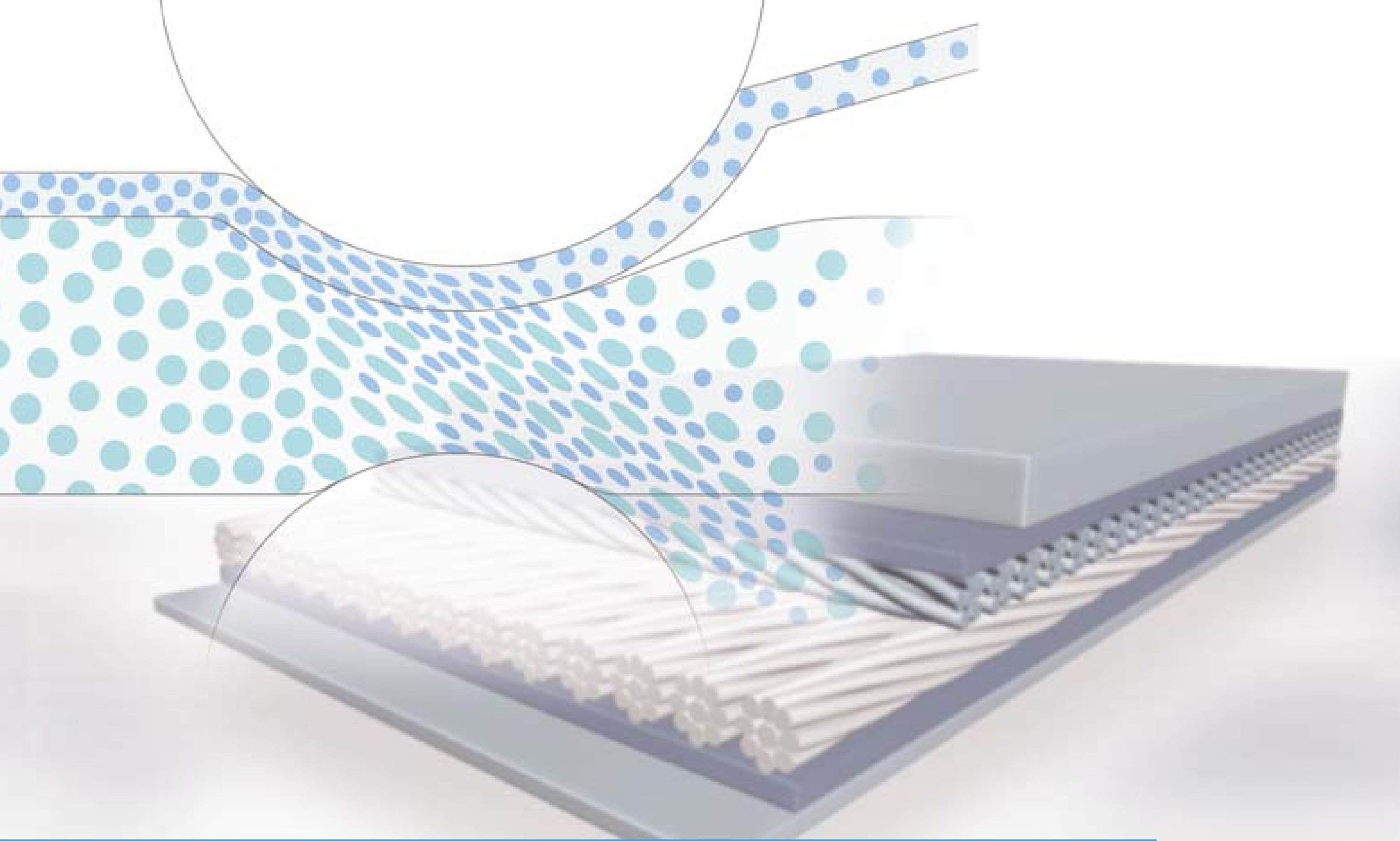

Press Release

The exit angle, saturation and the role of the press felts in the Tri-Nip press section

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Introduction

Consistent speed increases combined with the use of lower cost, but at the same time more "difficult" raw materials, have created for the paper making process, especially in the press section, a changed demand situation. This includes two particularly sensitive aspects of mechanical fine-tuning, which are of increasing importance and the operation of which can have significant effects both positive and negative. These aspects are: the adjustment of the felt exit angle after the press nip and the degree of felt saturation before the nip.

