Paper machine clothing cleaning and conditioning for recycled fiber use

Scope

The objective of this Technical Information Paper is to recommend specific guidelines for maintaining the efficient running of paper machine clothing when recycled fiber is utilized in the process. The paper also discusses reasons for the recommended cleaning and conditioning techniques and explains mechanisms of contamination from recycled furnish constituents.

Safety precautions

As with any mechanical or chemical system, hazards are inherent and manufacturer guidelines must be followed to ensure safe operation. MSDSs for chemical treatments should always be available, and referenced in advance of starting any new treatment program.

Introduction

A common concern of papermakers is the dewatering of new furnishes with increasing recycled fiber and contaminant content while maintaining sheet properties. Recycled fibers, primarily chemical pulps, are less able to swell by the absorption of water. When voids in the cell wall become irreversibly closed, an increase in the crystalline structure of the cell wall is also likely to occur. This unswollen, stiffer fiber cannot come close enough to other fibers to develop good bonding. Consequently, further refining is necessary to reach paper strength properties, which in turn stresses the formerly dried fiber. Additional fines production from this process scenario is typical. Due to their unhydrated fiber origin, these fines act like filler. Recycled fines and fiber cause drainage difficulties on a paper machine, and increase contamination of clothing.

In addition to changes in fiber properties, recycled furnishes bring with them increasing amounts of contaminants such as glues which tend to fill paper machine clothing in new and increasingly insidious ways. These glues are also responsible for one of the more colloquial technical terms in our industry: “stickies.”

Papermaking strategies must change to compensate for these new furnishes. Table design, vacuum application and wear surfaces need to be examined to maintain machine efficiency. Formation and retention levels can be negatively impacted by the addition of recycled fiber to the papermaking system.

Paper recycling raw materials interact with the chemical and physical characteristics of the recycling and papermaking process to produce a finished product. Deficiencies in either the raw material or the design and operation of the process will result in either an inefficient process, inferior product, or both. Contaminants impact the paper machine by affecting runnability, product quality or both. Contaminants from recycled fiber can be traced to adhesives (hot melt glues and contact adhesives); waxes, inks, and other materials contained in the wastepaper furnish. These materials are generally hydrophobic (water-hating), and are highly attracted to similar energy surfaces such as the polymers used to make paper machine clothing.

The physical size of the contaminant is most important. Large stickie particles (roughly greater than 200 microns in diameter) are not problematic; these can be removed through properly designed recycling and stock
preparation systems. Similarly, colloidal sized particles (roughly less than 2 microns in diameter) do not represent a problem if they remain small. However, they can and will often aggregate to a larger size and cause deposits. The mid-sized particles (2-200 microns in diameter) represent the real problem to the papermaker. They are too small to be removed by screening and cleaning equipment and too large to pass through the system unnoticed. Particles from 2 – 20 microns generally do not pass impact quality directly, but can still contribute to problems such as press fabric filling.

Contaminant problems begin with the wastepaper supply to the recycling plant. The most effective means to eliminate a contaminant situation is to remove the problematic material from the wastepaper supply. This is usually easier said than done. Once into the recycling process, the rule of thumb is to remove contaminants as early in the process and in as large a form as possible. Both of these situations are outside the scope of this paper, but should always be investigated in the early stages of dealing with any paper machine contamination problem.

Due to the current high use of recycle fiber furnish, additives which were previously used in a virgin system are contributors of contamination when used the second time around. Approximately 1% to 50% of recycled furnish consists of noncellulosic contaminants, such as:

- Fillers (clay, titanium dioxide, calcium carbonate and talc)
- Sizes (rosin and synthetic)
- Dyes and pigments
- Hot melts, plastics, and asphalt
- Styrofoam
- Tapes and other sources of contact adhesives
- Waxes
- Coating binders such as polyvinyl acetate (PVAC) and styrene-butadiene (SBR)

Important considerations are the surface energy, electrochemical charge, and size of contaminants such as PVAC, SBR, polyethylene, wax, and hot melts. Surface energy phenomena can explain why contaminants adhere to fabrics and other surfaces, causing problems. Surface chemistry can thus become an important consideration in resolving deposition problems.

