Resolving wire contamination on a tissue machine

Daniel J. Pekrul and Charles W. Neal

Analytical troubleshooting techniques can help identify the most probable cause of wire contamination.

Wire contamination on a tissue machine is usually due either to pitch or stickies adhering to the machine wire. Pitch occurs naturally in wood pulp, and stickies are from synthetic materials such as tape, adhesive materials, glue, and similar products. On the wire, these materials block drainage and result in small holes in the tissue substrate. To prevent holes, it is then necessary to shut down the paper machine and clean the wire. It can take from four to eight hours per incident to clean a wire, which can have a drastic impact on machine capacity and profits. Wire cleaning also puts worker safety at risk from handling wire cleaning chemicals and working in a nonroutine area with slip hazards. Additionally, the use of cleaning agents adds to a mill's output of reactive organic compounds. When safety and environmental factors are added to increased production costs resulting from wire contamination, the advantages of understanding the cause and solution of the problem far outweigh the choice to do nothing or improvise a cure. Actual losses on one of our paper machines amounted to $300,000 over a six-month period. Projected losses were $1,000,000 had the cause not been corrected and wire contamination continued at the severity initially experienced. This article explains the process used to solve the problem of wire contamination on one machine, together with short- and long-term direction for prevention.

Approach

The approach to resolving the wire contamination began with a clear understanding of the problem statement: "Small holes in tissue sheet." If it were not for a limit on small hole count for quality, it would not be necessary to shut down and clean the wires. **Figure 1** is a photograph of such small holes.

The Analytical Troubleshooting (ATS) technique used was developed by Kepner Tregoe, Inc., which guides the troubleshooter through a series of questions designed to identify possible causes to verify against the original problem statement. An example of the questions used is shown in **Fig. 2**.

The ATS effort identified the most probable cause to be wire contamination. A photograph of the results of pitch contamination on the wire is shown in **Fig. 3**. Cleaning the wire eliminated the holes in the sheet, as shown in **Fig. 4**.

The focus now shifted to identification of the source and cause of the wire contamination. Pinpointing when the problem began and the relative change in the severity of the problem was especially difficult because the machine is a swing machine and a brand upgrade had just occurred a short time earlier. This brand upgrade included a change in the whole grading procedure.

Initial data gathering to understand better the scope, possible causes, and potential fixes of the wire contamination problem included the following:

1. Identification of the contaminant on the wire
2. Identification of what changed in the process when the problem initially occurred
3. Information gathering from similar mills on their past contamination problems and fixes
4. Verification of the most suspect potential causes through testing or tracking schemes.

FT/IR micromolecular spectroscopy utilizing a diamond cell identified the wire contamination to be a combination of pitch and talc, as **Fig. 5** illustrates.

Two major furnish types, northern softwood kraft and a hardwood kraft, are utilized. Pitch deposits from the softwood refiner contained talc, while the pitch samples from the hardwood system contained no talc. However, it was hypothesized that once the two systems joined, all pitch deposits would contain talc. Therefore, the presence of talc in the wire contamination could not be used to implicate the softwood or clear the hardwood as potential causes of the wire contamination.

On a parallel path, process changes as well as any other factors that may have occurred around the time of the problem were researched. The following items were investigated as part two of the ATS process:

Pekrul is specialty brands machine/business department manager with the Procter & Gamble Co., 800 University Ave., P.O. Box 8010, Green Bay, Wis. 54308-8010. Neal is department manager, process reliability organization, with the Procter & Gamble Co., 6100 Center Hill Rd., Cincinnati, Ohio 45224.

2. Analytical troubleshooting questionnaire

What is the trouble statement?

SPECIFY	IS		IS NOT
WHAT	thing or group of things are you having trouble with?	**WHAT**	could you be having trouble with?
	is wrong with it or them?		could be wrong?
WHERE	is the thing when the trouble is noticed?	**WHERE**	could it be?
	is the trouble located on the thing?		could it be located?
WHEN	was the trouble first noticed (date, time)?	**WHEN**	could it have been first noticed?
	has the trouble been noticed since then?		could it have been noticed since then?
	in the history or life cycle of the thing is the trouble first noticed?		could it first be noticed?
EXTENT	How many units of the thing have the trouble?	**EXTENT**	How many could have the trouble?
	How much of any one unit has the trouble?		How much could have the trouble?
	How many flaws or defects are on any one unit?		How many could there be?

ANALYTICAL TROUBLE SHOOTING

What is different about the "is" compared to the "is not"?

What has changed in, around, or about each difference? (Date)

How could each change have **caused** the problem?

Test each possible cause: If ____________ is the true cause, how does it explain the "is" and the "is not"?