In the following paper the two themes – together with other relevant influences from the clothing – will be covered for Tri-Nip machines (mostly SymPress or Duocentri-Presses). With this press technology, equipped with shoe press and various special items of equipment speeds of over 1900 m/min (World Record: 1950 m/min) have been achieved and it does not appear impossible for the level of 2000 m/min to be reached.

(Comprehensive information on this subject can be obtained from Heimbach TASK Info Press Section No. 12 "The Optimisation of Sheet Transfer from the Forming Section into the Dryers" which can be downloaded from the internet: www.heimbach.com under Download TASK-Information, or by requesting the booklet from Heimbach by telephone).

1. Significance of the exit angle

The higher the machine speed, the more important is the precise adjustment of the exit angle. Non-optimal adjustment can lead to sheet following after the press nip – with the bottom felt into the basement, or upwards with the pick-up and 3. press felt. Such an outcome mostly causes a break and can lead to enormous losses.

In addition to costly damage to rolls and clothing, the major losses will be from extensive downtime and the resulting loss of production.

1.1 When is the exit angle adjustment "correct"?

Firstly: there is no firmly prescribed rule. Therefore the following major effects resulting from small variations in adjustment (Ill.1) are discussed. The following angle adjustments can be seen as a basis.

- **exit angle after 1. nip:** Slightly more than 0°
- **exit angle after 2. nip:** Slightly more than 5° (up to 10°)
- **exit angle after 3. nip:** Slightly more than 0°

In the adjustment of the exit angle there are two opposing factors. With larger exit angles the risk of the sheet following the felt is lower, but rewetting will be increased because the sheet and the felt run together for longer. With smaller exit angles there is less risk of rewetting, but the sheet can follow the felt.

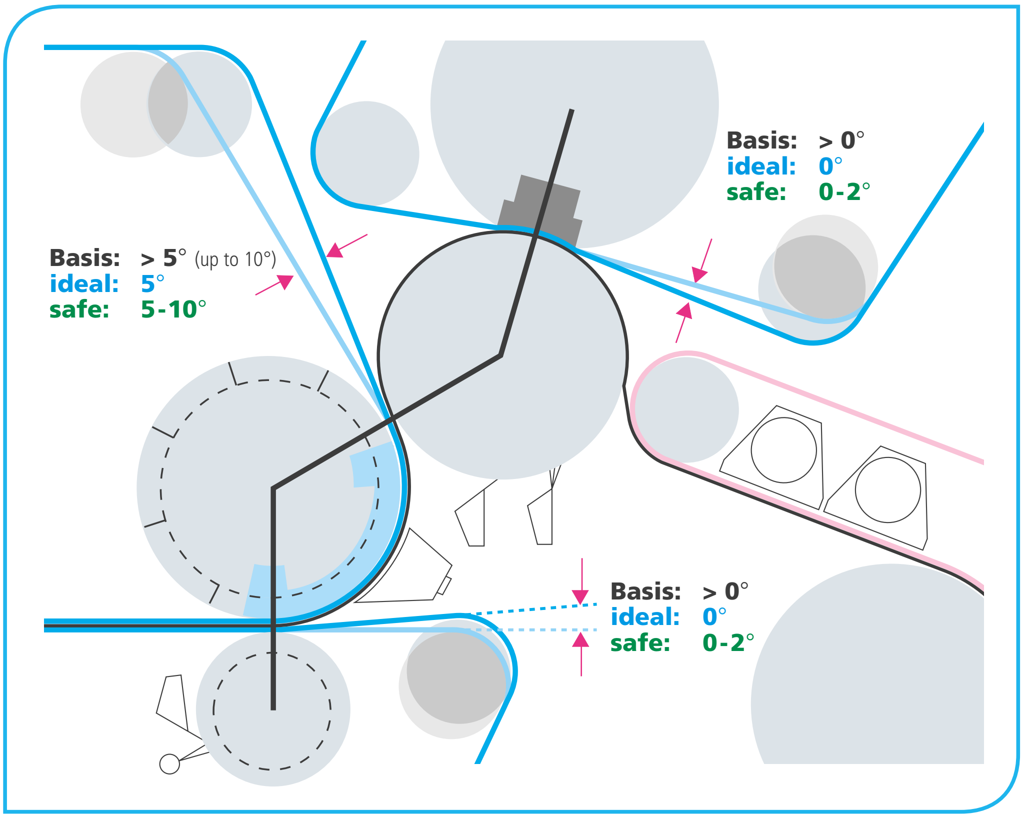
In a situation where a whole press section is optimally laid out and where all elements in contact with the sheet are in the best condition – and all this is a permanent situation – the exit angles could be as follows:

