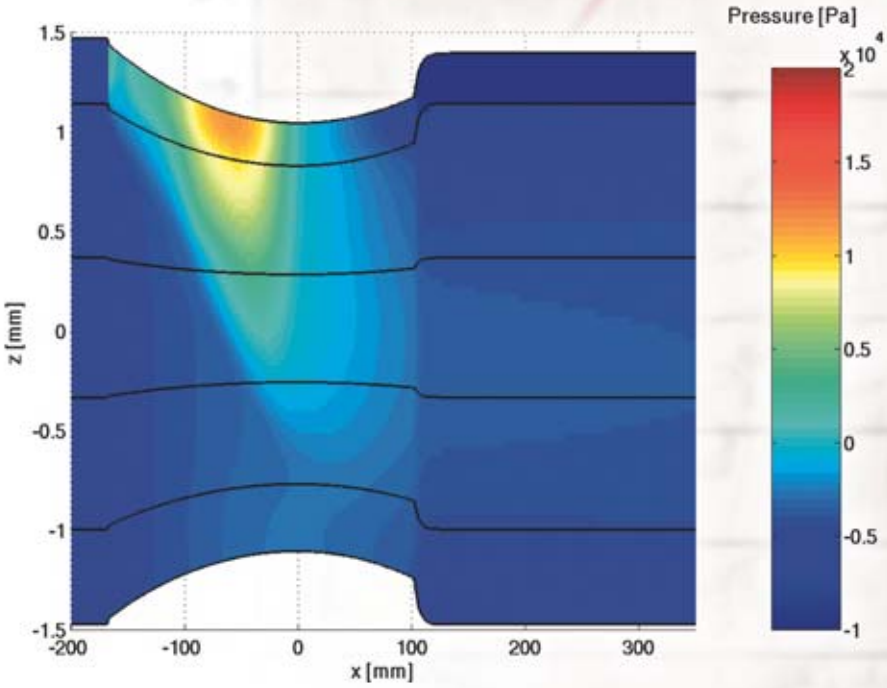

Press Release

Clothing for press sections of modern paper machines

Development of future oriented clothing through Press Nip Simulation

Dr. W. Best, R & D, Heimbach GmbH & Co. KG, walter.best@heimbach.com
C. Molls (Dipl.-Phys.), R & D, Heimbach GmbH & Co. KG, christian.molls@heimbach.com
M. Weiss (Dipl.-Ing), R & D, Heimbach Ibérica, michaela.weiss@heimbach.com

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Introduction

Press felts are significant components of the paper machine, which not only influence its effectiveness, but can even be responsible for its performance. The increasing speeds of paper machines in the future will be technically possible only if the dewatering of the sheet by the press felts can be guaranteed to keep pace at least to the same level.

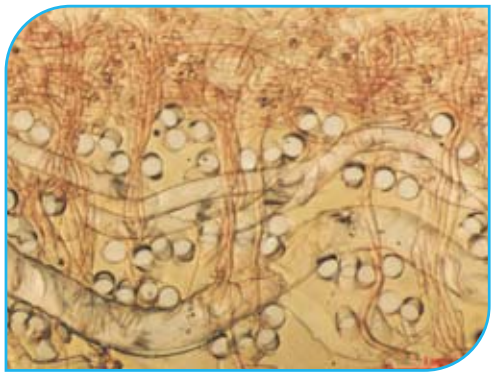
Brief history of press felt development

Forty years ago with the advent of new raw materials the basis of today's press felt development was established. Polyamide 6 and polyamide 6.6 were significantly superior to previously used wool. Yarns spun from wool were replaced by synthetic polymers in the form of monofilament or multifilament twists.

This change led to more favourable resistance characteristics of the base weave to the press load in the machine than was previously possible with wool. The running characteristics of the felts were significantly improved and the life of the felts increased. The fibre manufacturing industry soon provided very fine synthetic fibres in polyamide. This permitted after a short development period the manufacture of all-synthetic press felts. Then by modifications to the needling technology it became possible to produce needled felt structures of fine capillarity with suitable surfaces specifically matched to their applications.

Since then the manufacturing technology of press felt structures has not basically altered. The development of endless woven base weaves led to multi-layer base structures. The demand for more open void volume ended initially in triple-layer base weaves, a basic mistake – as was shown in practical trials.