**Machine approach flow and overall process considerations**

This section is intended to serve only as an overview. Several excellent references are listed which give more complete information.

**Screening system**

Tailings management is extremely important in dealing with recycled fiber contaminants on the paper machine. Many virgin fiber systems, especially those using mechanical pulp, collect screen tailings and refine them for eventual reintroduction to the paper machine system. This is an effective strategy for wood shive reduction, but not for elimination of plastics and stickies. If a significant amount of recycled fiber is used, these screen tailings must be eliminated from the process. Secondary or tertiary screening stages may be required in order to make the process yield loss acceptable. Lower screening stage barrier sizes should generally be the same used in the primary stage, or cycle-up of contaminants will occur. If the tailings are not removed from the process, or the screening system is not designed and operated properly, stickie contaminants simply cycle up in the system and eventually either exit with the sheet or deposit on paper machine clothing and other surfaces.

Changes in screen reject rates, basket sizes, and basket type (i.e. – switching to slotted stock approach screens) may all have to be considered in order to optimize the removal of hydrophobic contaminants before they reach the paper machine. The stock approach screening system should be audited or surveyed for contaminant removal efficiency on a scheduled basis (i.e. – weekly or monthly) to assure that it is operating as intended.

**Centrifugal cleaning system**

The forward centrifugal cleaners in common use on stock approach systems will only remove contaminants which have specific gravities significantly higher than water (greater than 1 g/cc). The majority of stickie contaminants have specific gravities slightly less than water. Forward cleaners will not effectively remove these
materials. Throughflow and reverse cleaners are designed to remove lightweight contaminants, but are not commonly found in stock approach systems.

The paper machine cleaner system is an important site for removal of other tramp materials (sand, dirt, glass, metal, and some inks) found in recycled fiber. Optimized operation of the cleaning system is essential when recycled fiber is used on the machine. In many mills, these cleaners may be one of the most ignored sections of the paper machine. The system should be visibly checked for plugged cones on each shift. Any plugs should be removed immediately. Reject rates may have to be increased to accommodate recycled fiber use. The system should be audited or surveyed for contaminant removal efficiency on a scheduled (weekly to monthly) basis.

Most modern paper machine cleaning systems are designed to minimize fiber loss. This often involves the use of a fiber recovery unit as a last cascading cleaning stage. Improper operation of the fiber recovery stage often allows heavy recycled fiber contaminants to cycle up in the upper cleaning stages and eventually reach the paper machine. In some cases, the fiber recovery unit may need to be shut down to allow greater purging of contaminants from the system. In all cases, the cleaner system rejects need to be removed from the process.

System chemistry

A number of chemical treatment programs are used in stock preparation systems to minimize the effects of stickies contaminants on the paper machine. The nature and severity of the contaminant problem will determine the program(s) which should be used. Program choice(s) will also be influenced by the mechanical aspects of the paper machine system and the grade(s) being produced.

Many types of dispersing systems are currently in use. The objective of these treatments is to keep the contamination particles in as small a form as possible. “Dispersion” may be a misnomer with respect to stock preparation systems, as there is rarely enough mechanical, chemical, and thermal energy to break up large stickies particles into smaller ones. Most stickies size reduction, if desired, needs to occur in the recycling plant. The primary objective of dispersing treatment in stock preparation systems is to keep microscopic material from agglomerating to the point where its size becomes a problem.

Contaminant particles can be “detackified” through the use of nonionic polymers, talc, or other inorganic compounds. The objective of these treatments is to create a hydrophilic layer of material on the stickie particle surface. The particle is then more likely to be retained in the paper, and less likely to absorb onto a low energy surface such as a paper machine forming fabric.

Another common stock preparation treatment technology is cationic fixation. This approach uses polymeric retention aid technology to retain the contaminant particles in the sheet. Both stickie particles and papermaking fiber have negative surface charges. A cationic polymer is used to “fix” the stickie particle to the sheet.

