# Modern Mode of Cleaning and Continuous Conditioning Wet Felts

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## SUMMARY

The article has described the purpose of continuous wet felt cleaning on paper, machine, causes of wet felt filling and different felt cleaning systems such as mechanical, high pressure showers and chemical felt cleaning system. The authors have given operational conditions for each system.

## INTRODUCTION

To maintain and obtain optimum production from the paper machines, the problem of keeping paper machine felts open, clean and absorbent throughout their effective life is certainly one of the most important problems in satisfactory wet felt operation and is the major responsibility of the paper makers. Time lost while stopping the machine to wash the felt is naturally of serious concern to the paper makers and the mill management as down time, particularly for wet felt washing, costs money and definitely reflects on the profitability of the mill. However some well managed mills are able to run their machines to the end point of the wet felts, without having to shut down the machine in particular for washing up the wet felts. This certainly is an ideal situation but most mills find it necessary to shut down regularly for periodic washup of wet felts. On closer studies by various observers and research workers it has been found that those mills who have judiciously equipped their paper machines with "on the-fly" or continuous felt cleaning equipment of satisfactory design are able to run their machines without stopping the machines for felt washing alone. In order to evaluate the proper felt conditioning equipment for any particular machine, it is necessary to find out the reasons associated with the felt plugging which also promotes compaction of felt and result in poor drainage at the press nip through the effective life of the felt.

## CAUSES OF WET FELT FILLING UP

To find out the solution to this problem, it is necessary to trace out actually what causes filling up of the paper machine wet felts. All raw-materials and chemical additives used for paper making process have been found to be potential contaminants of wet felts whether 100 percent synthetic or a combination of wool and synthetic. These contaminants can be identified as follows:

**1. ALKALI SOLUBLE CONTEMINANTS:** Any material that is soluble in alkaline solution, like lignin, starch, rosin etc.

**2. PAPER FINES:** Fine fibres that become entrapped in the felt. These fines are normally not removed by chemicals which are not detrimental to the felt itself. They are best loosened by a high pressure shower and scrapped out from the felt surface by a full width felt cleaning suction box.

**3. ASH:** This is a residue when a sample of plugged felt is incinerated at high temperature. Generally the ash comprises of materials such as China clay, Titanium di-oxide ($TiO_2$), sand, alum and other hard water salts. These contaminants are best removed by acid cleaning when pH control is vitally important.

**4. EXTRACTABLES:** These are resinous or polymeric materials such as pitch, tar, asphalt, latex, etc. and are soluble in appropriate solvents.

**5. WET STRENGTH ADDITIVES:** Wet strength additives added to paper such as Melamine and Urea-formaldehyde used for imparting wet strength to the paper.

A through analysis of the materials causing contamination and plugging of felts will naturally indicate the type of the felt conditioning system necessary for a particular installation but it has generally been found by leading manufacturers of felts that on "Batt-on-mesh" needled felts, approximately 94% of the plugging materials were retained by the base of the felt and only 6% in the "Batt". In fact contaminants tend to act as binders and stick the felt fibres, whether synthetic or wool together. This sticking of the fibre alongwith the compressive forces in the press nip results in compaction of the felt.

The compaction and permeability is not noly dependant on the construction of the felt but also

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on the nip loading, machine speed and the most important of all, the furnish of the paper.

## FELT CLEANING SYSTEM

The objective of a good felt cleaning system should be to improve over all paper machine efficiency and performance by minimizing the felt filling tendency and resisting compaction thereby not only improving the felt life but also the runnability of the machine.

The felt cleaning method must be provided which is most suitable for removing particular type of contaminants and stop filling up of the felts which will result in (a) Improved felt drainage throughout the effective life of the felt. (b) Higher production due to lower down time for felt washing and improved runnability (c) Improved felt life and consequenntly lower clothing cost and (d) finally better and uniform finish imparted to the product.

The key to successful application of either continuous or intermittant felt washing, is to remove the contaminants before the felt is plugged or gets dirty. Therefore full advantage of the principle of continuous washing, and conditioning of the machine felts should be given due consideration. It is highly desirable to clean the dirt from the surface of the felt before it has a chance of becoming embedded in the structure of the felt. There are in general two basic felt cleaning systems prevalent. The first being mechanical cleaning and the second being the chemical cleaning system or a judicious combinaion of both.

## CHOICE AND SELECTION OF FELT CONDITIONING SYSTEM

Before embarking on any felt cleaning device, the base felt construction and the distribution of synthetic in the felt should be taken into consideration as the design and synthetic content in the felt determines the amount of water pressure in needle jet showers and the amount of the vacuum required to remove the thrashed and contaminent from the felt. The type of chemicals that can be used to free up and remove fillers etc. can be determined only after the nature of the contaminants have been analysed. For instance a felt having less than 40% synthetic will not be aboe to withstand high pressure water)jet and the felt can easily be damaged if too high a jet pressure is used for cleaning the felt. Similarly the felt can also be damaged by use of strong acid and alkaline cleaning solutions if used on a felt not falling within the specified classification. It is, therefore, absolutely essential judicious application of high pressure needle jet shower, acid or alkaline solutions for felts that contain low, high or 100% synthetic contents.

