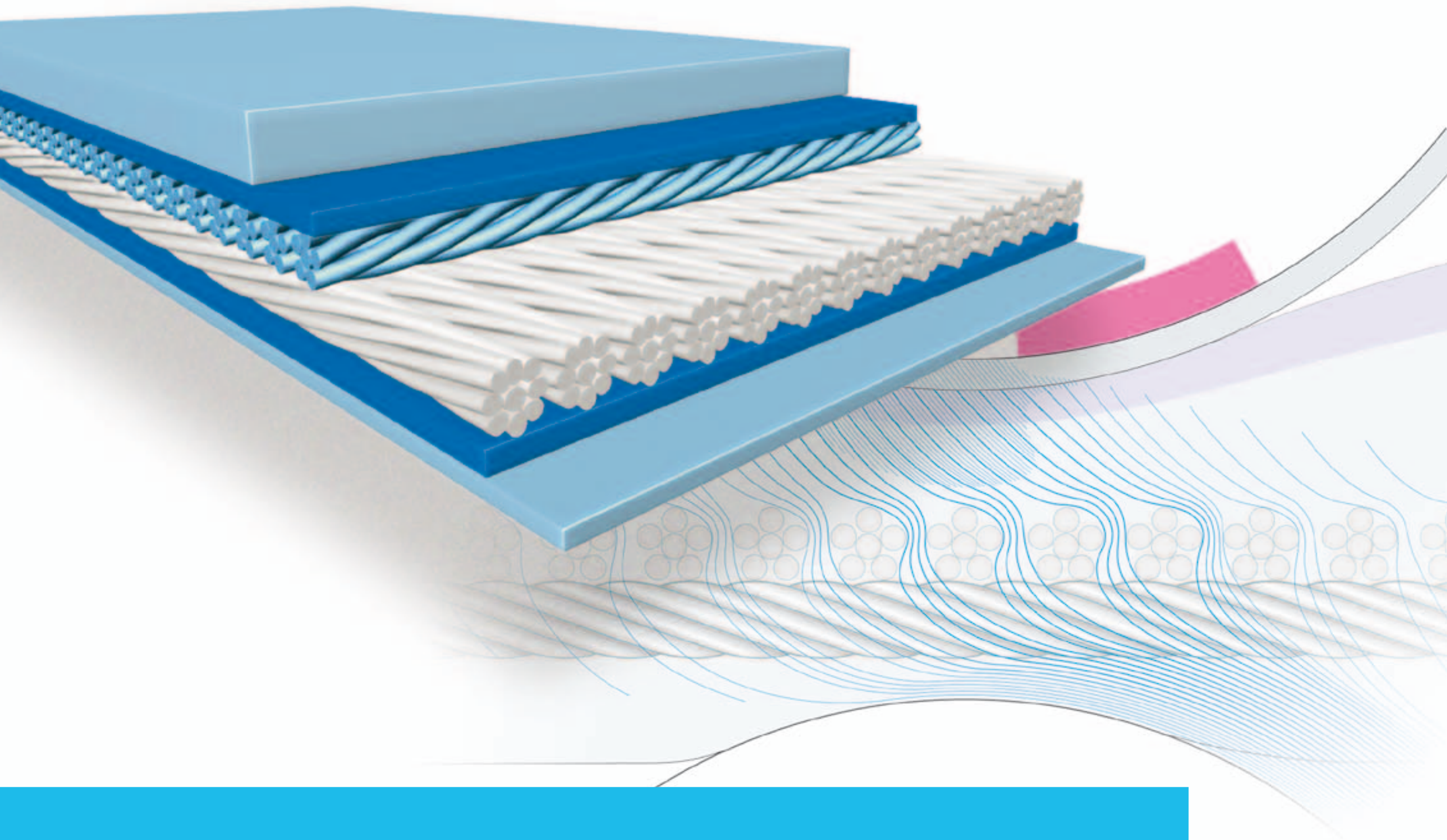

Press Release

Drastic Savings in the Press Section with Consequences for the Dryers

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Introduction

Paper production is extremely demanding on energy. After the cost of raw materials the energy costs constitute the next highest component and amount, depending on the paper grade, to 20-30 % of total manufacturing costs. The fact that energy is becoming increasingly expensive ensures that the motivation to save costs by optimising the production processes has never been so strong. New legislation for the reduction of greenhouse gases provide an additional level of urgency for energy saving.