A relatively recent technological advancement involves aggregating stickies particles early in the recycling process. A hydrophobic interaction allows the stickies particles to attach to one another. Subsequently, there are fewer but larger contaminant particles present in the pulp. These larger particles can then be efficiently removed through conventional screening and cleaning technology.

Finally, enzymatic treatments are starting to be used to break chemical bonds in stickies. These treatments reduce the molecular weight of the particles and make them more innocuous.

System temperature

Contrary to normal good papermaking practice, cooler wet end temperatures are often better for stickie contaminant control. Many contaminants become more deformable and tackier at higher wet end temperatures. They become more difficult to screen out and are more likely to deposit. Some waxes melt at temperatures as low as 120°F (50°C). Running a paper machine wet end at a cooler temperature may not be advisable or even possible, due to sheet dewatering and paper property development concerns. Of course, cooling the wet end only postpones the inevitable. The sheet must eventually be heated to be dried. Some of the retained contaminants will be drawn from the sheet by heat later in the machine. Some data suggest that running the wet end at greatly elevated temperatures (above 140°F or 60°C) may help solubilize and disperse some types of stickie contaminants. Sustainable operation at these very high temperatures is unlikely for most mills.

Exposure of the pulp to significant temperature or pH shocks should be minimized. Sudden changes or swings in either temperature or pH can greatly increase the severity of contaminant deposition problems. This also applies to paper machine showering systems. Wet end shower water should always be the same approximate temperature as the stock/whitewater system.
System closure and reuse of process water

Maximizing paper machine performance while using recycled fiber and attempts at system water closure and sewer loss reductions are often contradictory. Hydrophobic contaminants which enter the paper machine system with the pulp have three possible fates. They can either exit the system with the paper, be rejected as yield loss, or form deposits. Appropriate purge points must be made available without causing unacceptable fiber yield loss and excessive fresh water consumption.

It is generally inadvisable to reuse press fabric suction box water in high recycled content systems. This water usually contains high concentrations of contaminants and may contain press fabric cleaning chemicals. Filtering systems can be used to remove solid materials from recycled process water. However, dissolved and colloidal contaminants will cycle-up to the point where they will cause deposits or sheet quality problems. Water from batch cleaning washes or wet boilouts should be sewered for similar reasons.

The hydrophobic nature of most contaminants causes them to be attracted to the air/water interface in whitewater chests. Some mills utilize this property as a contaminant removal mechanism from the papermaking system. By running the whitewater chest level on the high side, contaminant-laden foam is allowed to overflow from the chest to the mill sewer. This can be an effective, if inelegant, contaminant removal strategy.

General fabric cleaning considerations

While papermaker’s fabrics are available with some level of “designed in” anticontaminant resistance, a comprehensive fabric cleaning program to address recycle fiber contaminants should include a complete system evaluation and custom designed treatment approach. This program will incorporate a mechanical approach for the removal of clothing contaminants supplemented by a chemical cleaning and conditioning strategy.

Fabric properties

Papermaking fabrics are expected to perform in a steady state fashion over their lives. Because fabrics wear, fill, compact, and otherwise steadily progress to failure, this theoretical steady state is impossible to maintain perfectly. Most conditioning systems are designed to maintain fabrics in some operational equilibrium.

Water handling is often the most important property of a forming or pressing fabric. Air permeability is usually most important for dryer fabrics. Permeability of fabrics to air and water is crucial, as are surface condition and void volume. All of these properties combine to determine the performance and efficiency of fabrics, and all are compromised by accumulation of contaminants. The added ingredients of recycled fiber contaminants complicate the battle to maintain steady state operation.

The impact of compromised fabric efficiency can be measured as decreased paper machine runnability and efficiency, increased energy costs, adverse product quality effects, and finally increased fabric costs.

Cleaning and conditioning systems

To optimize cleaning effectiveness, fabric cleaning and conditioning devices must be viewed as a system, including process water treatment. The system will include piping, high pressure oscillating needle jet showers, stationary fan type showers, doctors, and vacuum dewatering systems.