The way out of this situation led to the multi-base system (Ill.1). The adjustment of the batt surfaces to the growing demands of the paper machine resulted in the combination of finer and coarser fibre layers. The subsequent development of press felts was based substantially on the evaluation and application of the experience collected in numerous trials; with success and failure in most cases being unpredictable. Nevertheless the application of the experiences gained led to the continued further development of these types of press clothing.



Ill.1 Press felt
with multi-base weave

Modern press felt developments

The efforts of the past years to break away from conventional press felt structures led to successes at a number of clothing manufacturers. In this way Heimbach achieved worldwide best dewatering values, particularly on shoe presses, with their non-woven substrate felt ATROCROSS; similarly the multi-axial felt concept ATROMAXX was internationally successful under many highly demanding press conditions. Other concepts involved the application of special fibre layers with high capillarity and density combined with low permeability or with the use of drilled polyurethane foil sheets.

All these structural modifications to press felts could only be translated into practice with one reservation: only the installation of trial felts could confirm whether real advantages could be obtained by the customer. The example of the drilled polyurethane foil highlights the problems faced by the felt designer when the foil specifications and their location in the press felt have to be determined.

Firstly, in considering the caliper, the hardness (compressibility) and the open area of the foil sheet and assuming for each of these parameters just 3 possibilities, the choice would become 27 differing foil sheet types. If these 27 foil types are to be considered for 3 differing locations in the press felt structure the range of choice increases to 81 press felt types, which possibly cover a range of results from good to less good in dewatering terms.

Despite this not all possibilities have been covered. In order to obtain final clarification of the results these 81 press felt types must be trialled on paper machines of differing constructions and in the manufacture of differing paper grades.

A range of these press felts with drilled polyurethane foil sheets was produced. The running results from practice showed that this structural element had only a minimal influence on the dewatering efficiency of the press felt.

Computer Simulation of the dewatering process in the press nip

The above example shows clearly: New ways must be found to drastically reduce the number of demanding and particularly time consuming paper machine trials. The aim therefore is to use Computer Simulation to obtain an understanding of the dewatering processes in the press nip, and thereby to establish which structures offer the greatest promise for press clothing.

The software developed by Heimbach in cooperation with mathematicians from a research institute visualises very precisely the processes in the press nip of the paper machine. The physics of flow dynamics through porous media is the basis for all deliberations. The paper sheet, roll covers, belt and press clothing constitute in passing through the press nip a continuum composed of many layers, which in its non-compressed condition is partially saturated with water.

An example:

01. Layer	Roll cover (eg. grooved)
02. Layer	Roll-side batt surface press felt
03. Layer	Base weave layer B1 of base B
04. Layer	Base weave layer B2 of base B
05. Layer	Base weave A
06. Layer	Paper-side batt surface C1
07. Layer	Paper-side batt surface C2
08. Layer	Paper sheet
09. Layer	Paper-side batt surface D1
10. Layer	Paper-side batt surface D2
11. Layer	Base weave E
etc.	etc.

The paper sheet can also be subdivided into different layers if necessary.

This package of layers runs at high speed into the press nip and is compressed by the press load. Each layer is deformed in accordance with its E-module, i.e. its compressibility, which simultaneously alters its permeability, its porosity, its capillarity and other parameters. With increasing press load this behaviour is influenced by the structures of the base weaves and batt surfaces together with the types of raw materials used.

The Computer Simulation calculates the deformation of the individual layers and the resulting changes in the flow parameters including the paper sheet. The press load transfers to the water and produces at full saturation in the press felt, in the example calculated here together with the sheet, a continuous zone of high hydraulic pressure which reduces towards the press nip exit (Ill.2). In addition, the computer program takes into account the differing relaxation characteristics of the individual layers.

The effects on the press felt and the paper sheet are very dependent on the press geometry. Comparison between a two-roll press and a shoe-press both operating with the same mean specific pressure, shows a narrow contact area in the

two-roll press (plain rolls) producing a line pressure of 125 kN/m. This produces an appropriate hydraulic pressure pattern which drops towards the press exit (Ill.2).

If in the shoe-press with a plain belt the relevant line pressure of 800 kN/m is applied, this produces a significantly wider zone of hydraulic pressure – although with lower absolute values (Ill.3).

