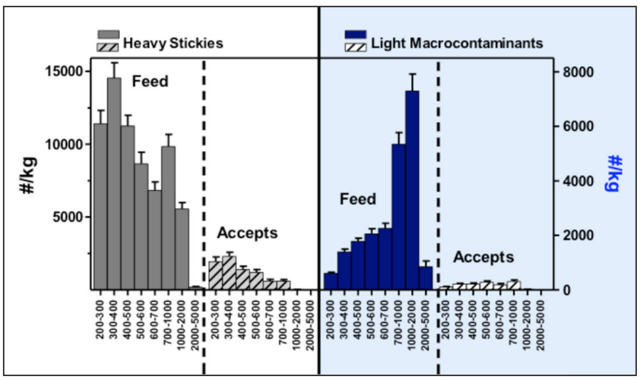
Survey of mill primary and secondary screens and primary flotation cell

During the prototype trial, composite samples of either primary or secondary feed and accepts were examined for heavy stickies and light macrocontaminant levels. These results, as shown in **Fig. 8**, provide a snapshot for mill operation of their fine screening units. Although not as statistically sound as 8158 data points from the online analyzer, the manual sampling mode allows easy validation of the operation of key recycling operation units. The number and area increased 4.0-4.2 times in the secondary screen feed recuperating fiber from primary screen rejects. Primary fine screening removed higher proportions of contaminants than the secondary screening.

At 2838/kg and 3016 mm²/kg, there were 83% and 51%, respectively, less light macrocontaminants than the heavy stickies in the primary fine screen accepts. Similarly, the secondary fine screen feeds had 83% less in number and 43% less



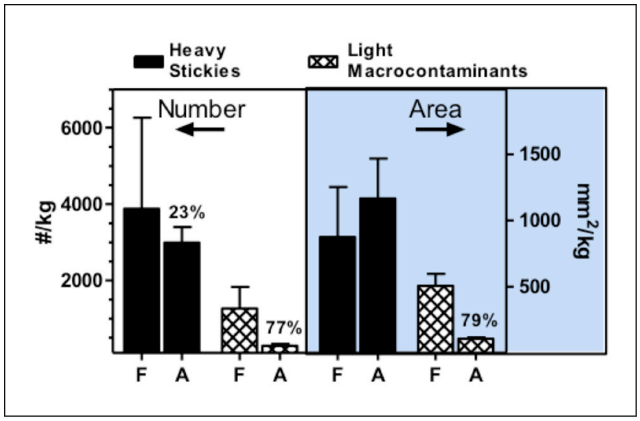
8. ***Mean number of heavy stickies and light macrocontaminants in feed (F) and accepts (A) of primary (left) and secondary (right) fine screens. Macrocontaminant removal efficiencies are indicated above the column of accepts. Error bars indicate the standard deviation from the mean of seven to nine replicate samples.***



9. ***Macrocontaminant analyzer results of secondary fine screen feed and accepts showing mean number of particles of heavy stickies (left, y axis) and light macrocontaminants (right, y axis) in a given particle size range. Each column represents the mean of seven to nine survey data points (± standard error of the mean). Note that the particle size range is repeated on the x axis four times, once for the feed and accepts of each type of macrocontaminant.***

in area light macrocontaminants than heavy stickies. Based on number, removal efficiencies were 12 and 8 percentage points lower than the heavy stickies for the primary and secondary fine screens, respectively. However, if the removal efficiencies were based on area rather than number, light macrocontaminants removal efficiencies were higher at 94% and 87% for primary and secondary fine screens, respectively.