Based upon whether fresh water or white water is used for cleaning, the appropriate solids separation must also be included. The quality of water produced by this system determines the proper type of showering equipment. Lightly loaded fresh and recycled process water will permit the use of fixed orifice showers, while more heavily loaded or contaminated water dictates showering equipment with a means of cleaning nozzle orifices while the machine is operating. Brush showers are the most common. Purgable nozzles are more efficient but are also more expensive. Recycled fiber contaminants in reclaimed white water increase the need for shower orifice maintenance. This is due both to an increased propensity to clog and because fabric requirements become even more critical, making the impact of a clogged nozzle greater.

The most common means of mechanical cleaning is via showering. There are two basic types of cleaning showers: flooding and energy showers. Flooding showers depend on high volumes of water to soak fabrics to the point of saturation. The water flowing into and through the fabric carries away debris on the surface and within the interstices. This method works well for cleaning of discrete particles such as cellulose fibers. It is also very gentle on fabrics. In the press section it is relatively easy to maintain proper mass balances in the fabrics by removing water at predictable levels. This is usually done with suction boxes and slotted covers. In addition to water removal, these
devices provide doctoring surfaces for removal of contaminants floated to the fabric surface by the flooding water. TAPPI TIP 0404-27 “Air Flow Requirements for Conditioning Press Felts at Suction Pipes,” provides detailed recommendations for press section vacuum requirements.

Kinetic energy showers are more demanding on fabric endurance because they rely on the application of concentrated water jets to blast contaminants off and out of fabrics. Care must be taken to apply enough energy for cleaning without exceeding damage thresholds. Sometimes this balance is very delicate and difficult to maintain.

Cleaning becomes more difficult as recycled fiber use introduces stickies and shorter, non-hydrated fibers which are more apt to fill fabrics. Flooding showers are less likely to be successful, and concentrated energy is usually needed to remove stubborn contaminants from fabrics. Narrow degree (15°) fan showers are sometimes used as substitutes for needle jets to minimize fabric surface damage. Such a substitution typically results in a 50:1 reduction in applied energy density. The chances of such gentle kinetic energy succeeding in cleaning non-particulate stickie contaminants from the fabric surface are not good, even if it was successful for cleaning fabrics running virgin furnishes.

Chemicals are generally added to cleaning systems to aid in the removal of contaminants. In some instances, heat can also be used. Specific instances for chemical and thermal technology are discussed below where appropriate.

Although showering is most common, mechanical contaminant removal can occasionally involve friction devices such as brushes. Brushes are used successfully to remove surface contaminants, particularly in forming fabric and dryer fabric applications. Brushes must always be used with showers which provide lubrication, prevent excessive wear, and to avoid static electricity build up. Typically, two brushes are mounted on a common shaft 180° opposed from each other, such that one can be engaged with the fabric while the other is cleaned. Brushes are most effective for “scab-like” surface contaminants which are most easily removed from the fabric by contacting elements. Brush systems are rarely preferred due to the tendency to cause excessive fabric wear.

Forming section cleaning considerations

When selecting a strategy for cleaning forming fabrics, one must consider the two types of contaminants to be dealt with. The first type fill the void volume between the yarns of the forming fabric, adversely affecting its drainage characteristics. The second type becomes lodged on the face side yarns and within the knuckles of the forming fabric, contaminating the surface of the fabric. Both types of contaminants have an adverse effect on sheet quality. When running recycled fiber, provisions generally must be made to deal with both void volume and surface contamination.

Mechanical cleaning and conditioning

Flooded nip showers can be used successfully for the removal of void volume contaminants. However, this implies running the shower on a continuous basis. This technique can be costly, because flooded nip showers require large volumes of water. These large volumes can also upset the white water system. It is more practical to use this shower only for sheet knockoff, except in very severe cases of fabric filling.