## MECHANICAL FELT CONDITIONING

All felts in low, high and 100% synthetic construction should be cleaned "on-the-fly" or continuosuly in order to obtain the optimum life and porformance from any of the above classes of wet felts. The ideal mechanical felt cleaning system utilizes hydraulic forces from high and low pressure showers for shaking out the contaminants followed by a full width suction box for extracting the dirt from the structure and the face of the wet-felt. The ideal location of the high pressure shower, low pressure shower and the felt cleaning box are shown in Fig. 1.

## HIGH PRESSURE SHOWER SYSTEM

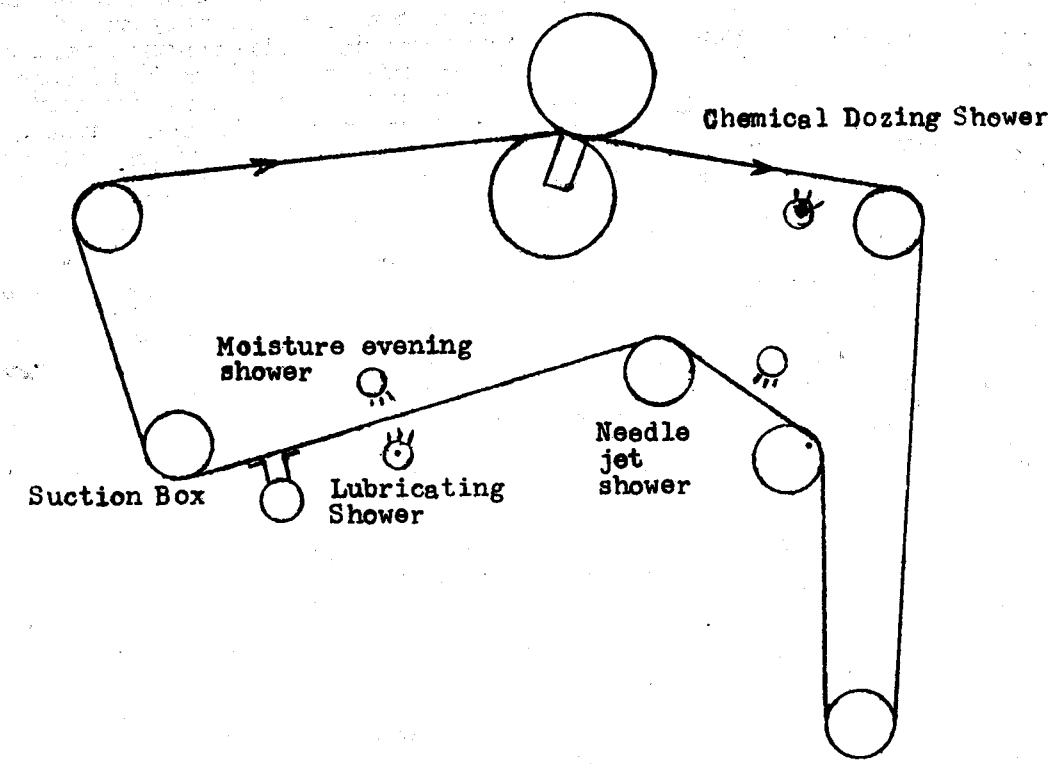
Most high pressure showers are designed to operate between 15 to 40 kgs/cm$^2$. Any shower over 10kg/cm$^1$ is normally considered as a high pressure shower.

The jet pressure required to clean a felt or a particular type of contaminant is determined by the classification of the felt as well as the nature of the contaminant. However to start with the needle jet shower the pump is initially adjusted approx at 15 kg/cm$^2$ pressure and the underside of the felt is observed to check if the jets are penetrating through the felt and loosening the dirt. The jet pressure is increased or decreased on the observation of the effect of jet on to the felt. On a new felt the jet pressure may be required to be low but as the felt may get older high jet pressure will be required to thresh out dirt and keep the felt suitably conditioned.

The high pressure needle jet shower may be followed by on the inside of the felt with a fan type low pressure shower for evening out the moisture profile on the felt and a fan type lubricating shower is often applied on the outside surface of the felt (paper side) for minimizing the wear and tear of the felt at the felt cleaning box.

The normal patching of the needle jet shower is 250 mm for the press felt with oscillating stroke of 300 mm. It is essential that the oscilator stroke be matched to the normal pitch to provide full coverage of the pitch but minimize overlapping which can cause excessive and rapid wear of the felt. The orifice of the needle jet shower is normally 1 mm dia. and the consumption of water per meter width of the felt is between 5–6 lit/min at 15 kg/cm$^2$ to 12 lit/min at 40 kg/cm$^2$ of water with wet press felts. Normal operation of these showers is intermittant and varies from 1.5 hrs. to 4 hrs. in 24 hrs. but the present trend is to use showers continuously for very high speed paper machines. In case of needle jet shower it is essential to provide an oscillating device and equip the same with a fail-safe device to cut-off the water supply in case the oscillator fails.