The following article describes the main possibilities for reducing energy consumption and other costs in the press section and their positive consequences into the dryer section and their effects on the runnability of the whole paper machine.

The costs in the press section consist mainly of the drive to the vacuum pumps, their lubrication and sealing water and maintenance, the drive to the press rolls and consumption of shower water and felt cleaning agents.

Overcoming the major cost factor

The major cost factor in the press section is the drive to the vacuum pumps. By optimising their adjustment the costs of the other "consumers" can be reduced to a minimum. Depending on the paper grade 10-20 % of the power consumption is required for the production of vacuum for the various dewatering elements (Uhle boxes, suction rolls etc.) About a quarter of this vacuum capacity is usually required for the Uhle boxes.

In terms of a big paper machine, optimisation of the Uhle box vacuum alone can lead to a saving of more than 1 million Euro per year – subject to the "correct" dewatering techniques being applied. Figure 1 shows with the example of a very high speed newsprint machine, that the felts can be run throughout their whole life without any problems at a significantly lower vacuum level (20-40 kPa) than was previously the case (45-75 kPa). On the contrary, at least one of the water-ring pumps can be shut down shortly after the start for the rest of the felt life subject to the use of "appropriate felts for the correct style of dewatering".

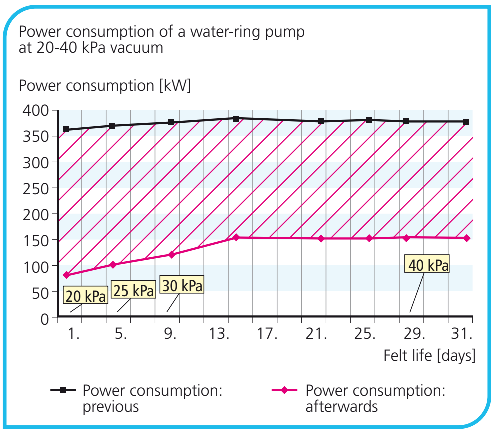

Fig.1 Vacuum reduction: Power saving

Example calculation:

Advantages for the energy and cost balance

Permanent saving of between 100 and 300 kW per felt from the reduction in vacuum energy – plus saving of ca.100 kW from the drive to the press rolls as a result of reduced braking of the felts – plus saving of drive energy, lubricating and sealing water from the elimination of a water-ring pump.

Total annual savings: approx. 1,000,000 EUR.

Prerequisite for reduction of Uhle box vacuum

The essential requirement for this is bringing about a nip dewatering if possible, or if need be, its maximisation. The dewatering performance is mainly influenced by the machine speed, the pressure impulses in the nips and the degree of saturation of the press felts. At lower speeds (< 600 m/min) nip dewatering is virtually impossible. With increasing speed (ca.1000 m/min) the importance of nip dewatering also increases, not only as the prerequisite for reducing Uhle box vacuum and providing the resultant energy savings, but also to improve the total dewatering with the resulting improvement in runnability.

For the highest possible nip dewatering the optimal functioning of all dewatering units is required: for example a highly efficient doctoring with evenly applied pressure for the removal of the water film from the rolls, clean grooves and drillings in rolls and shoe-press belts and a correctly dimensioned save-all.
With shoe-press belts in addition to the correct material hardness the relationship between grooves / drillings and smooth surfaces are critical as well as a need for the best achievable freedom from marking.

Uhle box vacuum and the influence of felt saturation on dewatering
The vacuum capacity of the Uhle box has a strong influence on the water content of the felt.
This influences in turn the whole dewatering performance of the felt through hydraulic pressure: with a higher pressure impulse (pressure : dwell time) it is easier to reach the correct level of felt saturation in the shortest possible time.

Felts which are inadequately saturated must first be compacted at the start of the run through the nip before the dewatering process can commence. Consequently, with adequately saturated felts as a result of an earlier start with a higher hydraulic pressure (= greater pressure impulse), the dewatering of the sheet can begin sooner and more fully (Fig.2) than with felts which run into the press in a less saturated condition.

The correct level of saturation ensures a "proportionally" faster start-up performance of the felt. There is a slight reservation about this with the shoe-press: although the pressure impulse in this case is high, the specific pressure (as part of the pressure impulse) is low. This leads to a somewhat slower saturation of the felt and therefore to a slightly reduced initial dewatering, particularly when previous woven felt constructions are used. On the other hand a high specific pressure can lead to a premature "decease" of the felt if it is not specifically designed for nip dewatering.