A second method of dealing with void volume contamination is a wash roll shower. This is a medium pressure, medium volume shower located on the inside of the fabric run. It is generally installed just over the first face side roll. The water applied is pulled through the fabric by the vacuum created as the forming fabric and roll diverge. As this water travels through the fabric, it puts void volume contaminants into suspension and transfers them to the roll. For this method to be successful, the roll must be doctored.

The third method of dealing with void volume contamination is to use a high pressure oscillating needle jet shower installed on the inside on the inside of the fabric run. This shower should be located 3 to 5 inches away from the fabric so that the needle jet penetrates the fabric. Usually, this shower is used in conjunction with either a flooded nip shower or the wash roll shower as described previously.

To remove face side contaminants, an oscillating high pressure needle jet shower must be used on a continuous basis. This shower is most effective when located 6 to 10 inches away from the fabric with its nozzles mounted on 3 inch centerlines. To ensure optimum performance, it should be oscillated at low frequency such that the shower advances one nozzle diameter per fabric revolution.

Twin wire forming fabrics and the top fabric of a hybrid former require much the same cleaning and conditioning strategy as previously described. However, often the high pressure oscillating needle jet shower creates a mist around the top former section. This results in water accumulation dropping onto the sheet, causing quality
problems as well as sheet breaks. To resolve this problem, mills are very successfully using single jet traversing showers which provide adequate cleaning and are virtually mist free.

Chemical cleaning and conditioning

The first step of any forming fabric treatment program should be the optimization of mechanical cleaning through high pressure oscillating and flooded nip showers.

There are two primary chemical treatment approaches used to address recycle fiber contaminants on forming fabrics and return rolls. The first is to use a preventative method by establishing a water soluble barrier (coating) on the fabric and roll surfaces. This barrier or passivation technology can be accomplished by using a low molecular weight cationic polymer to prevent stickies from adhering to surfaces or becoming trapped within the forming fabric void volume. The second method employs a batch wash method to remove stickies from fabrics and rolls once they have deposited. For heavily contaminated systems with an effective preventive program in place, periodic batch washes may be required to remove contaminants which have overwhelmed the continuous treatment capabilities.

A polymeric based barrier is generally continuously applied on the sheet side of the forming fabric, ahead of the breast roll, through a low volume fresh water fan shower. The shower temperature should be as close to system operating temperature as possible. A shower water pressure range of 40-80 psig is appropriate. System pH does not affect the cationic barrier effectiveness. Current applications range from about pH 4 – 11. Shower coverage is critical to the performance of the passivation technology. Inconsistent coverage produces streaks and bands which allow areas for stickies to deposit and result in profile variations.

The batch wash program can be implemented either “on-the-fly” or as a down batch application. The most effective chemical batch wash treatment for the recycle fiber contaminants is generally the use of a caustic, solvent, and surfactant based product. This blend will assist with dissolving stickies, providing some emulsification and wetting to enhance the cleaning of contaminants. A batch wash can be applied through a low volume fan or return roll shower. Always check for compatibility with roll and other surfaces before using caustic or solvent based products.

Press section cleaning considerations

One of the biggest challenges in papermaking is keeping press fabrics running clean in a high recycled fiber use application.

Mechanism of press fabric filling

Contaminant particle size distributions are a key to the degree of press fabric filling. A particle size of less than 50 microns in diameter is invisible to the naked eye. The needled batt on mesh fabric acts as a filter during the dewatering process. The majority of particles less than about 10 microns in diameter are able to penetrate through fabrics. However, it is possible for some of the particles to react with other additives and remain entrapped within the structure. Particles in the 10-15 micron range may penetrate the fabric structure and need to be continuously removed via mechanical and chemical means through showering and suction box operations. Otherwise, they will become fixed into the fabric structure and become difficult if not impossible to remove. Recycled fiber use, along with charged wet end additives, can increase the size of deposited particles making them more difficult to remove.