- **after 1. nip:** 0°
- **after 2. nip:** 5°
- **after 3. nip:** 0°

However, based on Heimbach's practical experience and all the possibilities of variation from a "permanent absolutely optimal condition" during normal production – and the resulting risks of serious damage – we recommend the use of larger angle variants:

- **after 1. nip:** 0-2°
- **after 2. nip:** 5-10°
- **after 3. nip:** 0-2°

With reference to rewetting the principle: "Separation of sheet and felt as soon as possible" should be amended to: "As soon as possible to ensure safety".



Ill. 1 Adjustment of Exit Angle

Also the rewetting can be reduced by the installation of "appropriately constructed" clothing (see further under 2.2 "Reduction of Rewetting").

2. The role of the press felts

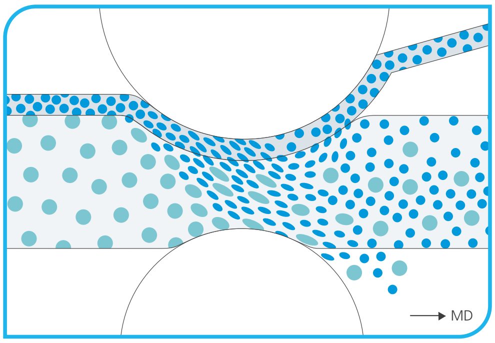
In relation to the total costs of paper production the costs of the press clothing at <1% are relatively insignificant. However, they play an important role in terms of paper quality and runnability, i.e. in the efficiency of the machine. "Efficiency" is in a substantial way determined by the start-up dewatering of the felts.

2.1 Influence of saturation, dewatering, felt weight

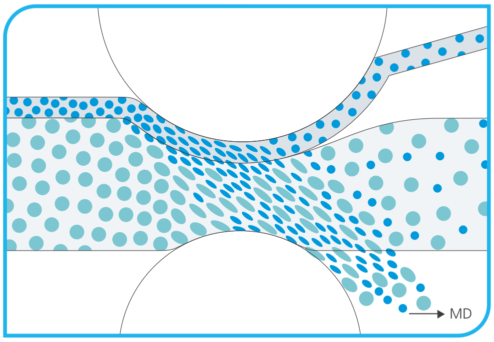
The saturation of the press felts as they enter the press nips is of major importance. The evaluation of the degree of saturation is decisive for the dewatering efficiency. Only a sufficiently saturated felt can achieve good dewatering – an essential prerequisite particularly for nip dewatering.

With inadequate saturation the dewatering pressure under the influence of volume reduction of the batt package in the nip is not sufficient to remove a high volume of water through the felt quickly and immediately after the nip (comparison Ill.2 and Ill.3). Instead the insufficiently saturated felt is simply "enriched" by the water from the sheet. This amount of water remains in the void volume of the felt (Ill.2) and can only be removed by the Uhle box. In addition there is an increase in the risk of rewetting.