Further reasons for nip dewatering
On fast machines the laws of physics conflict with Uhle box dewatering: there is just not enough dwell time available. Example calculation:
At 1800 m/min with two Uhle boxes each with two 15 mm wide slots the dewatering time amounts to only about 2 milliseconds. In addition the water has to be pulled from the horizontally

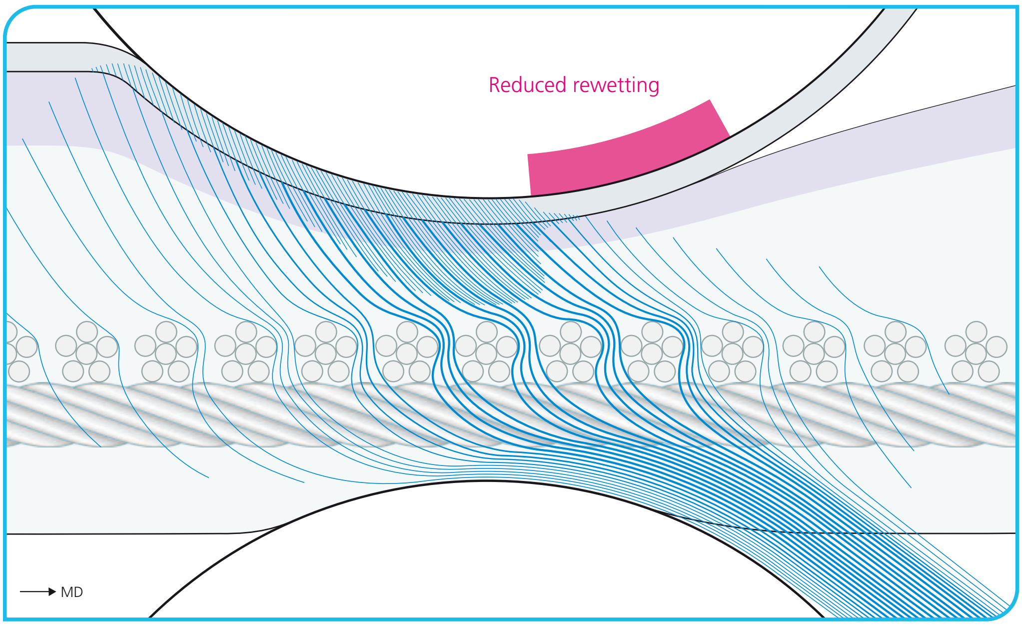

Fig.2 ATROCROSS from Heimbach: Nip dewatering

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running felt at an angle of 90° vertically into the slot – and this at an airflow speed of only about 10-15 m/sec (Fig.3). In this manner to achieve only a "nearly adequate" dewatering, more than two Uhle boxes combined with extremely high vacuum levels would be necessary – and even that would hardly achieve an increase in energy consumption without any increase in total dewatering.

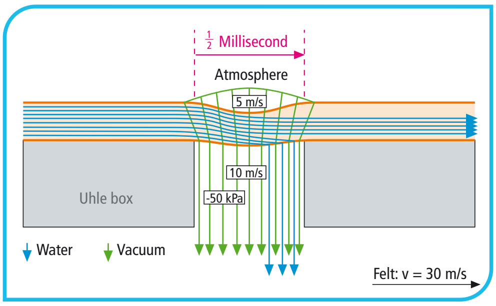

Fig.3 Uhle box dewatering

With a conventional woven new and "flexible" felt as a result of its volume compression over the Uhle box slots at relatively high vacuum a "certain degree" of Uhle box dewatering can be achieved, but when this felt is older and further compacted it is no longer possible. Neither is nip dewatering – because the felt can no longer handle the very high water volume in the nip.

This answers the question of the dewatering system for high speed machines in favour of nip dewatering. This system also provides a powerful "washing through" of the felts (see Fig.2) for a permanent system of self cleaning. The Uhle boxes in this case – at significantly reduced vacuum – serve to provide at most a residual dewatering combined with felt conditioning. In practice a number of cases have shown that with very efficient nip dewatering the Uhle boxes can be either partially or even completely shut down as the felt cleaning becomes superfluous. In addition the shower pressure can often be reduced: this also is a small energy saving, but more importantly improved protection of the felt surface, no fibre shedding and longer life.

