Improving Performance of Wires & Felts Through Efficient Showering

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ECONOMICS OF CLEANING

The need and benefits of suitable cleaning system for paper machine wire, fabric, felt, moulds and rolls has been told in so many words at many places. Different manufacturers of High Pressure Showers the world over have accumulated the experience mainly as follows:-

1. High pressure cleaning is an in-process cleaning. This reduces the shut down time of cleaning.
2. High pressure cleaning system cleans the wire, fabric or felt even before the contaminants have deeply settled before shut down cleaning.
3. In process cleaning system help to increase the machine speed thereby increased productivity.
4. Better cleaned wire improves the quality of product/efficiency of operation.
5. Well cleaned and lubricated wire runs longer giving an advantage of more output of the same wire and also less number of shut down for wire change.
6. It is seen the felts are more often changed not because of mechanical failure as much because of loss of porosity and reduction in water absorbency characteristics. On this account felt life can be considerably increased by way of using high pressure cleaning. The quality of paper also improves simultaneously.
7. A properly cleaned felt will drain out more water efficiently in first Press section thereby reducing much load on the drier sections and reducing steam consumption.
8. The properly cleaned wire and felts and lower loads on drier cylinders give the scope of increasing the machine speed and increasing productivity.

Quantitative evaluation of the economics of shower based on the above facts has shown that a shower 5 is ammortised in less than 2 months in an average unit. Normal life of a shower is much more, spanning to 5-6 years if properly maintained. Instances are available where—

1. Wire life has increased by 10-15%.
2. Shut down time for wire change has been reduced upto 15%.
3. Felt life has increased upto 100%.
4. Steam consumption in drier cylinders have reduced upto 20%.
5. Production on the machine has increased upto 15%.

All the above speak once again for the need and benefits of an efficint cleaning system.

TYPES OF CLEANING SHOWERS

Showers can be classified into various groups according to—

a. Working Pressure
b. Form of Spray
c. Position and Application

They are tabulated below :

Pressure	Form of Spray	Application
High pressure 25-49 kg/cm² (Upto 60 kg/cm²)	Needle Jet (Oscillating)	Felt cleaning/Fabric cleaning
Medium Pressure 5-15 kg/cm²	Needle (Oscillating)	Felt cleaning, Wire/Fabric cleaning, Couch roll cleaning Mould cleaning
	Fan	Foam killing
—do—	Rotary/Oscillating	Head Box
	Fan	Sheet knock of Trim knock off
	Stationary	Foam killing-Head Box
Low pressure Upto 5kg/cm²	Needle Jet Oscillating	Dandy Roll cleaning
	Fan	Return roll cleaning Felt lubricating (Wetting) Wire lubricating
	Stationary	

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CONSUMPTION OF WATER FOR SHOWERS

Consumption of water mostly depends upon the open area of the nozzle and the pressure. For all practical purposes open area of the nozzle is a direct function of the diameter of the nozzle hole. Given below in the table are the nozzle sizes and water consumption for different applications:

Type of Nozzles & Pressure for various applications

		Felt Cleaning	Fabric Cleaning	Metal wire Cleaning	Couch Roll Cleaning	Sheet Knock off	Mould Cleaning	Dandy Roll Cleaning	Return Roll Cleaning
Type of Nozzle		N-0 1 mm	N-0 1.2 mm N-0 1.0 mm	N-0 1.2 mm N-0 1.0 mm	N-0 1.2 mm 0 1.0 mm	F-60° 2.5	N-0 1 mm F-60° 0 0.5 mm	N-0 0.6	F-60° 0 1.5 mm
Pressure kg/cm²		25-40	10-30	10-30	10-30	5-15	5-10	4-5	Upto 5
Duty		Intermittent	Intermittent Continuous	Intermittent Continuous	Intermittent Continuous	Intermittent	Continuous	Continuous	Continuous
Nozzle Spacing mm	Needle-N Fan-F	100-150	100-150	100-150	100-150	75	100-150 75	75-100	75

WATER CONSUMPTION PER NOZZLE—LPM

Size/Type of Nozzle		Pressure—Kg/Cm² 5	10	15	20	25	30	40	50	60
Needle	00.9mm	0.39	0.5	X	X	X	X	X	X	X
Jet	00.8 mm	0.69	0.9	1.1	X	X	X	X	X	X
N	01 0 mm	1 10	1.0	1·0	2 2	2.45	2·7	3.1	3.5	3.8
	01.2 mm	1.55	2.0	2,5	2.9	3.2	3.5	4.0	4.5	4.9
Fan	01.5 mm	2.5	3.55	4 4	5.0	5.5	X	X	X	X
60°	02.5 mm	6.3	8.9	10.8	12.6	14.1	X	X	X	X
	03.0 mm	10.0	14.1	17.5	20.0	22.0	X	X	X	X