Returned press fabric analyses are important in understanding the type and source of filling material. However, results must be interpreted properly. When these particles are extracted from a wet fabric the substances are in a gel-like state. They can occupy 5 to 10 times more press fabric void volume than in a dry state. If the filling is concentrated near the surface of the fabric, it may render the batt area useless and the void volume below unusable. In this case, the fabric is often referred to as being sized or sealed. It becomes extremely hydrophobic, resulting in decreased water handling capabilities. A fabric may reveal via analysis that it contains 3% dry fillers by weight, but may be 20% “filled” (loss) in void volume because the filler exists as a gel while wet on the paper machine. With a water absorbent product, such as starch, a 2% dry filler content may mean a 30 – 40 % filled void volume.

If the fabric becomes filled beyond a critical state, it will not be able to absorb water from the sheet. Excess fabric filling may cause poor and nonuniform sheet water removal, crushing, blowing, sheet sealing, picking, marking and breaks.

Proper cleaning and conditioning systems can help to reduce these problems, using combinations of chemical and mechanical means. To insure optimum performance, these programs should be initiated from the moment of
start-up. Depending upon the severity of the problem, methods using batch cleaning on an intermittent or shut down basis can be a cost effective alternative.

Press fabric design aspects

Modern press fabrics are a balance of these key characteristics: uniform pressure distribution, adequate water-handling capability, good surface characteristics for sheet quality and machine runnability and proper compressibility/resiliency to achieve steady-state pressing conditions. Fabrics are structurally designed to perform at an optimum from start-up through an economically viable life time.

Press fabric structures are always compromises. Modifying the structure to be “more open” due to a severe filling problem will lead to less than overall optimal performance characteristics. It is better to fix the filling problem than to “band aid” it through a significant fabric modification.

Structures today are fairly rugged. Base fabrics are primarily composed of monofilaments in different forms and are excellent support platforms. Multi-layer weaves and the use of multiple bases (laminates) dominate the market place. Generally, fabrics are “more open under load” today than their historical cousins of just a few years ago.

The primary building block of press fabric yarns and fibers remains polyamide (nylon) of some type, sometimes chemically modified. Surface treatments are sometimes used to further toughen the fibers. They are stronger and more abrasion resistant than their predecessors due to increases in molecular weight and other process improvements. This is especially true of batt fibers.

However, they are still polyamide, and are still fibers. Excessive use of high pressure showers will cause high wear rates. Poor lubrication over stationary elements, such as suction boxes, will also cause accelerated wear rates. Build-up of foreign materials on suction boxes along with plugged or nonuniform showers will also cause abnormal wear. Proper use and maintenance of the mechanical conditioning components are necessary to maintain “steady state” runnability and performance of the fabric.

Strong acids will damage the batt fiber. Other cleaning solutions, including some solvents, may cause polyamides to swell and become more susceptible to chemical attack and mechanical failure. The presence of oxidizing agents such as chlorine and peroxide, especially at low pH, will also cause the fibers to degrade. Operating problems and eventually premature removal of the fabric will develop.

Mechanical cleaning and conditioning

Regardless of furnish or grade, the normal array of fabric cleaning equipment for cleaning and conditioning press fabrics consists of a vacuum source, suction boxes, showers, and doctors. The presence of recycled fibers in a furnish should not require any modifications to the vacuum source or to the suction boxes if they were originally adequately designed. Some changes to showers and doctors might be needed so that the efficiency of each component is maximized. Maximum efficiency is usually achieved by observing the five following guidelines:

1. A wetting or chemical shower should be installed to deliver into the nip of a 90 degree (or more) wrapped roll in a location that would give the chemicals maximum dwell time before removal by the suction box.
2. The first outside roll (sheet side) after the press nip, when it exists, must be doctoried and lubricated to remove contaminants.
3. A high pressure oscillating needle shower must be used continuously on the face side of the press fabric. Inside high pressure showers should also be considered.
4. There must be a lubricating shower prior to each suction box.
5. On third and fourth presses, shower water volume should be restricted to a minimum.

Based on these criteria, a typical modern four nip press section requires four similar but slightly different arrangements, as dictated by the fabric geometry.