An efficiently functioning nip dewatering with the associated reduction or elimination of Uhle box vacuum creates significantly less felt wear from the box slots with a reduced braking effect on the felts which then results in a reduced load on the drive to the rolls.

Nip Dewatering – the optimal clothing

The still existing opinion: "If a felt dewaters too strongly in the nip, it is too dense and will cause problems" (eg. edge problems, crushing), is only correct when referring to a previous open felt with a high void volume, as this type of structure is not able to cope with the high water volumes.
A felt specially designed for nip dewatering (Fig.4) will however be able to handle the large amounts

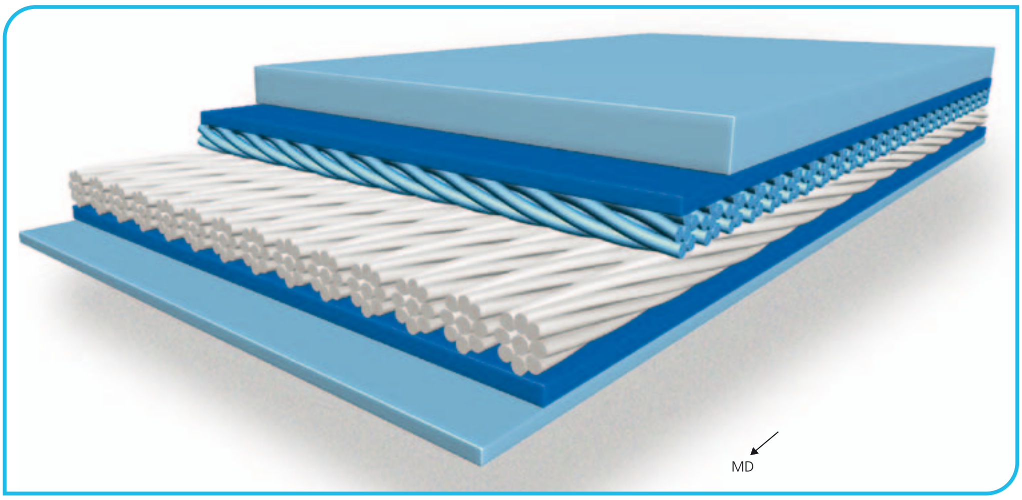

Fig.4 ATROCROSS from Heimbach

of water presented to it (see Fig.2). The most important features of such a felt construction are: high openness combined with low free volume = high water permeability, life-long minimal base compressibility, specially active water removal from the sheet and fast barrier-free water flow through the felt. In order to achieve an immediate high start-up speed the felts should, before installation, have virtually their (later) operating density.

Such press felts, combining all these characteristics, are the non-woven ATROCROSS layered felts from Heimbach. The basic requirement for this design is that there is no yarn system in the Z-direction and therefore no weave knuckles. Moreover the base structure is composed of cross directional non-woven yarn layers positioned flat on machine directional layers and combined with the batt surface (see Fig.4).

The special feature of the substrate base is the cross directional alignment of the upper layer. This causes this layer to function as “micro-foils” (see Fig.4), which “shovel” the water very fast and intensively from the sheet into the interior of the felt (see Fig.2). This also leads at low specific pressure to a high level of saturation and therefore reduces the risk of further water take-up (oversaturation, crushing). The fast and immediate “emptying” of the felt within the nip combined with a delayed relaxation of the fibre batt after the nip reduces rewetting (see Fig.2). For all of these reasons the non-woven felt from Heimbach has proved in practice to be an extremely fast starter and a pronounced nip dewaterer – and at the same time an active “energy saver”.

Proof of the life-long retained permeability of ATROCROSS is documented in the diagrams in Figure 5. With the example of a newsprint machine (1800 m/min, DIP) the development of the water permeability value of a conventional woven pick-up felt is compared with the value of a non-woven substrate pick-up felt from Heimbach. In addition to the substantially longer measuring period, the pattern of these figure is much more stable.

