wires & fabriks

- Forming Fabrics
- Metal Wire Cloth
- Dryer Screens
- Chemicals

SNIPPETS
FOR THE PAPER INDUSTRY

Vol.27 / Issue-02 FEBRUARY 2023 www.wirefabrik.com/snippets

PRESSING THEORY & FACTORS AFFECTING WATER REMOVAL ON PRESS

Introduction

The paper web formed on the wire part or the forming section passes onto the press section. Pressing of the web on the paper machine follows entering of wet web through the nip of two rolls running under pressure. Under the effect of pressure between the two rolls further water removal of paper is obtained and its compactness and strength is increased. The pressing operation is important for the capacity and economy of a paper machine and has great influence on paper quality. It determines the dryness of the sheet entering the dryer section. It has a major impact on the structure and runnability of the paper and thus the operating efficiency of the machine. The dewatering capacity of a press section and the properties of paper depend on the design and the number of nips. The risk of web breaks is determined by the general design of press section and the arrangement of open draws if any.

A modern press section should fulfill the following requirements:

- The highest possible dryness to be obtained with least number of nips.
- Pressing must not impair paper quality.
- The press section should be a compact, simple and rigid structure.
- Quick felt, fabric and roll changes must be possible

High dryness after the press is required to reduce steam consumption. Removal of water in the dryer section through evaporation is 7-10 times costlier than on presses and 60-70 times costlier than the wire part, though this depends to a great deal on power and steam costs and the efficiency of heat utilization. Dryness of web in the press part varies generally in the range of 15-21% to 35-55% depending on the grade being manufactured and the efficiency of the wet end operation. By using a high pressure and longer nip time it is theoretically possible to get a dryness of web up to 65%. This is the limit of dryness on the presses because 35% water is necessary for wetting of fibres. It is not possible to remove this water by pressing without damaging the structure of the fibres. Practical limit of dryness on the press section is 35-55% for different papers.

Pressing has two major objectives. The first is to remove water from the web, up to a consistency of 40-45%. The second is to consolidate the web, to bring fibres into close contact for bonding. In a simple single press nip is the web is squeezed between a solid roll and a felt supported by a perforated roll. The water is expelled into the felt and then into the holes of the perforated roll. The latter may be a suction roll. Suction is applied over the pressing zone, and when the roll rotates past this suction zone, the water is released to fly out into trays. Grooved or blind-drilled rolls may also fill this same purpose.

PRESSING THEORY

The nip has been divided into four phases. **Phase-1** starts at the entrance of the nip where the pressure curve begins and lasts until the paper has become saturated. The felt is unsaturated in phase 1. **Phase-2** extends from the point of saturation to the mid-nip or more accurately to the maximum point of the total nip pressure curve. In this phase felt also reaches saturation. **Phase-3** extends from the maximum point of the nip curve to the point of maximum paper dryness. This point corresponds to the maximum of the paper structure, pressure curve and zero hydraulic pressure in the paper. In this expanding part of the nip the felt passes zero hydraulic pressure and becomes unsaturated. **Phase-4** covers the point where the paper starts to expand and becomes unsaturated. The felt is unsaturated through this whole phase and expands continuously. The total nip pressure curve is divided into a fluid pressure component and a fibre structure pressure component. The sum of these two components is equal to the total pressure.

The proportion of the hydraulic pressure and the pressure in the structure will vary along the nip and through the thickness of the felt and the paper. Hydraulic pressure in the area of paper facing the felt is almost identical to the total hydraulic pressure in the felt. Hydraulic pressure will then grow with the distance from the felt surface and be the highest at the roll. This means that the forces compressing the fibre structure will be largest close to the felt. Pressure gradients therefore, exist both in machine as well as perpendicular direction to the sheet and felt.

In addition to the pressure curve, area is indicated in the figure above to show the type of mechanism acting in different parts of the nip. This includes the flow of water through compression, two phase flow through capillary forces and the two phase flow through compression and expansion.