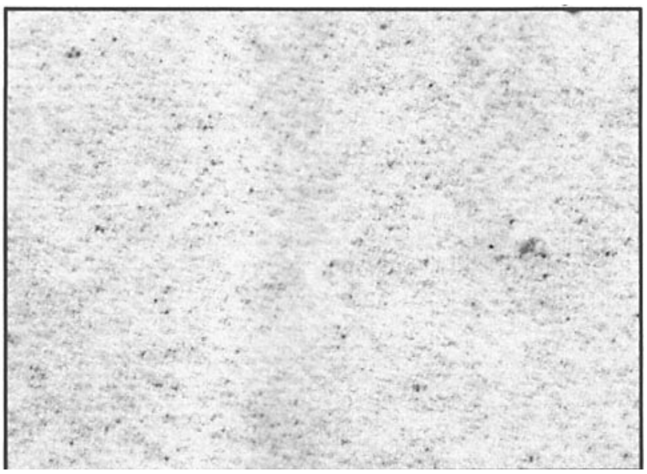
Does the most probable cause **verify**?

THINK BEYOND THE FIX:

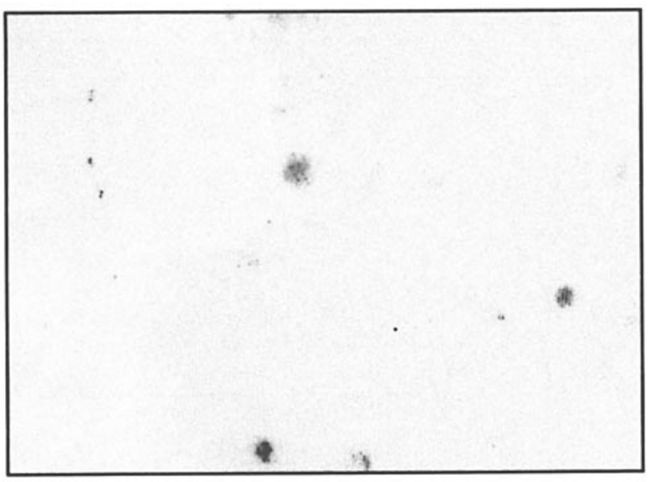
- Are there identical things that need the same fix?
- What other damage has this cause done here?
- Where else could this cause create trouble?
- What caused the cause? Are you 100% sure? (If not, start a new Problem Analysis.)

1. Determining when the problem first occurred and when subsequent problems occurred
2. Identification of changes in furnish usages
3. Identification of changes in water temperature, chemistry, and pH
4. Identification of changes in mechanical equipment that could cause a change in shearing action upstream from the headbox
5. Identification of changes in showering ability

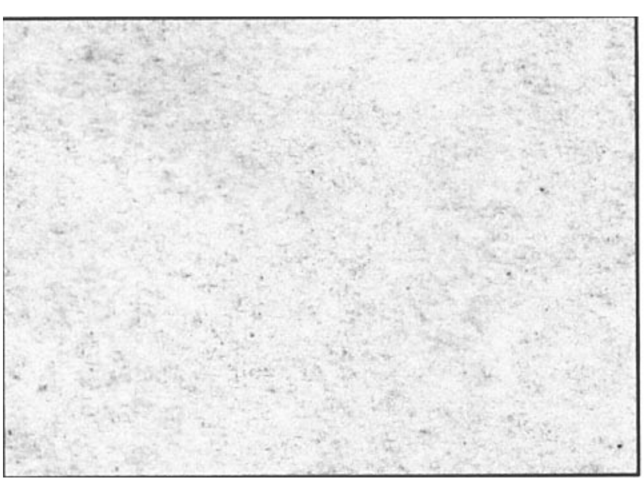
1. Small holes in tissue sheet



3. Pitch contamination on wire



4. Normal tissue sheet



6. Identification of changes in pulp processing from each supplier and the extractives content of each pulp
7. Identification of changes in brand swings and effect of tissue upgrade on forming and fabric hygiene
8. Identification of changes in bacterial growth in the entire process.

Findings

Several of the items mentioned above changed to one degree or another, but pH stood out as the most probable cause. Within three days after pH fell below 5.2 at the headbox, the wire would become contaminated with pitch and require a shutdown for cleaning, as **Fig. 6** indicates. This finding was confirmed with each shutdown and matched data acquired from a similar paper machine. Further investigation showed a pH control problem which caused spiked drops in pH and thus wire contamination.

Another observation was unexplained contamination incidents following paper machine downtime with no apparent problem with pH control. **Figure 7** illustrates these occurrences. The finding here was acid valve leakage when the paper machine was down. The acid caused system pH to drop, resulting in pitch precipitation and contamination of the wire.

This paper machine has a layered headbox and thus separate furnish chests for each layer. The hardwood kraft is present in the two outer layers and the softwood in the center layer. Each stock stream was traced from the headbox back to the pulper to identify areas of high pitch accumulation. One hardwood kraft chest was severely contaminated with pitch. Upstream from this chest is another supply chest that swings from hardwood kraft to CTMP. The CTMP is pulped at a basic pH. When this chest is filled with hardwood kraft and there are no pH problems, the walls remain clean of pitch deposits. If a low pH problem does occur and pitch is deposited on the walls, the pitch is eventually cleaned when the higher pH CTMP is used in this chest.

