Energy Saving Potential at Felt Conditioning

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The artile conserning dimensioning PM vacuum system and uhlebox air flow estimation is now available also in English, thus please find it now in here. This articel has originally been published at Wochenblatt fur Papierfabrikation.

Abstract

Air permeability of the press section felts varies a great deal during the operation, and the correlation of the air permeability in dry, static conditions compared to a wet felt in an operating condition has not yet been determined.

This has been the main reason for poor efficiency and energy losses in the PM vacuum systems. A vacuum system rebuild is often required to fit the existing systems to the present-day operating conditions.

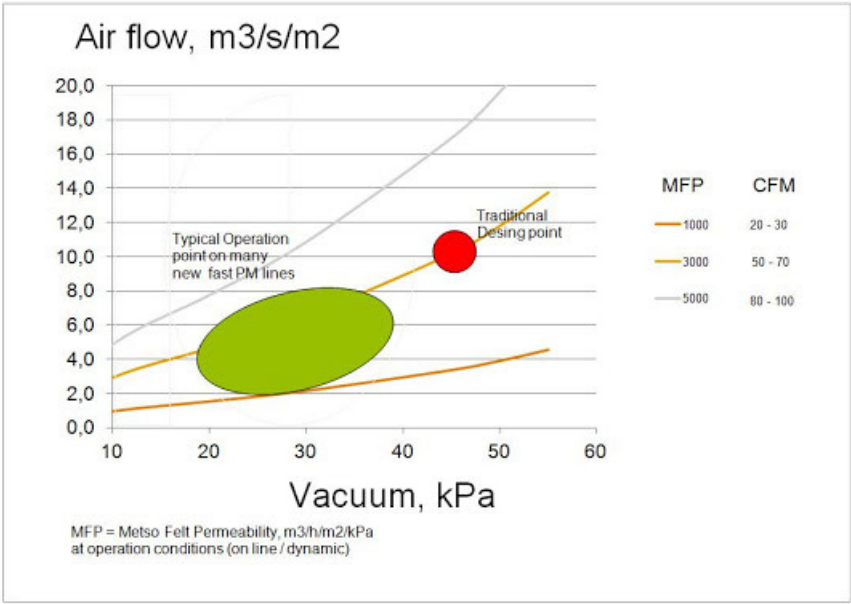
A model for estimating the dynamic felt air permeability (= air flow from the felt suction box) in the operating conditions was developed on the basis of mill measurements.

Energy and investment cost savings can be achieved also in the new PM lines, as the vacuum system dimensioning can be conducted more accurately than before compared to the actual operating conditions.

1. Felt Conditioning Requirements

The operating conditions of the PM press section Uhle boxes vary extensively at different paper machines. The operation of several low basis weight machines is based on nip dewatering, and the usse of vacuum is minimized *(refer to Article 1).*

On the other hand, the machines producing high basis weight paper or board, often still need vacuum for their uhle boxes to keep the felt dryness at the required level. Due to the different ways of operation, the felt types also vary a lot in different machines.



***Picture 1**: Operating conditions of felt conditioning.*

2. Dimensioning Criteria for Felt Suction Boxes

Traditionally, the dimensioning of felt conditioning at a Uhle box has been done based on constant vacuum or air speed at the slot of the felt suction box. This traditional method often leads to the over-dimensioning of the vacuum system, and huge energy losses in variable operating conditions. Additionally, the vacuum system efficiency is often low (= too large pumps or blowers combined with traditional, vacuum level controlling principles).

3. Estimation of Felt Air Permeability

To be able to design the felt conditioning and vacuum system better, a more accurate method for estimating the requirements for the felt suction boxes in the operating condition was required. Based on the measurements at different paper machines, it seems that air permeability of the felts in the operating conditions can be estimated at a sufficient accuracy for dimensioning purposes.

The dynamic felt air permeability in the operating condition was specified as MFP (= Metso Felt Air Permeability).

$$\mathbf{MFP = Q / A / sqrt(dP)} \quad (1)$$

Where:

- MFP is **M**etso **F**elt Air **P**ermeability (Nm3/h/m2 @ 1 kPa),
- Q is air flow from the Uhle box (Nm3/h),
- A is the suction box open area (m2), and
- dP is suction box vacuum (kPa)

