

REDUCTION IN PITCH ADHERENCE OF MACHINE CLOTHING

BERND H. FISCHER

KNOWING THE PROBLEMS OF CONTAMINATION IN THE PAPER INDUSTRY AND POSSIBLE METHODS FOR SOLUTION CAN PROVIDE REDUCTION IN PITCH ADHERENCE OF MACHINE CLOTHING.

CONTAMINATION IS A GROWING PROBLEM IN A recovered paper stock preparation system and on the paper machine. Deposits cause interruptions in production and poor quality of the paper product. Substances in the production process that adversely influence or prevent trouble-free production and high quality are pitch particles by definition. These substances occur in solid, colloidal, or dissolved form. They can be macro stickies larger than 100 µm or micro stickies between 1 nm and 100 µm.

In the paper machine, deposits occur in many different locations such as at dryer cylinders or in fabric clothing. They influence the runnability of the paper machine. The deposits can be unwanted resins or resin components ("pitch"), tacky contaminants ("stickies"), or plastic particles ("white pitch").

Contaminated paper machine clothing is not suitable for transporting and dewatering the paper web. Especially in the dryer section, energy consumption increases. The abnormal running behavior of the fabrics can cause web breaks. Stopping the paper machine may be necessary to clean the clothing or install new clothing due to reduced fabric life. This adds significantly to the total cost of paper production. Causes of deposits formed during the papermaking process are the following:

- Increased use of closed water systems
- Trend to a neutral or pseudo-neutral process
- Increased use of calcium carbonate
- Reducing the unit area mass of paper
- Increase in filler content
- Abrasion of paper machine content
- Electrostatic charges
- Use of hydrophobic machine components
- Increasing production speed
- Elevated process temperatures
- Enhanced use of recovered paper.

How does one optimize paper production? The obvious answer is to eliminate all contamination problems during the paper production process. A monofilament producer must have no pitch adherence to paper machine clothing or deposited dirt particles must be easy to remove. The following techniques are some possibilities to reduce the problem of contamination in the paper industry:

- Use of stock preparation plants for recovered paper
- Cleaning of closed water systems
 - Removing pitch particles from the process
 - Change of contaminants
 - Adapt prevailing conditions in the system
- Cleaning of paper machine clothing
 - Mechanical cleaning
 - Chemical cleaning
- Choice of suitable fabric structures and monofilaments
- Treatment of paper machine clothing
- Suitable surface characteristics of monofilaments.

PAPER MACHINE CLOTHING

Different types of paper machine clothing using monofilaments providing improved cleaning characteristics are available in the United States and Europe. For forming fabrics, a blend of polyester (PET) with a small amount of polyvinylidene fluoride (PVDF) is popular in the United States and used in Europe to a small extent. In Europe for dryer fabrics, the mixture of PET and PVDF is popular. In the United States, the same combination has use, but the material has a lower additive content. Practical experience with all these materials has shown that they can contribute toward improved cleaning properties of fabrics. Depending on the particular conditions in a paper machine, the effects are usually positive. Why is their evaluation not always positive?

Pitch adherence is a complex process. **Figure 1** shows that it is primarily the interaction of paper machine clothing and other machine parts, water, and dirt and pitch particles. The basic mechanisms of pitch adherence involve aggregation, adsorption, and tack.

Various adhesion mechanisms cause deposits in a recovered paper preparation plant and the paper machine. These mechanisms can be purely mechanical adhesion or adsorption processes. In adsorption, the hydrophobic, hydrophilic, or both interactions are responsible for the adhesion of dirt to solid matter. A precondition for formation of deposits requires the pitch particles to aggregate and deposit on machine parts. The driving force is the reduction of free interfacial energy.

The surface tension of fabrics and dirt particles provides a determination of wetting behavior. For example, paper machine clothing made from PET has a surface tension of approximately 43 mN/m. Tacky contaminations have a surface tension of 20–40 mN/m.

The aggregation of pitch particles in a water system depends on the specific surface and its hydration. Larger and more hydrophobic particles have a stronger tendency to aggregate and deposit on fabrics. The tack and flexibility of dirt are also important factors that require consideration.