LOCATION OF WATER SHOWERS

The principle behind the cleaning by high pressure showers is to knock the contaminants out of felt, fabric and wire by high impact energy needle jets. In most cases, the showers are located from inside the felt, fabric or wire. The next point that must be seen while locating a high pressure sh ower is to see that showers are located as closer as possible to a supporting roll. However, in case of wire cleaning shower, the ideal position is before the first return roll. The idea is to clean the wire before the contaminants get further compacted by roll. In case of felts, the shower must be located such that after being subjected to high pressure cleaning, the felt outer surface should not come in contact with any roller before being passed over the VACUUM BOX.

Knock off shower of the wire is located on the wire nearest to couch or forward drive roll in such a way that the knocked out sheet falls properly into the couch pit.

It must be remembered, however, that exact position of the showers will much depend upon the machine conditions and the individual reqirement. Where and how they are to be mounted has to be studied individually. Some machine situations are perhaps such that they will flout the recommendations in general. In those case, best possible locations will have to be worked out considering the constraints.

The main points that are considered for finding a most suitable location are as follows :

1. The prime objective must be served to the best.
2. Consider the suitability of locations as per the recommendations.

3. There must be place enough for easy mounting and dismounting at every wire and felt change.
4. The oscillating mechanisms must be well protected from being damaged.
5. The distance between the nozzles and the sprayed surface must be around 4 to 8 inches.
6. High pressure shower must be preferably located at such a place where there is a support underneath the felt or fabric close by in the form of a return roll or vacuum box. This will spare the felt or fabric from creasing.
7. The electrical oscillating device must be safeguard against electrical hazards.

CONSTRUCTIOAL FEATURES OF SHOWERS

Constructionwise certain specific features that distinguish the showers from each other are as follows:

1. Type of oscillating mechanism - Pneumatic, Electromechanical or water Hydraulic.
2. Stroke and speed of oscillation - if they are adjustable.
3. Type of Nozzles - fan or needle and if they are interchangeable easily.
4. Type of guiding of the oscillating - bush or roller.
5. Type of supporting of the pipe on two ends whether swivel joints are provided to take up the bending the pipe.
6. Type of mounting of supports - if quick mounting and dismounting possible.
7. Take up ends of the shower - threaded or plain with type and size of threads.
8. Internal cleaning device etc. provided or not.
9. Covering shell on shower for on run mounting and dismounting.

Moreover, the lengthwise dimensions of showers are made to suit individual machine dimensions which include :

1. Wire/felt width
2. Centre distance between frames where the shower is mounted
3. Distance between edges of wire/felt and the frame centres

INSTALLATION AND COMMISSIONING OF SHOWER

Most convenient location of the shower for a machine is given a proper thought before hand. Accordingly, the shower is installed on the machine. Two fixed supports at two ends of the shower are mounted straightaway on the machine frame or some additional supports are made for this purpose if required.

Following points must be considered and checked by the customer at the time of installation of shower :

1. All inserts are properly secured.
2. All holes are clean and free.
3. Water line connections are proper.
4. For oscillating shower, a flexible hose of sufficient length must be used.
5. A proper filter must be used in the water line before the shower. Sometime, the dirt remaining in the line chokes the nozzles when the shower is started.
6. The distance of nozzles must be proper from the sprayed surface. While for fan showers this must be adjusted for proper coverage, for needle showers, proper focussing must be considered. Also, it must be seen that nozzles should not touch the running wire or felt any moment.
7. Before connecting the oscillating mechanism to the shower pipe, i e. oscillating cylinder or electromechanical device, it must be checked if the shower pipe moves free with hand. Also check that at two extreme ends of the oscillating device, shower pipe does not overshoot at the guiding system.
8. If the shower pipe moves with jerks or vibrations then either the alignment is not proper or the air pressure is not sufficient.
9. The gear box of elmech device must be properly filled with oil while for pneumatic cylinder min. 3 kg/sq.cm. pressure air must be available in filtered and lubricated condition. It is advisable to instal a proper filter lubricator for this purpose.
10. If the nozzles get choked too often it means the water entering the shower pipe is not clean or some dirt has remained trapped, for the former, the proper filter is the reply and for the later, pipe must be cleaned thoroughly.