To clean and condition the pickup press fabric, the recommended cleaning system requires the five following elements:

1. A stationary fan type shower to provide maximum dwell time for chemicals by being situated as close as possible after the press nip. The flow delivered into a nip with a wrapped roll ensures deep penetration of the chemicals into the press fabric.
2. The first outside roll after the press nip will likely accumulate most of the “stickies” found on the press fabric surface. A doctor and lube shower combination will keep the roll clean by removing contaminants transferred from the fabric.

3. An inside high pressure oscillating needle shower is used intermittently as needed, mostly towards the end of the fabric life.

4. An outside high pressure oscillating needle shower is used continuously to prevent fabric compaction and to remove any remaining surface contamination from the fabric.

5. Fan type lubricating showers minimize fabric wear and prolong suction box surface life. It is recommended they be oscillated to improve water distribution in the fabric. This results in a more even moisture profile which in turn improves the moisture profile of the sheet and the fabric caliper.

The arrangement for cleaning and conditioning the first press bottom fabric is similar to the pickup. The same principles and equipment apply except they are adapted to the different geometry of the fabric run.

The requirements of the third press fabric are different from the first two. Most of the “stickies” usually have been already removed from the wet paper web. Pitch, however, can still remain a significant surface contaminant. Also, moisture content in this fabric must be kept lower. Therefore, the equipment required and application are somewhat different.

1. A stationary fan type wetting and chemical shower is normally run intermittently or during machine shutdowns.

2. As in the case for the first two press positions, the first outside roll is doctored and lubricated to maintain cleanliness.

3. An inside high pressure oscillated needle shower is used only under extreme conditions of contamination or to open the press fabric just enough to reach a scheduled shutdown for its removal.

4. Continuous face side cleaning is recommended and is achieved by a single jet traversing high pressure shower. This ensures full controlled coverage with a minimum of water applied. If full width high pressure showers are used, they must be oscillated. Nozzle maintenance is of prime importance to maintain proper moisture profile.

5. Oscillated lubricating showers are recommended for use with the fabric suction boxes.

The cleaning and conditioning strategy for the fourth press fabric is similar to the third press except for the absence of an inside high pressure shower. The rest of the equipment is identical and should be operated in the same manner.

Chemical cleaning and conditioning

There are four means of chemically cleaning and conditioning press fabrics:

- Continuous
- Intermittent
- Batch on the fly
- Down batch

The chemical conditioning strategy depends on the type of contaminants identified, the degree of contamination, back system cleaning and screening efficiency, wet end additives and pH, retention programs, fabric design, mechanical showering, vacuum system dewatering, and press section design/operational practices. Chemical cleaning products may contain mixtures of acids or alkalis, surfactants, and solvents. The formulation of the product for a given application is dependent upon the above variables.

Continuous fabric conditioning with a individual feedpoint to each fabric is most effective to minimize and prevent fabric filling and compaction. Specific product chemistry and mechanisms can be chosen to address specific machine contaminants. Individual feed points provide control and flexibility to allow optimum feed rate based on fabric filling by position. Continuous treatment can reduce or eliminate the need for downtime for batch washing. The purpose of continuous conditioning is to maintain as close to original fabric design characteristics as possible during the economic life of the fabric. Continuous treatment with neutral pH conditioners provides safe and environmentally friendly means to enhance press section performance. Continuous treatment systems are traditionally surfactant-based. Recently, enzyme-based systems have been introduced. A given enzyme is only
capable of attacking a single type of chemical bond. As a result, enzymes are not “broad spectrum” treatment options when used alone.

Intermittent fabric conditioning can be effective if a low deposition rate is observed. It does introduce variation as contaminants are allowed an opportunity to build up between cleaning cycles and are flushed away only when the cleaning product is used. This method will also reduce or eliminate the need to take downtime to batch wash fabrics.

Batch on the fly applications can be done while the machine is running and producing paper. Certain paper grades require specific FDA approvals; product selections are limited. This cleaning process will remove contaminants that may have deposited during system upsets and when large variations in normal system operating parameters occur. This process will also eliminate or reduce downtime to batch-wash fabrics.