The basis for evaluation of felt saturation in the production of graphic papers: The water content in the felt before entry into the nip should be approximately 40% of the felt weight (Ill.3). In evaluating the dewatering process in the nip, the felt saturation share of the total water volume should be greater than the amount of water removed from the sheet as a share of the total water volume. Therefore in a well functioning (nip-)



Ill. 2 Insufficient Saturation: Uhle Box Dewatering



Ill. 3 Optimal Saturation: Nip Dewatering

dewatering process the total dewatering should be greater than the volume of water removed from the sheet. Only in this way the felt will be less saturated leaving the nip than it was before entering – the prerequisite for a successful reduction in rewetting through the use of "appropriately constructed" clothing.

In evaluating the degree of saturation, account should be taken of the fact that it is much more difficult to assess in the case of heavy, or too heavy felts than in the case of lighter felts.

There is always the risk with heavier felts that they run too wet. This increases the risk of crushing – both because of the higher water content and also because of the lower flow velocity resulting from the higher resistance of the thicker felt structure. Furthermore, the adhesion forces of the felt for the paper sheet are increased leading to sheet following and the damage described. Heavier felts can also frequently run too dry if the optimal saturation level is not reached. Result: Inadequate dewatering. The "band width" of the appropriate level of saturation for heavier felts is markedly narrower than for lighter felts. A consequence of this differential in determining the correct degree of saturation is that start-up dewatering of heavier felts is often less good than with lighter felts.

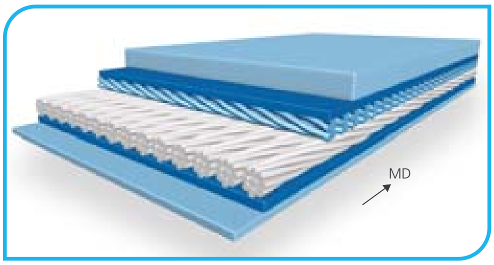
The general rule is that the more optimal the degree of saturation of the felts – combined with optimised press conditions in general – the more effective is the dewatering both throughout the felt life and also at start-up.

(More detailed explanations on dewatering on high speed machines are contained in Heimbach TASK Info Press Section No.11 "Influence of Vacuum Capacity on Press Dewatering and Energy Consumption" which can be downloaded from the internet: www.heimbach.com under Download/TASK-Information or by requesting the booklet from Heimbach by telephone.)

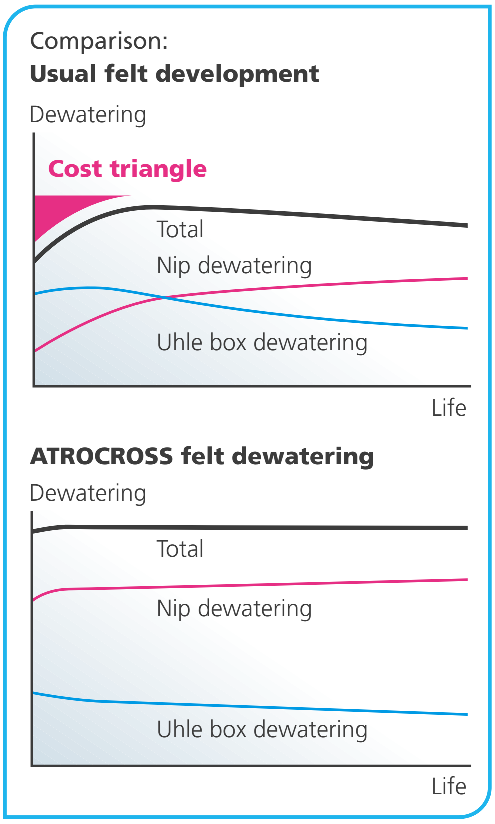
The velocity at which an efficient dewatering builds up at the start is largely dependent on the start-up speed of the machine. This contains a significant production potential. If a 10 m wide newsprint machine (45 g/m^2) as a result of optimal start-up dewatering can run 100 m/min faster, the gain in production amounts to about 65 tonnes per day.