Phase-1 The total pressure of the sheet increases through compression. In this phase air is expelled out of both paper and felt and there is no hydraulic pressure at this point. Felt and paper are both unsaturated and transfer of water can only occur through capillary forces or two phase flow. Very little change in the dryness of the paper in this phase and all the forces are taken by the compression of fibre structure.

Phase-2:. Hydraulic pressure increases squeezing water from paper to felt. In this phase paper and felt are saturated. Hydraulic pressure is generated resulting in the flow of water from the felt into the receptacles under the felt. Compression force acting on the fibre and the felt structure increases through the whole of phase 2. Fluid pressure in the felt and paper reaches maximum ahead of mid-nip. In phase 2 water is flowing out of the system through compression. Before the felt is saturated, there are capillary forces promoting water transfer from paper to felt. **Phase-3**: The total pressure curve decreases. The fibre structure pressure increases to a maximum point which is also the point of maximum paper dryness, corresponding to the point where fluid pressure in the paper is zero. This means that paper is getting dryer after the mid-nip as long as there is a hydraulic pressure gradient between the paper and felt. As the phase 3 is expanding portion of the nip and paper in this phase gets still further compressed, the felt must take up all compression. Owing to some lateral flow of water through the nip the felt is saturated through a small part of phase 3 corresponding approximately to the felt forcing air and water to enter from underneath through the fabric or grooves. **Phase-4:** Both paper and felt are exposed in this phase and the paper becomes unsaturated.

A negative pressure is created in both the structures. Compressive forces on the fibre structure and felt are larger than total pressure. In this phase it must be assumed that air will enter for the same reason as air would enter the felt in phase 3. However, the vacuum due to the expansion will be larger in the paper than in the felt creating a two phase of air and water into the felt and from felt to paper. In addition capillary forces will act within and between paper and the felt into this phase

INDUSTRY NEWS	
	Directorate General of Foreign Trade has issue a clarification on the implementation of the Paper Import Monitoring in India. **W& F** Wires & Fabriks has launched specific customer need concept for Forming fabric with **AQUAPRINT** brand for customer quality need. **W&F** takes necessary fumigation and safety measures in packing of fabric and screens before movement, this ensures safety at consumption end.

system. When paper and felt are separated at the end of phase 4 water existing at the interface between them will be divided due to splitting. Paper absorbs water from felt. The transfer mechanism is due to the pressure difference between air and water due to expansion.

Factors affecting the water removal at presses:

Pressing is basically a flow phenomena controlled by flow of water between fibres and from the fibre wall. The structural resistance from the fibres themselves is normally a minor portion at today's dryness levels of between 30% and 50%. The distinction between pressure controlled and flow controlled pressing is very important in understanding pressing. In pressure controlled pressing the resistance to flow between fibres is insignificant. The dryness is then basically determined by the resistance to flow out of the fibre wall. The driving force is the press impulse with an independent positive contribution by the specific pressure. Hydraulic pressure for low basis weight sheets the hydraulic pressure at the solid interface is only a small part of the total pressure. By increasing the basis weight we reach flow controlled conditions. At these conditions, further increasing the basis weight does not increase the water removed, which stays constant for a given set of press conditions. Under these conditions, the hydraulic pressure at the impermeable surface is equal to the total pressure. The minimum time concept is even more important. The minimum time defines a minimum nip width characteristic for a given press operation. As the time available for compression is equal to the nip width through machine speed, minimum time becomes critical at higher speeds. Pressure and time data for different kinds of papers will be of extreme importance for optimizing press performance especially for flow controlled pressing at high speeds. It's difficult to maintain pressing time at higher speeds, hence the need for larger rolls, wider nips and more compressible felts are the latest trends in pressing. Nip width has been shown to be an important factor in pressing for two reasons. At a given pressure nip width determines the average specific pressure and to a degree the pressure distribution curve. Nip width is therefore an important factor in defining the driving force in a specific nip.