IMPROVED SYSTEMS

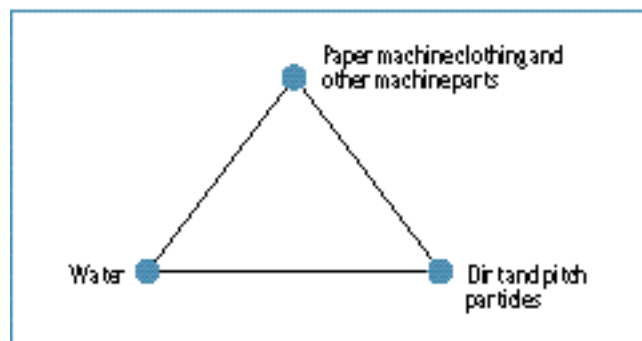
Fluoro polymers and polyolefins—especially polyethylene (PE)—offer interesting characteristics. Polymer mixtures are best because the desired effect remains permanently despite any abrasion of the cross section of the monofilament yarn. PET is an excellent material due to its technical properties. Ethylenetetrafluoroethylene (ETFE), PVDF, and PE are good secondary polymers.

To optimize dirt repelling in 100% recovered paper use, a study examined increasing amounts of modifier. The allowable percentage of modifier had a restraint that the quality and processability of the monofilaments must correspond as much as possible to the normal level for forming and dryer fabrics. The extra cost for the dirt repelling properties needed to consider the costs and benefits to the paper industry.

In the study, successful extrusion products were possible for dryer fabrics and forming fabrics. The technical data of the yarns was satisfactory in all extrusions. By adding high percentages of fluorine polymers or polyethylene, the strength compared with pure PET decreased. Elongation increased, and thermal shrinkage varied minimally. The diameter variation was within normal limits. Hydrolysis and dry heat resistance with the fluorine polymer variants were higher than a standard material. With the PE version, hydrolysis and dry heat resistance were minimally lower.

MEASURING METHODS

How can dirt repelling properties of monofilaments and fabrics be demonstrated? What measuring methods are



1. interaction triangle

available? Unequivocal and meaningful laboratory tests are not available today. Tests for the evaluation of individual physical parameters such as the wetting behavior of monofilaments or fabrics do exist. This testing has use to predict possible anti-dirt properties of paper machine clothing.

Contact angle measurements performed for several cycles with various solvents have shown the different wetting behavior of pure PET monofilaments compared with PET polyester monofilaments of high fluorine content. The height of the contact angle measured from the immersion and emerging angles indicates the wetting. Small angles have good wetting, and large angles have poor wetting.

The wetting properties of the dirt repelling material in homopolar media such as n-hexane differ significantly from the wetting behavior of the pure PET. The height of the contact angle in a homopolar medium might therefore indicate the capability for dirt repelling. Measuring the descent of the contact angles under cyclical operation should characterize the permanency of dirt repelling.

A disadvantage of this type of isolated examination is not considering the varying conditions in a paper mill. Ignoring the interaction of the different components in a changing environment can drastically reduce practicality. Parameters considered in isolation make interpretation of measured results difficult.

Pitch adhering behavior of monofilament yarns produced in the test extrusions described above were studied using a simple but practical measuring method. The tests used a rosin ester. Rosin esters are present in glues and have a high adsorption tendency. A dirt suspension used equal amounts of rosin ester and pulp mixed in distilled water. After breaking into fibers, the suspension was filtered through a 150- μ m fabric. The filtrate was adjusted to pH 7 and poured into a beaker.

Filtration is necessary to remove larger agglomerations since these are unsuitable for adsorption at the monofilament surface due to their particle size. Normally, dirt particles in a paper machine are greater than 150 μ m. A pH value of 7 is appropriate because it corre-

sponds to common operating conditions for a paper machine. Pitch adhering in this range is greatest.

Approximately 5 m of monofilament yarns were wound around a frame at intervals of approximately 2 mm, cleaned in methanol, weighed, and placed into a beaker. A propeller mixer was placed in the center of the unit for stirring. With stirring, the monofilament remained for 1 h at 45°C in the dirt suspension.