CACESSORIES TO A WATER SHOWER

The accessories, that are required along with a water shower, are as follows :-

1. Water Pump
2. Flexible High Pressure Hose
3. Quick couplings
4. Filter
5. Cleaning Device
6. Fail safe device
7. Programming and Controlling Devices etc.

Here below, certain specific points are considered on these accessories which often come for discussion while considering on the proposals for putting up a shower.

WATER PUMP

While considering the installation of a shower, a customer perhaps can think in two ways;

1. He must be having a pump with spare capacity to feed an extra shower.
2. He must be thinking of procuring, pump along with the shower.

In either case the factors that effect the pump are as follows :—

1. The delivery of shower
2. Pressure of shower
3. Duty of Cleaning - Intermittent or continuous
4. Type of water

If an existing pump is visualised to be used for the shower, it must be checked if water at pressure and delivery around 10-20% higher than that rated for shower is available. It is also to be seen whether the pump is available economically all the time the shower is required to be run.

In case, the idea is to procure a pump also along with the shower, following must be considered :

1. How many showers are to be connected with the same pump.
2. If all the showers are continuously running.
3. If all are intermittently running.
4. If some are intermittent and some are continuous.
5. Pressure and delivery desired from the pump must be 10-20% higher than shower rating.
6. Upto 20-25 kg/cm^2 pressure one can get centrifugal pumps which are cheaper and easily available.
7. Pumps of higher pressure (more than 25 kg/cm^2) are generally of volume displacement type. They are normally plunger type. Pressure available from these pumps are upto 80 kg/cm^2 and higher. They are costly.
8. High pressure plunger pumps are available mounted on a troley in delivery ranges to suit one or two showers (200-300 LPM). Advantage is that one can run many showers intermittently with the help of one pump only.

Some problems suppliers of pumps are as follows :

CENTRIFUGAL PUMPS

Pressure	Upto 25 kg/cm^2 (350 psi 250 M Head)	1. B E. Pumps 2. Kirloskar Pumps 3. Jyoti Limited 4. Mather & Platt
Delivery	800-900 LPM	5. Best of Crompton 6. Wasp

PLUNGER PUMPS

Pressure	Upto 80 kg/cm^2 (1120 psi 800 M)	1. WASP 2. MATZ 3. Bharat Pump Comp.,Naini
Delivery	300 LPM	4. V K Pumps

FLEXIBLE HOSE

Flexible Hose is an essential component to connect the shower with the water line. Flexibility is required for easy connecting and disconnecting. It is also required for oscillating showers, In this case it must be seen that the length and diameter of the hose must allow enough flexibility so that oscillating shower movement is not restricted.

The flexible home rating must be such that pressurewise it must be minimum 1 5 times the shower working pressure and diameterwise it must have around twice the open area than all the nozzles on the pipe taken together.

QUICK COUPLING

A quick type of coupling is used for connecting the water line with the shower. The essence is that minimum time should be lost in connecting and

disconnecting the shower which is done every time the wire or the felt is changed.

FILTER

Use of a proper filter along with the shower is always advisable. Needle Jet Nozzles are more prone to choking because of their construction. A few nozzles choked halfway will mean improperly cleaned wire or felt. Cleaning of nozzles in the running condition of machine is very difficult.

Provision of filter will reduce the problem of choking.

Filters have fine mesh (60 mesdh of finer) filtering medium which screen out the rough particles and save the nozzles from choking. The choking rate of filter will be different in different conditions of water and water flow. A filter will choke faster if volume of water flowing is large. In another case where the contaminants are more the choking will be fast.

For the sake of continuity of operation normally two filters are used in parallel. While one of the filters is running the other can be cleaned. The cleaning operation is very easy. The basket of the basket type filters can be taken out and cleaned with a brush and water.

In a normal working condition the pressure drop across the filter should not be more than 1 kg/cm^2. this implies if the pressure fall noted between the inlet and the outlet is more than 1 kg/cm^2, it must be concluded that filter has sufficiently choked and requires cleaning.

CLEANING DEVICE

Different types of cleaning devices are provided these days for internal cleaning of the shower pipes. They are cleaned by wire brushes running the whole length of the shower pipe or a short brush mounted at the end of a long rod etc. There may be high pressure nozzle with a flexible pipe also to clean the interior of the pipe.

Cleaning of the nozzle inserts are best done by removing them from shower only. For this purpose spare nozzle inserts are advised to be kept. Continuous inside cleaning by brush has an advantage that pipes can be cleaned even when the shower is working. But the system is more complicated and costly and the process is more relevant when back water is used.