Examples of energy and cost savings

Example start-up phase

The example of a machine (56 g/m^2, 10.5 m wide) shows the development of two different dewatering systems with two different felts. Figure 6, left hand diagram shows the typical dewatering development of a very open, conventional woven felt. During the start-up phase the felt dewaters almost exclusively via the Uhle boxes and returns to the nip with too low a saturation level. As a result the total dewatering during the start-up phase suffers considerably. Therefore the machine must be run more slowly and with a higher energy consump-

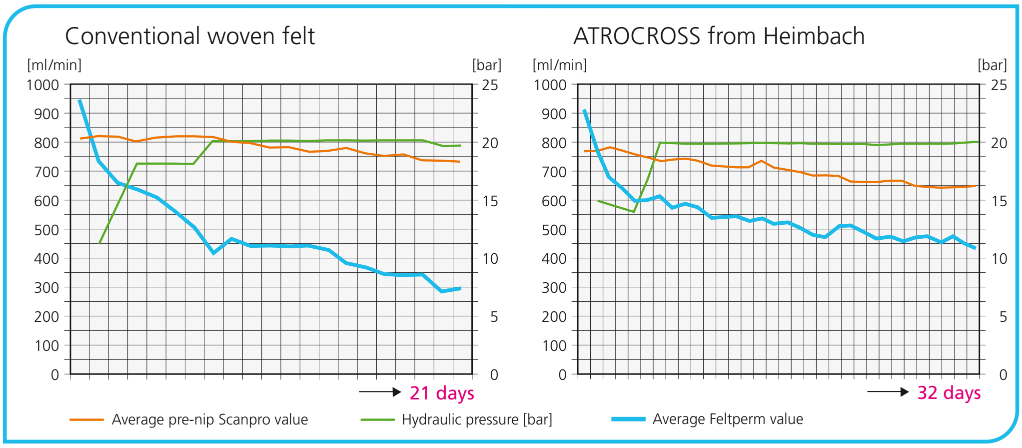

Fig.5 Comparison: Water permeability of pick-up felts

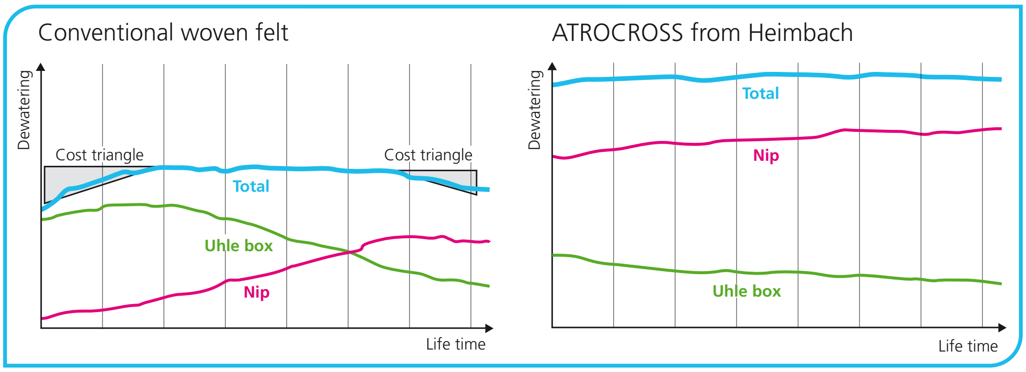

Fig.6 Comparison: Dewatering development

tion. Also such a felt will frequently show indications of fatigue towards the end of its life: in addition to the sinking level of Uhle box dewatering the high compaction/density level will cause the weakly developed nip dewatering to fall again.

These two time periods of inadequate dewatering – described here as a "cost triangle"– involve not only significant energy costs but also the level of production.

In contrast Figure 6, right hand diagram shows the ideal dewatering development with an ATROCROSS felt: Immediately high nip dewatering = start-up dewatering with merely residual dewatering via the Uhle boxes – in total significantly increased total dewatering with virtual "fatigue-resistance" throughout its life. As a result of such good start-up dewatering, the above machine (56 g/m^2, 10.5 m wide) can run on average 100 m/min faster during the start-up phase.

The following calculation is restricted only to the resulting additional production. (Energy saving or increased production resulting from fewer shuts/fewer breaks and lower felt costs from longer life can to be added).

Example calculation:
Advantages for the cost balance
100 m/min higher start-up speed
= 3,528 kg/h production increase
= additional 84.67 t production per day.

At 650 EUR/t = 2,293 EUR/h
= 55,037 EUR increased turnover per day.

Rounding these figures up **for a year** with 11 felt changes and only 1 day start-up phase with each gives an **increased production of 931.40 t with a value of 605,410 EUR.**

If the relevant production is unchanged there would be comparable savings.