In mills using high percentage of fine stock or recycled fibres and high nip pressures on their presses, face or paper side showering of felts have provided better results as compaction and blinding of felts have been found to be less pronounced. The jet streams are required to be set at a slight angle against the travel of the felt which seems to have a chiseling




action on the felt rendering the felt more open and bulky and receptive to more water at the press nip.

**HOT WATER SHOWER :** Hot water shower has a definite edge over the cold water as it has lower viscosity and tends to soften certain contaminants/ fillers more readily. However, it is not advisable to use water temperature beyond 48°C for woollen felts but for 100% synthetic felts shower temperature upto 70°C can be safely used.

**FELT SUCTION BOXES :** The felt suction boxes have high density polythene top with 10–12 mm. slot running across the full width of the felt. The function of these boxes is firstly to remove the contaminants threshed out by the high pressure needled jet showers and secondly to dewater the felt in order the felt may accept further water squeezed out from the wet-web of the sheet in the press nip. For selecting the type and open area of suction box cover the following factors should betaken into consideration :

1. Felt construction and classification.
2. Machine speed and dwell time.
3. Quality of paper and type of furnish.
4. Vacuum capacity available or to be provided depending on the above ennumerated three factors.

The felt manufacturers recommendations for the operating vacuum level is 4–6 mts. w.g. for single slot box whereas herring-bone top should run at 2–4 mts. w.g.

Mainly due to high air volume requirement of a Herring-bone cover area of which is 3–4 times the open area of a twin slot box, the single slot or twin slot box is preferred. The general guidelines for suction box are :

1. Single slot box with 10–12 mm slot opening felt machine speed upto 300 M/min.

Twin slots can however be advantageous wherever felt moisture is of prime importance.

2. Twin slots boxes with minimum of 9 mm slots for speed in excess of 500 M/min are to be preferred.

The air flow through the felt cleaning boxes will depend on the operating vacuum at different speed and different felt permeabilities, but can generally be taken at (4–7 $ft^3$/min per square inch) .0174–.0307 $m^3$/ min/$cm^2$ of open area for machine speed upto 153 M/min (500 ft/min) and .0218–.0438 $m^3$/min/$cm^2$ (5–10 $ft^3$/min/$inch^2$) for machine speeds upto 610 m/min (2000 ft/min) of course, depending upon the factors ennumerated above.

## CHEMICAL FELT CLEANING

Although on slower and mederate speeds high pressure needle jet showers followed by fan type moisture equalizing shower and a lubricating shower should condition the felt satisfactorily yet for special conditions where short fibred stock and chemical additives including the wet strength resins are used which bind the felt fibres together. Dozing of chemical solvent will be advantageous in removing the contaminants thoroughly. As stated earlier the type and use of solvent will depend on the nature of contaminant. Generally the chemical felt felt cleaners fall in three categories namely:

**1. ACID DETERGENTS :** Essentially help a non-ionic base with either Muratic, Sulphuric, Phosphoric or Sulphamine acid as a builder. These detergents are very effective in mill making paper with high Ash content.

**2. ALKALINE DETERGENTS :** Alkaline detergents helps a non-ionic detergent base but may be an-ionic to promote formulation stability. It may have strong alkaline base e.g. Caustic soda, Potassium hydroxide or mild Alkali like Soda ash, $K_2CO_3$. These detergents are effective in getting rid off rosin, paper fines and Alkali soluble materials.

**3. SOLVENT DETERGENTS :** Solvent detergents have detergent and emulsifying agent mixed with solvents. They are used mainly for heavy concentration of resinous fillers found in the mills which use poor grade of contaminated secondary fibres.

## CONTROLS FOR CHEMICAL FELT CLEANING

Mechanical felt conditioning equipments when installed and operated properly will enable reasonably good performance and production from a wet felt. But in these days of ever rising energy cost, it has become essential to extract as much water at the press and as economically as possible. The pressing economics demand that stress should be paid to higher water removal at press nip with fewer press breaks. It is always cheaper to remove water at the press section than at the dryers and for every one percent increase in sheet dryness the machine speeds increase of upto 5% are generally obtained. These results can be obtained when mechanical cleaning of felts is combined with appropriate chemical cleaning of wet felts.

## CONCLUSION

The ever rising cost of energy (power, steam and coal), chemicals, machine clothings etc. demands that paper is produced on Paper machines as economically as possible with as few breaks as practical. While newer and improved designs of wet felts with high synthetic contents alongwith modern press configurations have gave a long way to help the Paper Makers to improve the machine performance yet even the best designed felt will not offer the optimum results if felts are not thoroughly conditioned. To achieve optimum results press section felt conditioning is necessary and quite often may need mechanical as well as chemical felt conditioning, depending on individual machine and furnish conditions.

The potential savings and efficiency improvements through the introduction of complete conditioning systems are too attractive to overlook and ignore. A combination of mechanical and chemical felt cleaning programme, when introduced suiting individual needs, is most likely to go a long way to cut down the clothing and operating costs and improve overall efficiency of Paper Machines.

## LITERATURE CITED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