The nip width is defined by the total compression of the felt, paper and rubber in the nip and the size of the rolls, disregarding the flow of rubber in the nip. The variables affecting water removal at the presses are as follows: - **(a) Nip pressure**: Water removal increases exponentially with increased nip pressure. Increasing nip pressure is one of the most common and best methods of increasing water removal. Pressure on the presses is applied in ascending order and then only it is possible to give high pressure on the last press without crushing the sheet. Number of presses depends on the degree of refining of stock, machine speed and amount of water removal. **(b) Speed:** With the rise of machine speed drainage time is reduced which reduces drainage. Pressing time is inversely proportional to the machine speed. It is necessary to increasing the pressing time for high speed machines and also for papers with higher basis weight made from highly beaten stock. As speed is increased higher nip loading will be required to maintain same moisture removal or for the same nip loading water removal from the sheet will decrease with increased speed. With the increase of speed press performance will be less tolerant to dirty and filled felts. At higher speed it will be necessary to change the angle of the felt leaving the nip to avoid rewetting. **(c) Roll parameter:** Open area, type of perforations, roll diameter, rubber hardness and thickness are variables which are normally fixed by the grades of paper made, the speed and the loading of the press. Water removal increases with smaller rolls and harder covers but the practical limitations of roll design and paper quality often limit the degree of improvement. Rubber hardness and diameter of rolls have got much influence on the drainage of water in the press. **(d) Off couch moisture:** The dryness of the sheet leaving the press is dependent on the sheet dryness entering the press section. For economic benefits dryness at couch should be raised. **(e) Felts**: The felt is not only the most important variable but a variable over which some control can be exercised. This is dealt in detail in a separate section. **(f) Sheet porosity:** Sheet characteristics influence drainage. The porosity of Paper web is very important for drainage on the press. Less porous the sheet more is the tendency of crushing. Kraft pulps are very porous and elastic and then comes sulphite pulps. mechanical pulps have less porous structure. Freeness of stock can appreciably change the drainage property of the press. A press will remove more water from a free sheet than from a wet sheet at the same loading. **(g) Temperature:** Increasing of pressing temperature increases drainage rate on the press. Rise in the temperature of the stock by 90 C increases the dryness of the paper from 2% to 3%. Affect of temperature on drainage rate during pressing is attributed to the change in viscosity of water with temperature.

QUOTABLE QUOTE

"The road to ***SUCCESS*** is always ***UNDER CONSTRUCTION***" - **LILY TOMLIN**

SCRABBLE
email answers by 25th Feb' 23

Form a word :
LERP SUIT QON
First correct answer will win a gift from Wires & Fabriks (S.A.) Ltd. (Maximum two prizes for one person in a year)

WINNER
JAN. 2023

ANITA THOMAS, Admin, M/s Bazargaon Paper & Pulp mills Pvt Ltd, Nagpur (MS)
Answer : SPECIFIC GRAVITY

?QUIZ
email answers by 25th Feb' 23

QUIZ: The _________ process of Repap enterprises using 50% ethanol and 50% water at 195 degree celcius for nearly 1 hour has been demonstrated at 15 t/d.
(a) Copper cell (b) Megnesium cell (c) Aluminium cell (d) Strontium cell

WINNER
JAN. 2023

Quiz: : __________ consist of individual polymers with varying molecular weights. The properties of the polymers depend on the distribution of molecular weights.
(a) Monodisperse (b) Polydispersity (c) cellulose chain (d) Synthetic polymer

No Correct Answer.
Answer : (a) Monodisperse

Prizes

Best / first correct answer received will win one-year subscription to **IPPTA Journal**
(Maximum one prize for one person in a year).

☺ Teaser

Teacher: Explain the Newton's Law of Motion...
Student: Sir….. I only know the last line of it...
Teacher: Okay…. Tell the last line.
Student: "….and this is called Newton's Law of Motion"..

Published by >> **Wires & Fabriks (S.A.) Ltd.** **JAIPUR-302012,** India.
Phone: +91-141-2341722
Email: snippets@wirefabrik.com
Only For Private Circulation

Website: www.wirefabrik.com