Example moisture profile
Based on a machine (80 g/m^2 woodfree, 1400 m/min, 10.0 m wide) the comparison is made between the moisture profile from the Uhle box dewatering with a conventional woven felt and the moisture profile from the nip dewatering with a non-woven felt (Fig.7). The horizontal, even profile curve of the non-woven felt as a result of nip dewatering is clearly visible. The bowed profile from the Uhle box dewatering could only be "bent straight" by partial rewetting.
Result: additional energy consumption.

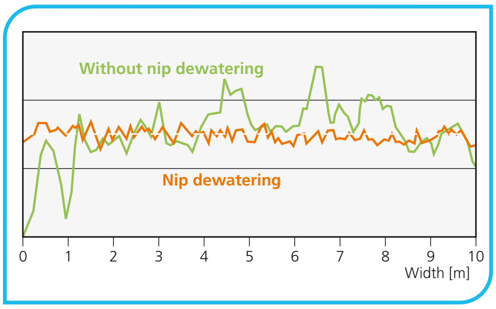

Fig.7 Comparison: Moisture profile of press felts

In this case as a result of the very good profile from nip dewatering with the non-woven felt the end moisture of the sheet could increase e.g. by 1% from 4 % to 5 %.

Example calculation:

Advantages for the cost balance

Production (at 85 % efficiency) = 493,776 t/yr.

Pulp component to be used

at 4 % end moisture = 473,776 t/yr

at 5 % end moisture = 468,841 t/yr.

Saving = 4,935 t pulp per year x 550 EUR/t

= saving of 2,714,250 EUR per year.

Example break rate

On the machine mentioned in the above example and the successful introduction of nip dewatering with a non-woven felt from Heimbach the dry content after the press could also increase e.g. from 49 % to 50 %. This in turn can increase the wet strength of the sheet by about 6 % (Fig.8). As a result of this improvement the break rate could lower e.g. by around 100 breaks per year.

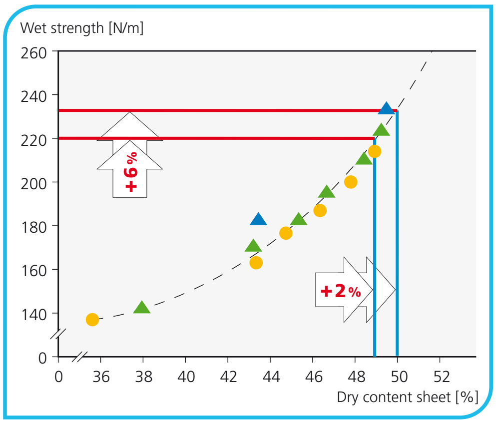

Fig.8 Relationship of wet tensiles to dry content

The following calculation is limited to the increased production obtained as a result. Energy savings, also in the dryers, are to be added.

Example calculation:

Advantages for the cost balance

Production = 57.1 t/h. **100 fewer breaks per year** each with 20 minute shut

= 33.33 hours gained production time x 57.1 t/h

= 1,903 t per year extra production x 800 EUR/t

= 1,522,400 EUR increased turnover.

Example steam consumption

This example also relates to the above mentioned machine (80 g/m^2 woodfree, 1400 m/min, 10.0 m wide). The positive result of nip dewatering with the non-woven felt and the higher dry content achieved after the press section also could reduce the steam consumption in the dryers by about 5%.

Example calculation:

Advantages for the energy and cost balance

At a daily production of 1,371 t the steam consumption is approx. 1,300 t/day.

Steam saving in the dryer section of 5 %

= 65 t/day x 45 EUR/t steam

= 2,925 EUR/day x 350 days

= 1,023,750 EUR saving per year.

In the event that the steam saving is used for the production, an additional production with a sales value of several million EUR could be achieved.

Conclusion

In relation to total paper production costs the cost of press clothing at less than 1% is insignificant. However, its importance for the process, for the sheet quality and for the focus of this paper "Energy and Cost Savings" goes technologically and economically far beyond the above cost relationship as proved by the example calculations highlighted.

This fact demonstrates that not the lowest price for the clothing, but its degree of efficiency should be the determining factor. The felt that pays for itself to the greatest degree – by fulfilling all technical parameters – is the most economical, independent of its purchase price. This argument is made here convincingly for Heimbach felts.

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