Figure 9 compares frequency distribution according to particle size for secondary fine screen feeds and accepts. Because of the fewer points analyzed in the manual sampling mode, the standard error of the mean is greater than shown for online data in Fig. 7. When based on number, 68% of the heavy stickies and secondary screen feed were between



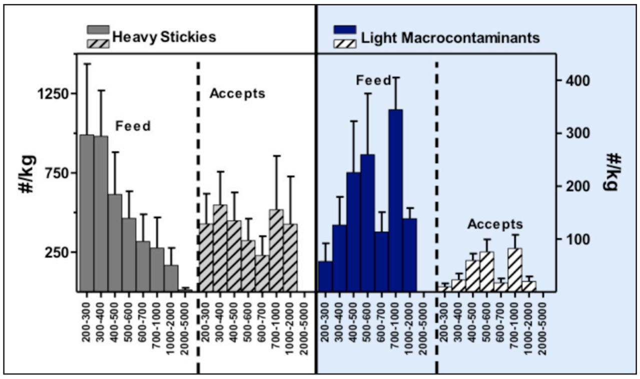
10. ***Mean number (right, y axis) and area (left, y axis) of heavy stickies and light macrocontaminants in primary flotation cell pulp feed (F) and accepts (A). Macrocontaminant removal efficiencies are indicated above the accepts column. Error bars indicate the standard deviation from the mean of three replicate samples.***

200 μm and 600 μm. The same trend for the primary and secondary screen accepts was observed with most of the heavy stickies, which were between 200 μm and 600 μm.

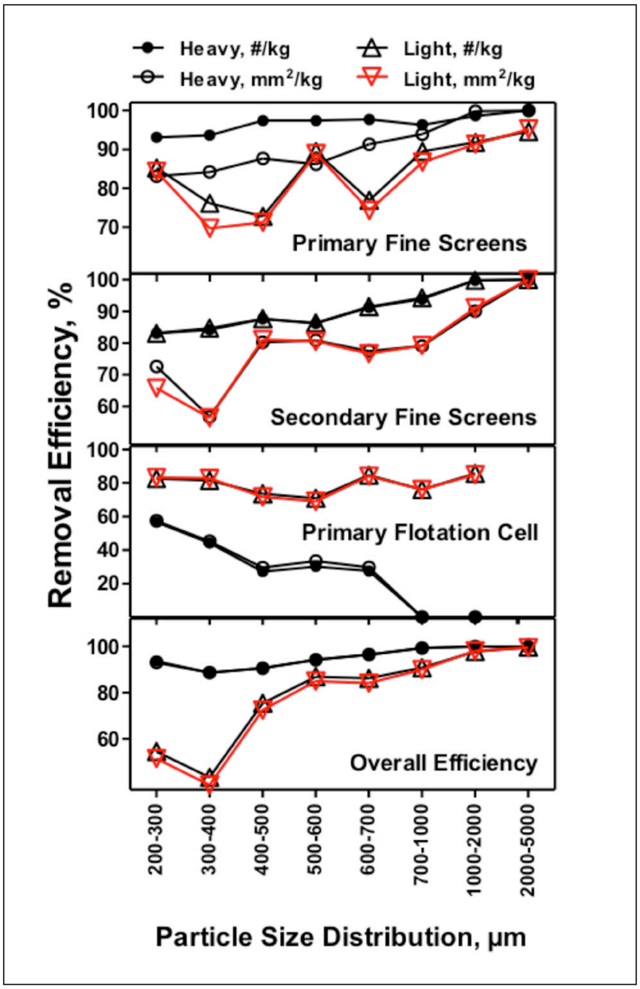
Figure 10 shows that the primary flotation cell contains 3 times and 1.7 times more heavy stickies than light macrocontaminants, based on number and area. Overall removal of heavy stickies by flotation was poor. Contrary to fine screening that removes heavy stickies and light macrocontaminants, flotation is more efficient in the removal of light macrocontaminants. As such, it is not surprising that the analyzer well reflects these changes, because light macrocontaminants are separated from the heavy stickies and dirt based on their lower density relative to water and their propensity to float. Even though the absolute numbers are not the same, the tendency observed with the online analyzer is the same for the heavy stickies, but not for the light macrocontaminants, where flotation removed 22% of the heavy stickies based on number but none based on area.