Thus completes the circle of causal factors, which to a high degree are influenced by one factor: saturation of the press felts.

On this theme the world-renowned fast starter ATROCROSS non-woven felts from Heimbach should be mentioned (Ill.4 and 5). The typical speciality of the ATROCROSS base is the layer of paper side yarns in the cross-machine direction. These operate as "micro foils" which "shovel" the water fast and intensively out of the sheet and into the interior of the felt (Ill.6).



Ill. 4 ATROCROSS from Heimbach



Ill. 5 Elimination of "Cost Triangle"

This leads to an optimal nip saturation even at low specific pressures and rapidly initiates maximum nip dewatering and at the same time minimises rewetting (Ill.6).

With its incompressible base construction and variable batt surfaces for all positions, ATROCROSS belongs to the type of press felt, which permits its degree of saturation to be fairly accurately determined. Conceived specifically as a nip dewaterer, ATROCROSS is running on most of the shoe presses around the world.

2.2 Reduction of rewetting

The longer the felt and sheet run together after the nip, the greater is the tendency for rewetting. The selection of a slightly larger exit angle in line with the principle (see 1.1) "Separation of sheet and felt as soon as possible subject to safety considerations" can contribute to this tendency – unless specially "preventively designed" felts can eliminate this. The main characteristic of a felt designed to reduce rewetting consists of its ability, in addition to a strong and rapid dewatering, to prevent a "backwards" directed water flow to the paper side. The previously mentioned ATROCROSS fast-starter non-woven felts from Heimbach are equipped with "preventive" characteristics against rewetting:

1. The paper side cross-machine yarns for the base function as micro foils and "shovel" the water rapidly from the sheet into the interior of the felt. High saturation, low flow resistance and the resulting through-flow velocity lead inevitably to nip dewatering (Ill.6).

2. The intensity of nip dewatering creates with its high dewatering volume a significant reduction in the felt water content after the nip (Ill.6).

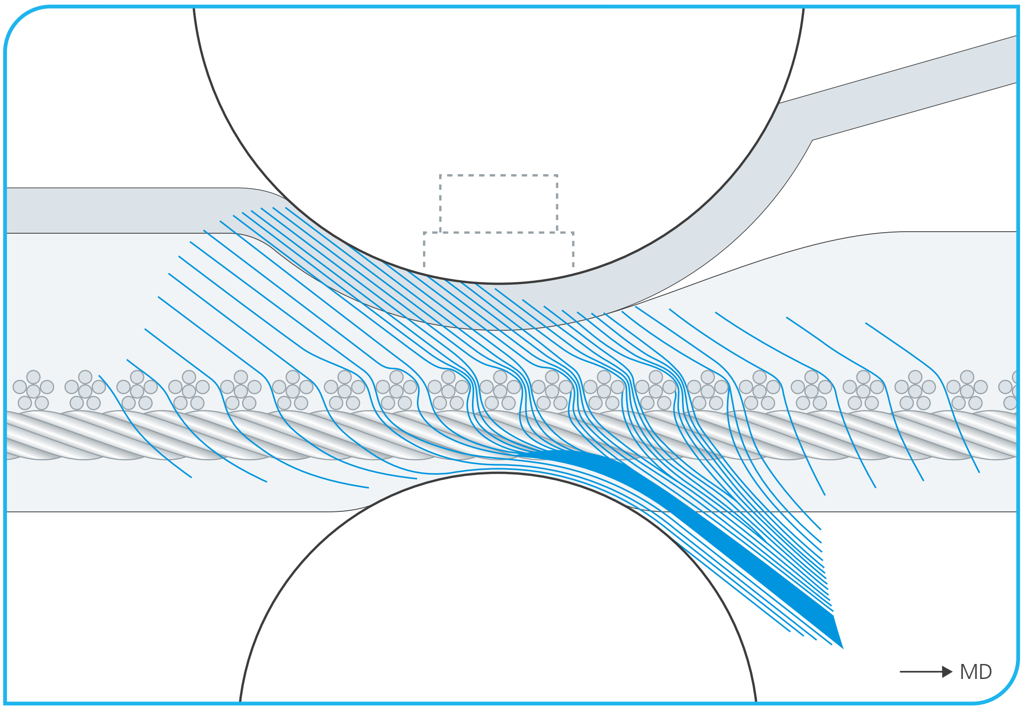
3. The intentionally delayed relaxation of the batt package after the nip ensures a very early separation of the felt from the sheet – and alone can compensate for a somewhat larger exit angle (Ill.6).