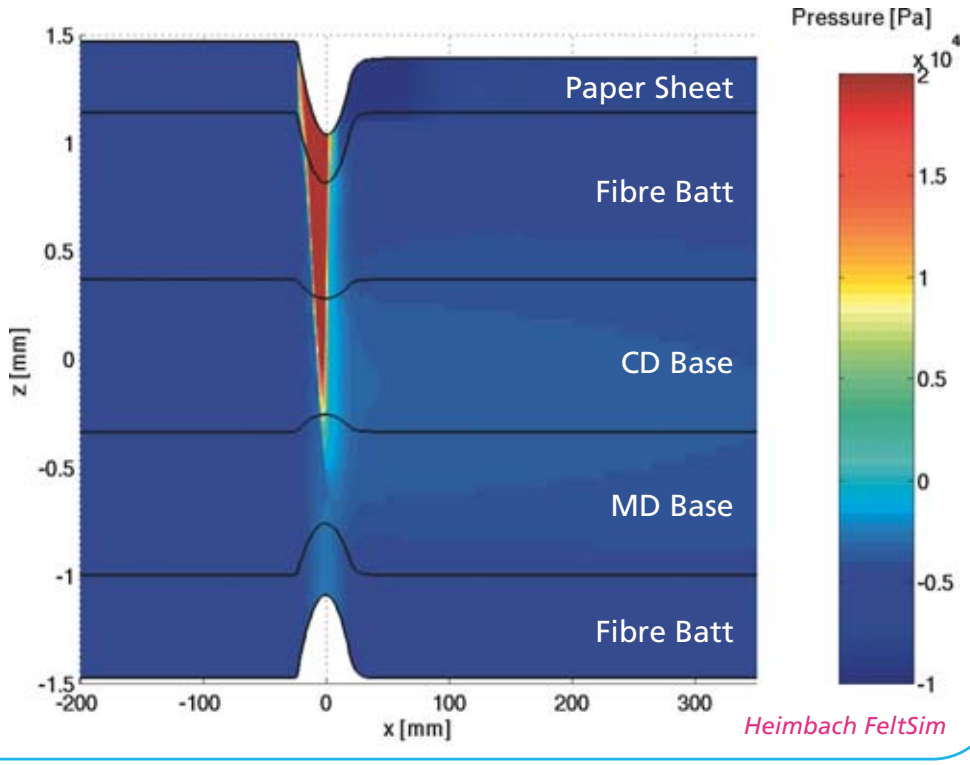
The simulation calculation shows that the dry content achieved as a result of the enormous rewetting in each case in the second half of the pressing process is severely reduced (Ill.2a and 3a).

In practice the shoe-press belt usually has grooves. This creates additional free volume in the press nip. This free volume is always incorporated into the simulation calculations. According to the physical laws of flow dynamics in porous media the water under the effects of outside forces (press load) flows out of the sheet into the press felt and onward into the grooves of the roll cover or belt. However, there is also some reverse flow which causes rewetting of the sheet.

The amount and direction of the relative speeds of water flow in the sheet and the press felt can be calculated at every point in the press nip. This results in a calculable amount of water in the sheet at any one time from which in consequence the dry content is achieved.

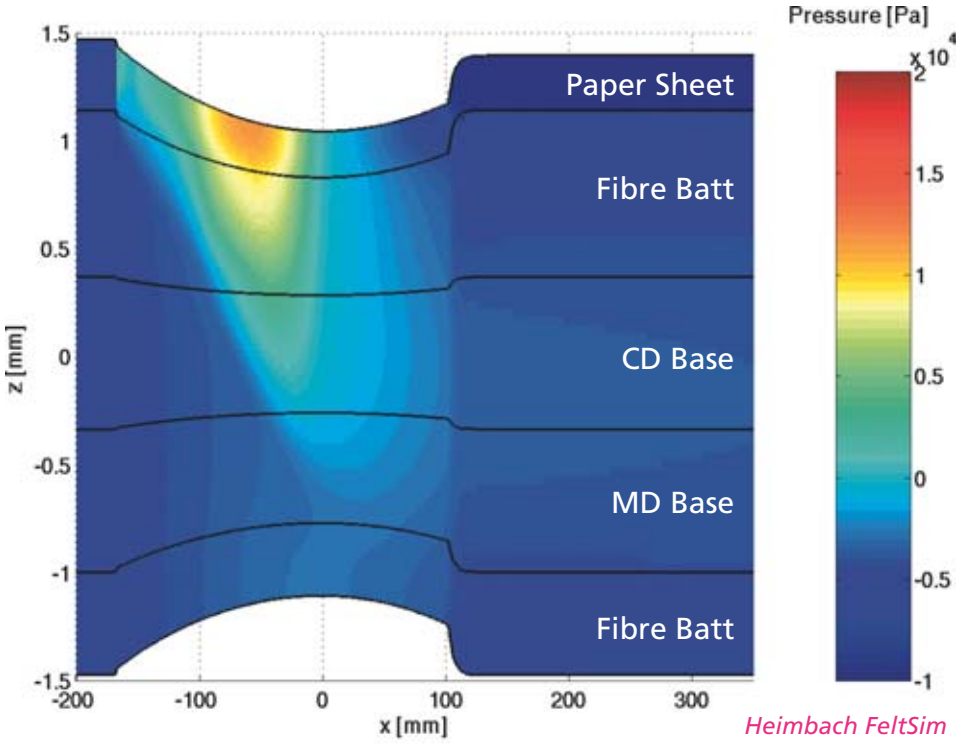
The calculation offers finally the possibility to produce a dry content profile of the sheet during its run through the press nip.