In a hydrous solution, a hydrate film covers a monofilament surface. This film must be destroyed to provide contact between the dirt particles and the solid. Stirring and the resulting turbulence accomplish this.

The temperature of 45°C corresponds with practical conditions in a headbox. Pitch adhering also increases with higher temperature because of the reduction in viscosity and the improved flow behavior of the potentially tacky contaminants.

After the test, the monofilament was lightly rinsed under cold running water, dried at 45°C, and weighed again. The increase in weight is the deposit of potentially tacky contaminants and provides a measure of the monofilament anti-dirt behavior. The results showed that addition of PE compared with pure PET does not give any improvement in limiting pitch adherence. Using small quantities of fluorine polymers did give significant effects. Higher percentages of fluorine polymer increased the dirt repelling effect.

In another test, a paper machine fabric is fastened onto a wheel. One-third is then immersed in a dirt suspension. By slow rotation of the wheel, the fabric is alternately in contact with fluid and air. This simulates the formation of deposits. The applied trial conditions were 45°C for 2 hours at pH 7 in 0.8 L of dirt suspension.

In the first series of trials, 5 m of monofilament were wound around the wheel. Using the previously described methodology, measurements of various monofilaments were made. For dirt substances, polyacrylate and polyvinyl acetate were used. Conclusions were drawn by measuring the consequent weight increase of the monofilament. Initial experience showed this measuring method was suitable.

RESULTS

The results of the tests and the technical properties of the different types indicated that the version with a high percentage of PVDF offers the best solution for the paper industry. Many forming and dryer fabric manufacturers have successfully used trial quantities. Dryer fabrics have had the most common use with significant quantities processed to date. The practical results obtained to date are the following:

- Demand for a dirt repelling monofilament is higher in the dryer section than in the wet end.
- Technical properties and processing are satisfactory.

- Screens have reduced pitch adhering.
- Cleanability of fabrics has improved significantly.
- Cleaning intervals in the paper machine are greater.
- Cleaning duration of paper machine clothing is less.
- Paper machine has reduced downtime and costs.

Due to the high level of fluoro polymer, note that the mechanical resistance is lower. The fabrics are therefore sensitive to increased pressures during cleaning that can cause fibrillation of the monofilament surface. If the papermaker does not monitor this parameter, the dirt repellent properties will eventually disappear completely.

These technical limitations should be overcome soon. With forming fabric yarns, we have already gained a significant improvement by using a second additive proven by internal laboratory testing. For dryer fabric yarns, a comprehensive trial program is occurring. The results are incomplete, but initial work shows that mechanical stability can increase significantly with use of a different fluor polymer.

CONCLUSION

To overcome completely the contamination problems in the paper industry, a system-wide approach involving machine builders, papermakers, fabric makers, and monofilament yarn makers is necessary. Due to the increase in recycling and the resulting increased use of recovered paper furnishes, removing contaminating substances from the loop by effective preparation systems is essential.

Simulating the long term effects on a paper machine in the laboratory is difficult in any meaningful, reproducible, and time-efficient way. The optimal measuring method would need to consider all three aspects—the influence of the monofilaments, the fabric design, and the paper machine conditions. Since this is not presently possible, field trials in the immediate future will remain the only way to judge success of any development.

Choosing the correct polymers can reduce the pitch adhering of fabrics provided certain preconditions in the paper machine are met. The demand for new materials also means that users must be ready to adapt their existing behavior within the confines of what is reasonable and appropriate. This means the pressure of the cleaning systems must be lower to accommodate the currently limited mechanical properties of the product.

The next logical development will probably be a two-component monofilament of the core and sheath type. This will use a single-step process to extrude a pure PET core with a sheath of PET and PVDF.TJ

Fischer is key account manager at Johns Manville GmbH (formerly Hoechst Trevira GmbH & Co. KG), Max-Fischer-Str. 11, D-86399 Bobingen, Germany; email: Bernd.Fischer@JM.COM