2.3 Influence of batt finenesses

The selection of batt finenesses within the "combination of press felt functions" substantially effects the sheet guiding, the dewatering and also the sheet surface.

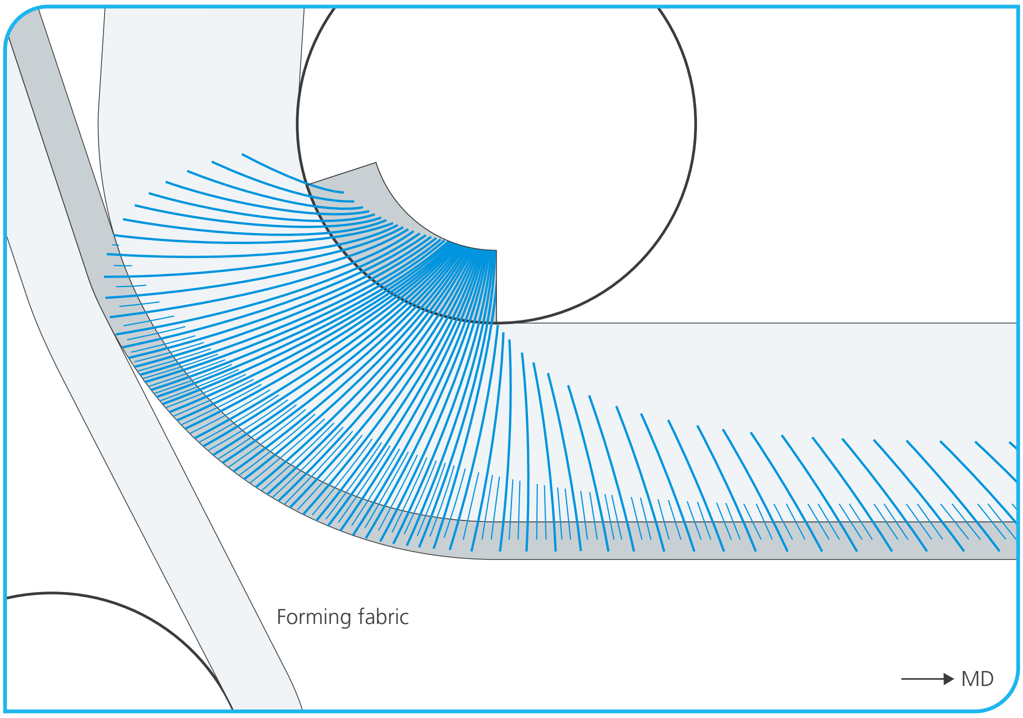
2.3.1 Batt fineness pick-up felt

The pick-up felt is the most important felt in the Tri-Nip press section. Its double function requires both a perfect and reliable sheet pick-up



Ill. 6 ATROCROSS: Nip dewatering, reduced rewetting

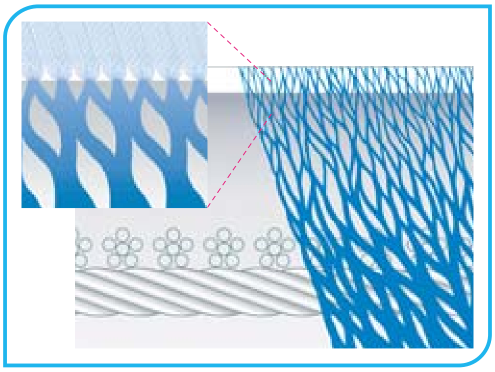
combined with high dewatering efficiency in the 1. and 2. presses. In order to fulfil these requirements both retained openness based on a stable felt structure and particularly the selection of the batt fineness are of great importance.
On the one hand the batt should not be too coarse, so that its capillarity can initiate immediate water flow even before effects of the nip (Ill.7).