Hydraulic pressure in press nip of roll press with compression and relaxation characteristics of the individual layers at the press nip exit at 1 000 m/min
Press felt: CD and MD base layers;
Batt surfaces paper and roll-side

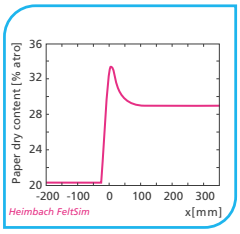


Ill.2 Hydraulic pressure in press nip of roll press

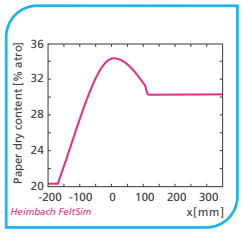
Hydraulic pressure in press nip of shoe-press with compression and relaxation characteristics of the individual layers at the press nip exit at 1 000 m/min
Press felt: CD and MD base layers;
Batt surfaces paper and roll-side



Ill.3 Hydraulic pressure in press nip of shoe-press



Ill.2a Dry content curve of roll press



Ill.3a Dry content curve of shoe-press

Further possibilities of Computer Simulation

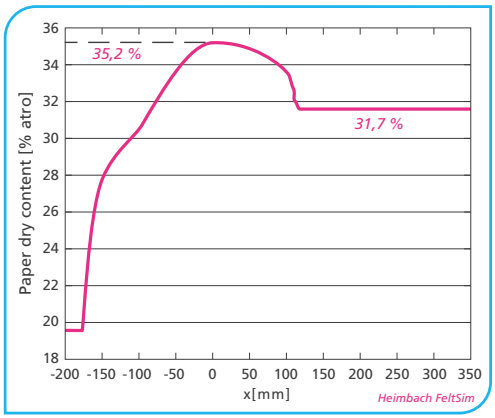
Computer Simulation can provide information on different relationships within the laws of physics of the process of sheet dewatering. Its major future-oriented significance is based on the fact that it can calculate "in advance" with a high degree of reliability the results of trial design changes in press felt clothing. The design change which from its "pre-calculated" results most closely meets the desired = improved influence on dewatering is then manufactured as a trial felt and submitted for mill evaluation.

The following case study provides evidence of the reliability of Computer Simulation and its relevance to practice in the reverse direction:

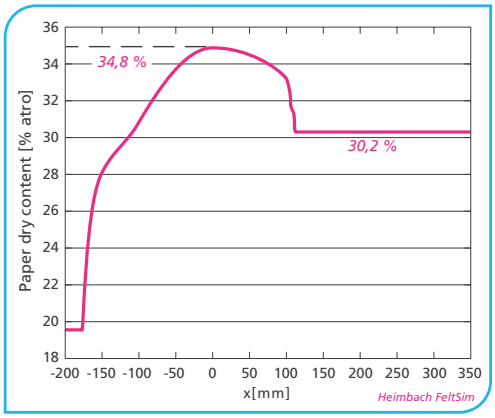
Trial installations (Newsprint, 1. Shoe-press, 1000 m/min) had showed that press felts with finer, heavier and denser paper side batt surfaces, in addition to a higher peak dry content, achieve above all a lower level of rewetting in the press than is the case with coarser, lighter and more open batt surfaces. As a result the final dry content with the denser felt types is significantly higher.

This fact now had to be subsequently proved with the help of Computer Simulation.