Down batch washing is done during machine outages or sheet breaks. Fabrics are heavily soaked with cleaning agents. Tenacious deposits are removed with the fabrics at a crawl speed and the suction box vacuum either turned off or reduced significantly. Usually stronger alkali, acids, or solvents are used during this process and additional safety precautions must be taken. Solvent washes are typically most effective for stickies removal. However, volatile organic compound emission regulations may limit their application in certain mills.

Steam cleaning and conditioning

The use of steam showers over uhle boxes is particularly popular on machines using 100% recycled furnish. Elevating the fabric temperature to close to the same temperature as the sheet helps prevent contaminant transfer, eases water movement in the nip and helps maintain sheet temperatures into downstream press nips and the dryer. The steam shower should be mounted as close as possible to the press felt to reduce steam loss to the machine room. To send a drier press fabric to the nip the steam shower should be positioned over the leading of a pair of uhle boxes, or leading double slotted single uhle box. To send as hot a fabric as possible to the press, and in all nip dewatering conditions, the steam shower should be mounted over the trailing of two uhle boxes so cooling air is not pulled though the fabric downstream. Elevating the temperature of a press fabric with a steam shower is especially effective for removing paraffin and wax infestations in which case the uhle box discharge effluent should be sewered or skimmed before recycling.

Dryer section cleaning considerations

Present approaches to clean dryer sections involve either an intermittent or continuous cleaning. With the use of recycle fiber, cross-directional paper shrinkage increases while drying. Sheet draws may need to be adjusted to avoid wrinkles and streaks. Stickies and other thermoplastics, including coated broke recycle, often manifest themselves as a problem in the early dryer sections because that is where they first encounter their melting points.

Mechanical cleaning and conditioning

Intermittent cleaning is normally done during planned shutdowns. It requires oscillating high pressure showers with alternating needle and fan jets nozzles. A similar method uses a low pressure high volume chemical/rinse shower during machine shutdowns. Depending on the type of contaminant and style of dryer fabric, intermittent cleaning can be accomplished using one of the above techniques or both in combination.

Continuous cleaning is gaining wider acceptance as technology progresses in both shower equipment and in operating conditions. The hardware involves use of a traversing shower system employing a single water jet followed by an air jet. Volumes of shower water must be small enough to preclude streaking, and applied cleaning energy must be large enough to remove contaminants. The simplest systems use a simple water jet/air jet shower. More complex systems incorporate an evacuation/dewatering system which travels along with the shower nozzle. The conditions of speed, coverage, pressure, water temperature, and other criteria are becoming better known and more widely accepted as a technique to improve dryer section efficiency.

The continuous cleaning concept is becoming almost mandatory for uniruns and single tier dryer sections where fabric permeabilities are typically low and must be adequately maintained to preclude sheet blowing and picking. Also, as the use of recycled fiber increases, higher levels of contamination will be experienced on dryer fabrics, thereby dictating continuous cleaning.

Traditional continuous showers use a conventional size single nozzle to apply water at moderate pressures. The disadvantage of this approach is the vestigial streaks left by the water spray. These showers almost always use an air jet immediately after the water shower to blow the water from the fabric, but if the paper is at all sensitive to
moisture streaks, it is often inadequate. It has been shown that a very small nozzle operating at very high pressures can clean just as effectively, but at very reduced water volumes. This system has proven effective to keep fabrics clean, even with very contamination prone furnishes. The use of the very high pressure system is conventionally limited to monofilaments dryer fabrics.

Chemical Cleaning and Conditioning

Chemical treatments may be applied to passivate dryer can and dryer fabric surfaces. Treatments are typically continuous and made at low dose. The treatment transfers with the sheet and/or the fabric to protect surfaces towards the dry end of the machine. Stickies deposition problems are most prone to occur in the first dryer section. Chemical treatments are typically applied there, rather than further down the machine.

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Additional information

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