Ill. 7 ATROCROSS: Initial water flow sheet – pick-up felt

This will also ensure safe sheet pick-up as well as transfer into the 1. press (glass sheet effect).
In the same way the fineness of the batt surface assists in the achievement of a rapid high start-up dewatering together with a continued high level of dewatering throughout the felt life.

On the other hand the batt surface should not be too fine in order to have a sufficient batt volume for the high water flow and a high flow-through velocity at the 1. press (Ill.8). Also "stable" fibres have better and longer lasting relaxation characteristics (spring constant) and ensure longer batt openness.



Ill. 8 Fine batt surface – adequate batt volume

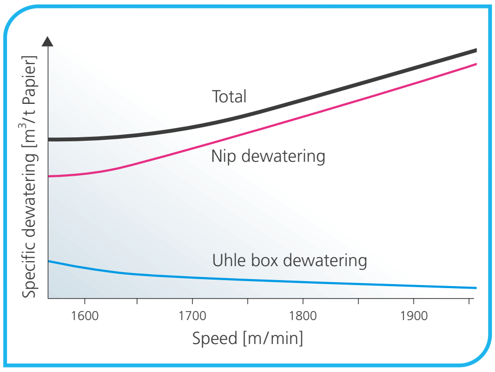
It is particularly important that the surface fineness of the batt is selected to ensure that the sheet does not follow the felt after the 2. nip.
The most commonly used fibre fineness for pick-up felts in Tri-Nip presses is 17-22 dtex.
Obviously it is important for the runnability of the whole press section that the pick-up felt and the bottom felt perform well together.
It is therefore logical in these positions that both felts are matched to one another and from one supplier. The effects of the combination of fibre finenesses/batt structures and felt surfaces on dewatering volumes, felt weights and the intended levels of saturation in the functioning of the 1. press influence the operation of the whole press section. Heimbach refers to this combination of functions as "married couple".

2.3.2 Batt fineness bottom felt

Firstly, the rule of thumb is:The batt fineness of the bottom felt surface must not be higher than the batt fineness of the pick-up felt surface. In addition, the surface fineness off the bottom felt should be matched to that of the pick-up felt, since the pick-up felt because of its dual function can react more sensitively than the bottom felt. Equally, the surface fineness of the bottom felt should be chosen so that the sheet never follows it into the basement. In determining the fineness of both felt surfaces the possibility should also be considered that a new pick-up felt may have to run with an old bottom felt. Even then the sheet must not follow the bottom felt but only the pick-up felt – and only to the 2. nip. For these reasons the most commonly used finenesses for bottom felts have ranged between 22-30 dtex.

In connection with the "combined function 1. press" the significance of the dewatering characteristics of the bottom felt have to be considered – for which the selection of the appropriate batt fineness is more important. The criteria mentioned for the pick-up felt in relation to effective dewatering are equally valid for the bottom felt.

The result of a Heimbach test series shows that with increasing machine speed the proportion of the dewatering obtained from the bottom felt increases as a share of the total dewatering of the press section.



Ill. 9 Specific dewatering in 1. Press of a Tri-Nip press section

Ill. 9 confirms this with a measurement of a 1. press. The higher the speed, the greater the dewatering from the bottom felt – and the more intensive is the dewatering at the 1. press nip.

2.3.3 Batt fineness 3. press felt

It is obvious that the surface fineness of the 3. press felt will be decided by the required surface quality of the paper sheet. The Tri-Nip press creates a one-sided dewatering. The pick-up and 3. press dewater – in relation to the sheet – upwards. Only the bottom felt dewaters downwards. Therefore two-sidedness (smoothness, oil absorption) can become a problem.