Development of future oriented clothing through Press Nip Simulation



Ill.4 Dry content with finer, heavier and denser batt surface



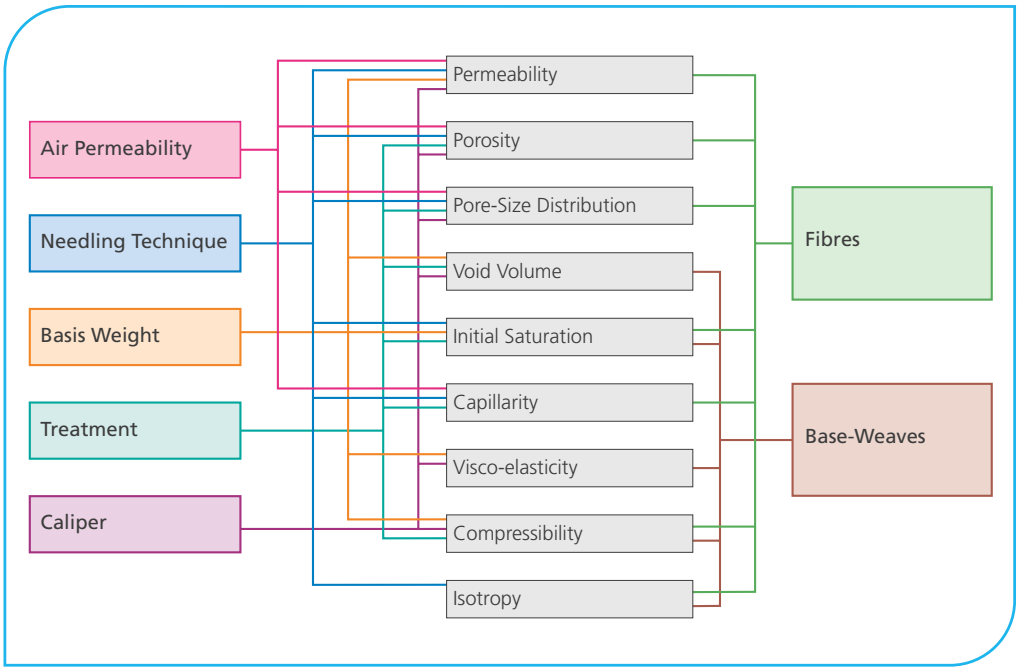
Ill.5 Dry content with coarser, lighter and more open batt surface

For this the structural and flow parameters of the roll cover, paper sheet and belt were first entered into the computer. The calculated results (Ill.4 and 5) confirmed the results in practice with a high degree of accuracy.

A series of further comparisons between the measured results of practical trials and the results calculated by means of the Computer Simulation prove the high level of reliability of the computer simulation.

The ability of the Computer Simulation to visualise flow and pressure conditions inside and after the press nip by means of calculated colour pictures is of great significance for the development of future oriented press clothing. These pictures can provide information about the behaviour of the individual elements of the "layer-continuum" in the press – or: how they would behave under increasingly demanding conditions.

The complex relationships between press felt specifications and the physical parameters of the individual layers are shown schematically in Ill.6.



Ill.6 Complex relationships between press felt specifications and physical parameters of the individual layers

Development of future oriented clothing through Press Nip Simulation

The task of the designer is then to make sure that the experiences obtained from Computer Simulation are translated into the development of modern press clothing. Therefore the most important job of Computer Simulation consists of testing virtual press clothing for its dewatering efficiency. Additionally, the simulation also permits calculations to be made on structures which are quite different from the range of currently available press felts.

A further aim of Press Nip Simulation, both for existing press felt types and obviously also for new constructions which have been developed using the simulation technique, is the determination of suitable operating positions. The catalogued results then assist the engineers to select the optimal construction with greater safety.

The press section of the paper machine will also continue to develop in the future in order to produce good paper more cost effectively. The simulation calculations improve the understanding of sheet dewatering and ensure a deeper insight into dewatering mechanisms. They also permit a more rapid adaptation of the clothing to new press concepts and the development of new clothing structures.

A complete description of the operation together with the possibilities and aims of Computer Simulation with calculated illustrations and examples can be found in the brochure "Research Report Nip Simulation – development of future oriented clothing through Press Nip Simulation."

This brochure is available in German, English and French from Info:

Heimbach GmbH & Co.KG D-52348 Dueren
Tel +49 (0) 24 21 8 02-0
Fax +49 (0) 24 21 8 02-7 00
E-Mail info@heimbach.com
www.heimbach.com

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