Figure 11 shows the frequency distribution according to particle size for the primary flotation cell feed and accepts. Based on number in flotation feed, the heavy stickies have a similar distribution pattern to that seen previously in Figs. 7 and 9 for the final pulp and fine screen feed. Most (86%-97%) of the light macrocontaminants of flotation feed and accepts are greater than 400 μm in size.

Although the recycling unit feeds were not monitored frequently, **Fig. 12** gives insights on how fine screening and flotation contribute to contaminant removal by comparing removal efficiencies of heavy stickies and light macrocontaminants across the particle size distribution. The recycling plant removed more than 80% of heavy stickies and light macrocontaminants. Whether based on number or area, heavy stickies are better removed at particle sizes larger than 700 μm. Even over the lower particle size range of 200-700 μm, removal efficiencies range from 89% to 97%.



11. Macrocontaminant analyzer results of flotation cell feed and accepts showing mean number of particles of heavy stickies (left, y axis) and light macrocontaminants (right, y axis) in a given particle size range. Each column represents the mean of three survey data points (± standard error of the mean). Note that the particle size range is repeated on the x axis four times, once for the feed and accepts of each type of macrocontaminant.



12. Within each particle size range, mean heavy stickies (heavy) and light macrocontaminant (light) removal efficiencies based on number (number/kg) or area (mm²/kg).

Removal efficiencies in the smaller particle size range of 200-400 µm for the light macrocontaminants is between 40% and 55%, whether based on number or area. There is then a gradual increase in the removal efficiencies from 73% to 99% as the particle size increases.

The heavy stickies removal by the primary fine screens is superior to that found by the secondary fine screens, independent of the particle size. At the smaller particle size ranges of 200-400 µm, the heavy stickies removal was 93%, based on number. As size of the heavy stickies increased, the removal rates increased to 99%. At particle sizes of 200-400 µm, the heavy stickies removal rates drop by 10%-27% for both fine screens, based on number and area. Furthermore, the heavy stickies removal efficiencies by area are lower at all particle size ranges for the secondary screen when compared to the primary screen. For the light macrocontaminants, removal rates stay about the same if based on number/kg; however, the rates drop to 56%-66% if based on area for particle sizes of 200-400 µm. Although it is difficult to compare the mean surface area of dried and flattened stickies isolated using INGEDE Method 4 [13] to the undried and unflattened particle size measured by the macrocontaminant analyzer, it is well established that smaller macrostickies or ministickies ranging from 100 µm to 1000 µm [10,11,14] are more difficult to remove by screening.

From the primary flotation cell, Fig. 12 shows 57% removal of heavy stickies with particle sizes of 200-300 µm, with a gradual drop in removal efficiency as particle size increases to 700 µm, whether based on number or area. This might partly explain the results shown in Fig. 11, where few of the heavy stickies are removed by number, and none by area. In contrast, flotation removes 69%-86% of light macrocontaminants, independent of particle size, whether based on area or number.

Figures 11 and 12 clearly show that heavy stickies with sizes of 200-400 µm are more easily removed than those with sizes greater than 400 µm. No heavy stickies larger than 700 µm were removed by flotation. Although no distinction between heavy stickies and light macrocontaminants was made, flotation of pressure sensitive adhesives between 80 µm and 5000 µm in size has been reported since 1997 (Nerez et al. [15]). Of the three types of pressure sensitive adhesives floated in the laboratory, acrylic and styrene isopropylene styrene formulations floated well across all particle size ranges, whereas only styrene butadiene particles 80-400 µm in size floated well. Although particle sizes from these dried stickies might not be the same dimensions as those observed in the analyzer, these results agree well with those presented in Fig. 6, where 63% of light macrocontaminants were polyacrylates.