To combat too much smoothness two-sidedness, a specially fine homogeneous batt surface for the 3. press is required. The most commonly used fibre fineness ranges between 6.7 and 11 dtex.
For more demanding cases significantly finer fibres, eg. 3.5 dtex are used. For still further maximisation of surface fineness – and therefore virtual elimination of two-sidedness – Heimbach applies a high tech process using special fibres which are subjected to a patented high temperature and pressure process resulting in a microfine felt surface as smooth as any available world wide.
For too much two-sidedness in relation to oil absorption only increased "downward" dewatering via the 1. press bottom felt can help.

This fact, often seen as only secondary, confirms the comprehensive contribution of the bottom felt to the combined functioning of all the press felts.

In summary, it can be seen from the interaction of press section and batt surface fineness how important and sensitive is optimal batt adjustment both for the individual position and for the whole press section.

2.4 Dry content of the paper sheet

The dry content of the sheet before and after the press section effectively determines the runnability of the whole press section. Too low a dry content after the forming section leads not only to process-relevant but also inevitably to economic problems in the press section. Only 1% lower dry content after the forming section requires about 10% more water to be handled by the press section.
The effects of the sheet dry content after the forming section on the volume of water to be handled by the press section are shown in the comparative values obtained on a newsprint machine (Ill.10).

Too low a dry content after the forming section requires a significantly higher dewatering efficiency in the press section – especially when a dry content of 50% has to be reached after the presses (Ill.10).

Comparison newsprint

Weight [g/m²]		45.0		
Weight otro [g/m²]		41.4		
Speed [m/min]		1900		
Width [m]		10.00		
Dry content [%] before press		**15**	**17**	**18**
Required dry content [%] after press		50	50	50
Necessary dewatering	[g/m²]	193	161	147
	[l/min]	3671	3063	2797
Difference		**31.25 %**	9.52 %	

Ill. 10 Dry content – dewatering volume

Such an increased demand on dewatering brings in many cases other demands with it, such as increasing the capacity of the catcher trays or modification of the Uhle boxes. Furthermore, there is generally an increase in energy usage.

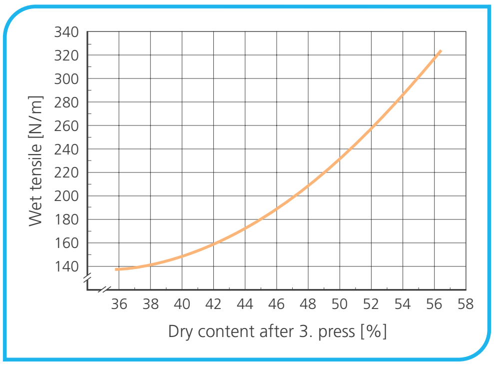
The higher quantity of water also increases the adhesion forces between sheet and felt, which again increases the risk of sheet following. (Precisely this risk should be reduced by a somewhat greater exit angle adjustment.)

Above all the higher dewatering necessary has a damaging effect on the economics of the operation. The planned production speed can often not be achieved or maintained.

In conclusion this means: the higher the dry content before the press section – and the higher it is afterwards as a result of good dewatering – the greater are the process and economic benefits that can be achieved.

- Lower draws within the press section and between presses and dryers, from which better paper quality results.
- Significant strengthening of the sheet and higher wet tensiles (Ill. 11), which improve sheet transfer between presses and dryers.
- Significantly reduced energy consumption in the dryer section.

(More precise information on this subject can be found in TASK Information Press Section Nos. 11 and 12 – which can be downloaded from the internet as explained above.)



Ill. 11 Dry content vs. wet tensiles

Summary

In no other field of operation do efficiency developments so quickly lead to new, more complex and detailed demands as in papermaking. The paper maker's knowledge is constantly growing.
This paper now highlights the extraordinary constellation of the interdependence of exit angles, felt saturation and the influence of optimised clothing design based on the example of Tri-Nip presses. The most important prerequisites are quoted whereby with current "classic" press technology (such as SymPress or Duocentri) perhaps the magic 2000 m/min, or at least in some cases more efficient operation, can be achieved.

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