FAIL SAFE DEVICE

While high pressure oscillating showers are being used, it is envisaged that the high energy needle jet should have an impact on the wire and felt directly over the contaminants to loosen their grip on the wire/felt. If the high energy jets continue knocking at the same place without break the pattern of the wave gets demaged and ultimately the wire or the felt is permanently damaged. This type of situation may arise if the water spraying continues even if the oscillation of the shower or the running of the wire/felt stops which may occur for any reason. To avoid damaging the felt/wire the spraying of water should stop as soon as the oscillation or the wire running stops. The unit which is used for this type of control is called Fail Safe Device.

Programme Controlled Showers

At times a few showers and pumps are connected together in such a fashion that their working is desired as per certain programme. This type of control is used economise on the high pressure pump and other things.

Cleaning time by Showers

This problem has been approached differently at different places but the end result are not strictly quantitative. They are rather qualitative in approach. Let us examine here what are the parameters involved.

By cleaning time 'T' If we mean the time taken to change the condition of wire or felt from a certain level of uncleanliness Xo to a level X_t then it will be seen that 'T' is variable :

1. X_o and X_t
2. Type of felt/wire
3. Type of water used for cleaning
4. Type of paper being made, substance and furnish
5. Machine speed
6. Nozzle diameter
7. Pitch of nozzle and stroke of oscillations
8. speed of Oscillations
9. The pressure of water etc.

Based on experience a paper maker, by trial and error finds the most suitable time for a proper cleaning. For a given felt/wire and type of paper making

he can alter the oscillating speed and pressure of showers, two most easily viable parameters to obtain the desired cleaning.

However, there is another important parameter called the Coverage Time which can rather be quantified to a certain degree of accuracy. The coverage time 'T_{cov},' is the time required to cover with needle jets all the points on the running wire once.

Let us assume the following :

Width of wire/felt	=	W (Meters)
Open length of wire/felt	=	L (Meters)
Speed of Wire	=	V (Meter/Min)
Oscillation per minute of shower	=	n
Stroke of Oscillations	=	S (MM)
Pitch of Nozzles	=	P (MM)
Number of Nozzles	=	d (MM)

It will be seen that area covered by one noozle of dia 'd' during one strock of 'S' mm in I/N meters is equivalent to :—

$$= 2\ d \times S^2 + \frac{(V.\ 1000)^2}{(\ 2n\ )} \qquad (MM)^2$$

Hence the area covered by N Nozzles during (1/n) min

$$= 2\ N.d \times S^2 + \frac{(V.\ 10000)^2}{(\ 2n\ )} \qquad (MM)^2$$

But $N = \frac{W.\ 10000}{P}$

Hence, area covered by N nozzles during (1/N) min

$$= 2\frac{W.\ 1000}{P}\ d \times S^2 + \frac{(V.\ 10000)^2}{2n} \qquad (MM)^2$$

We now make an assumption that as the shower keeps on oscillating and wire keeps running, the needle jets always fall on at a different point till the wire is covered once fully. This assumption is based on certain probabilities and certainly it is not hundred percent correct with all types of showers but we will arrive to a certain result which can be modified to take into account the probabilities of error. Thus the time taken to cover the entire area of wire :—

$L \times W\ (1000 \times 1000\ MM^2)$

$$= \frac{1}{n}\ L.\ W.\ \frac{1000 \times 1000}{2.\ W.\ 100\ d.\ S^2 + \frac{(V.\ 1000)^2}{2n}} \text{ Min}$$

$$= \frac{L.\ P.\ 1000}{2.n\ d.\ S^2 + \frac{(V.\ 1000)^2}{(\ 2n\ )}} \text{ Min}$$

$$= \frac{L\ p.\ 1000}{2.n.d.\ \frac{V.\ 1000}{2n}} \qquad \text{Since } S \overset{V.\ 1000}{2n}$$

$$= \frac{L\ P.}{Vd}$$

Thus T_{cov}

$$= K.\ \frac{L.p}{Vd}\ [Min]$$ where K is a probability factor.

The factor 'K' itself is a function of L, p, V, d, S & n.

For practical purposes it may be assumed 1.25 to 1.5.

EXAMPLE

A wiren 40 Meter long is running at 100 M/Min. having a shower with nozzles of dia 1.2 mm and pitch 100 mm. Find coverage time.

$$T_{cov} = K.\ \frac{L.p.}{V.d} \text{ Min}$$

$$= 1.4.\ \frac{40 \times 100}{100 \times 1.2} = 46\ 7 \text{ Min approx.}$$