Further checking showed a problem of consistently maintaining proper hardwood kraft pH at the pulper. pH is controlled on the machine via acid addition. The pH of the incoming hardwood kraft is oftentimes lower than target pH on the machine. For this reason, we add soda ash at the hardwood pulper to raise the furnish pH above the target pH on the machine. The addition of soda ash is manually adjusted by the stock prep operator. If a batch is skipped or not enough soda ash is added, the hardwood pH will be too low, resulting in pitch precipitation and deposition downstream through the process.

The problem of wire contamination on this tissue machine was clearly due to low pH excursions in the hardwood kraft streams at the pulper and the headbox.

Short-term solution

Several action steps were immediately put in place to gain control of the wire contamination problem. The first step was to educate the operators on the findings so they would understand the importance of the manual pH control at the pulper. They would also be more likely to identify other signs or changes if they occurred in the future. A clear procedure was issued for maintaining proper pH levels at the pulper. The quantity of soda ash was increased to ensure pulp pH swings from the supplier would not fall below what was observed to be the acceptable lower limit.

In addition to improved pulper pH control, headbox acid valves were replaced, and a procedure for maintaining valves and pH probes was initiated. The new valves eliminated acid leakage, and thus low pH excursions, while the paper machine was down.

Long-term solution

We are currently implementing this long-term solution:

1. Installation of automatic caustic addition at the hardwood pulper as a replacement for the manually added soda ash. This will prevent the possibility of operator error and reduce variability of the hardwood pH delivered to the machine.
2. Reduction in the number of automatic pH control loops at the headbox and lengthening of the response time of the loop. These steps will improve the ability to maintain properly fewer control loops and dampen the pH swings inherently induced by system overcorrection and water purging.
3. The net effect will be a system that will respond to broader swings in pH and have a more accurate and precise response.

Summary

Prior to implementing the short-term solution, this tissue machine experienced one to three downtime incidents per month over a seven-month period due to wire contamination. Since that time, only one wire contamination related shutdown has occurred over the last seven months. This single incident was caused by human error in control of hardwood pH at the pulper.

The significance of this study is a direct application of following a structured ATS approach in solving a costly problem. It also speaks to the importance of pH control in preventing wire contamination. Expensive mechanical means of reducing the effects of wire contamination may be avoided or reduced by focusing problem-solving effort on the source of the problem versus treating the symptoms (pitch on wire) for reducing the impacts of wire contamination.☐

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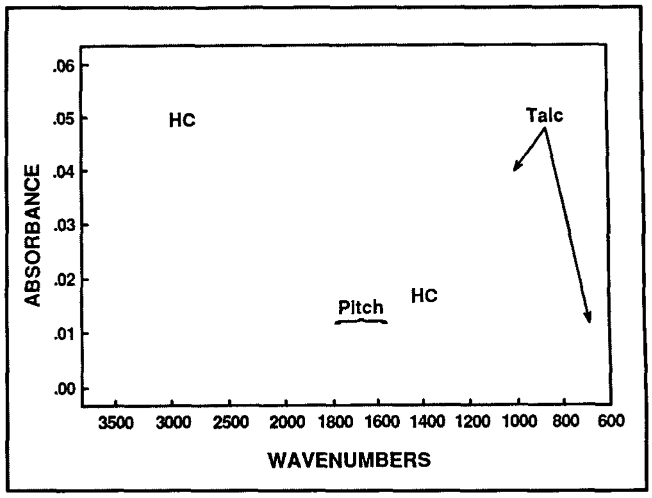
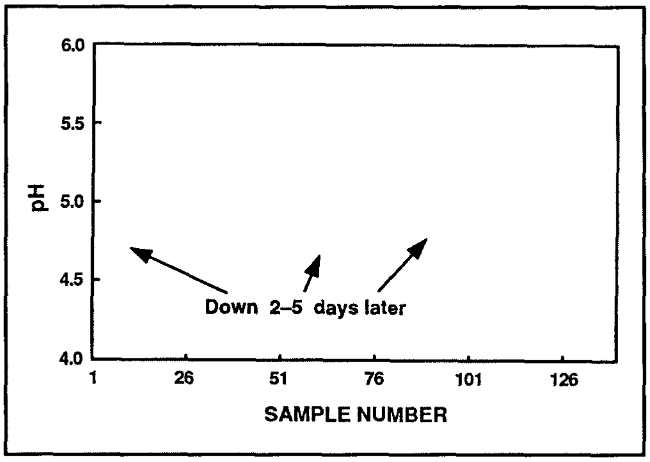
5. FT/IR of wire contamination



6. Fabric layer pH (shift averages)



7. Fabric layer pH (12 minute averages)