CONCLUSIONS

This is a first report of more than 8158 online data points that include heavy stickies, light macrocontaminant, and dirt analysis measured during two noncongruent periods spanning more than 8 months by the FPAutoSpeck. In DIP, the area of light macrocontaminants was equivalent to that of the heavy stickies, although their number was 1.3-4.5 times lower. The online data showed periods of high contamination or "storms" that varied in time for each of the three contaminant types. Although at times, peaks of high contamination of the heavy stickies and light macrocontaminants seemed to coincide, at other times the three contaminant types varied independently of the other. The peaks of high dirt counts and area coincided with furnish known to contain more dirt while peaks of heavy stickies coincided with higher solvent usage by the mill to clean the paper machine wires.

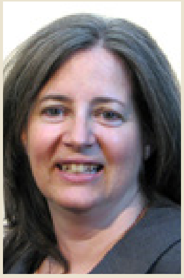
Some of the heavy stickies were small and roundish, while portions of other stickies were more two-dimensional or film-like in nature. In this particular mill, many of the heavy stickies were filiform in nature, almost as if the stickies or films had been rolled. A more in-depth study of the mill contaminants from the pulping to the final pulp might reveal if the shape of the contaminants arises from changes in furnish or from passage through mill unit operations.

The particle size distribution for the light macrocontaminants was very different than that of the heavy stickies or dirt. FTIR analysis of primary screen feed revealed that the light macrocontaminants were mostly pressure sensitive adhesives and hot melts. Repeat analysis of the light macrocontaminants would confirm these findings over time or after passage through mill unit operations.

Mill surveys of primary and secondary fine screening systems and primary flotation cells gave a snapshot of the level of heavy stickies and light macrocontaminants and their removal efficiencies. Particle size analysis showed that, overall, the mill was more efficient at removing macrocontaminants greater than 400 μm. Although efficient at contaminant removal in all size ranges, surveys conducted on unit operations showed that the fine screens were efficient for removal of heavy stickies and light macrocontaminants particularly at particle sizes greater than 400 μm. Figure 12 shows that fine screens were more efficient at removing heavy stickies at particle sizes greater than 400 μm, whereas flotation removed 57% of the heavy stickies between 200 μm and 300 μm. The ability of the macrocontaminant analyzer to separate heavy stickies and light macrocontaminants based on their relative density to water also showed that flotation was able to remove 69%-86% of the light macrocontaminants independent of their particle size and could remove 57% heavy stickies with particle sizes ranging between 200 μm and 300 μm. Clearly, online examination of feed and accepts from various separa-

ABOUT THE AUTHORS


Dorris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Filion


Ricard

We chose this topic to research to help recycling mills better understand issues with stickies to improve their contaminant removal operations.

The results of this study proved the ability of the analyzer to measure three different types of macrocontaminants online on the final deinked pulp produced at a sorted office mill recycling plant. The results helped the mill make decisions on their recycling.

The development of the unit and subsequent transfer of the technology to the mill was exciting but filled with unforeseen challenges. We greatly underestimated the time that it takes for each. We addressed both these issues by having a multidisciplinary team supported by the industry and keen on finding a solution.

We learned some fundamental aspects of contaminant removal through analysis of the images and the size of macrocontaminants before and after screening and flotation. For example, we learned that the two-dimensional aspect of the macrocontaminants allowed some larger dimension stickies to pass through the fine screens, but that they could be easily removed by flotation.

It was interesting to see the mill immediately use this data to ensure that their pulp met client specifications and that the instrument demonstrated the usefulness of modifying their unit operations.

FPInnovations has licensed the technology for the FPAutoSpeck to a commercial partner (Technidyne) who will build and sell future units. We will continue to work with the tissue mill to help them improve their contaminant removal operations.

Dorris is research manager, Pagé is researcher, Filion is senior technologist, and Ricard is research leader, Cellulosic Biomaterials, FPInnovations – Pulp and Paper Division, Pointe-Claire, QC, Canada. Email Ricard at michelle.ricard@fpinnovations.ca.

tion units could lead to optimal macrocontaminant removal if not control. **TJ**

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