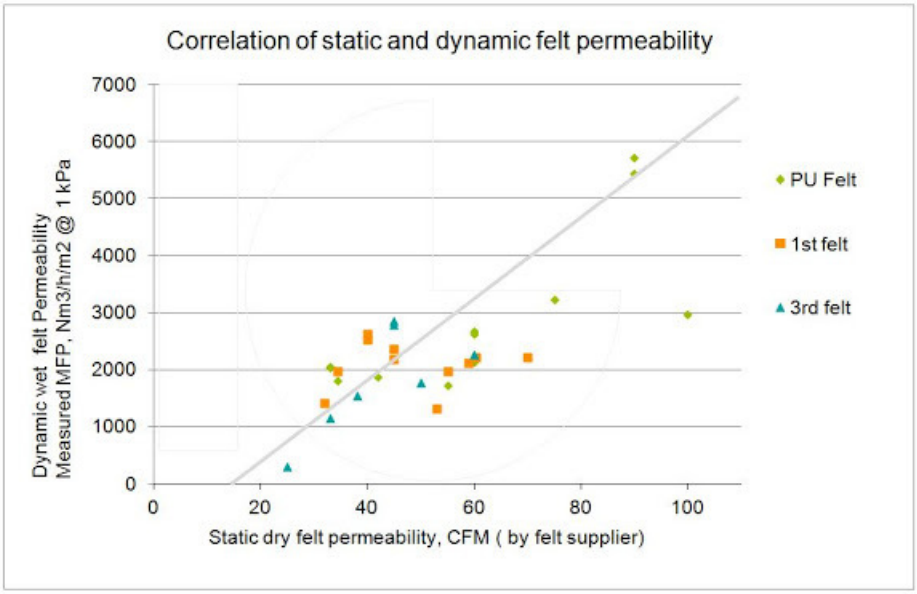
4. Correlation of Static and Dynamic Air Permeability of Felts

Felt suppliers typically give for the felts with the air permeability of a new felt, which is measured in dry conditions (CFM @ 1/2 in, or l/dm2/min at 200 Pa, etc.). It is also well known that the air permeability of the felt drops dramatically during the operation in the first few days, typically to a level of 20 ... 40% (= new felt 100%).

It has often been suggested that the air permeability of a new, dry felt does not correlate with the "dynamic" air permeability in wet operating conditions.

The PM vacuum system energy consumption and air flows were examined at several paper machines between 2005 and 2011. The air flows were also measured and compared with the felt data. The measured machines produced a wide range of paper grades, and used the felts of different suppliers (Huyck, Albany,Heimbach, Tamfelt, Voith, etc.). The felt ages varied between two days and four weeks during the measurements.

According to our measurements, it seems that a correlation between MFP and CFM is possible (for further details, see picture 2, and the referred Article 2).



***Picture 2**: Operating conditions of felt conditioning.*

5. Vacuum System Dimensioning

If the felt type at a PM is sufficiently known, it seems to be possible to estimate the required maximum capacity of the vacuum system more accurately than before. For details, compare to the Picture 2.

$$MFP < K * CFM \qquad (2)$$

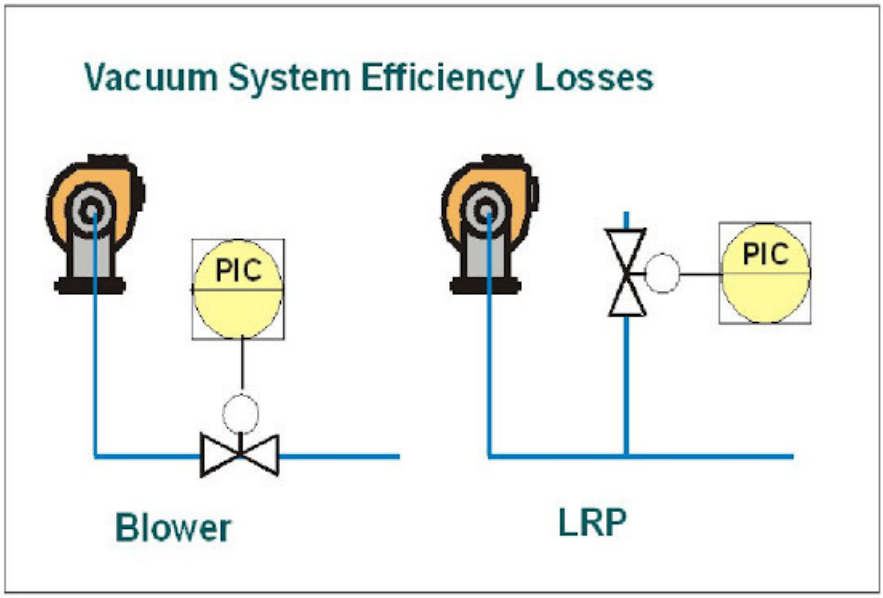
Where:

- MFP is dynamic felt air permeability
- K is constant (50 … 60)
- CFM is dry air felt permeability (CFM / in2 @ 127 kPa)

However, it must be remembered, that the aging of a felt still has a significant effect on capacity requirements, the required operating window can still be as high as 1:2, and the vacuum system must be able to operate at a good efficiency level at all operating conditions.

6. Vacuum Systems of Existing PM Lines

The existing PM lines, where the operating conditions have changed, very often suffer from an extremely poor vacuum system efficiency. This is caused by the traditional design principle of the systems. Huge efficiency losses can also take place in controlling the vacuum level (compare to Picture 3).



Picture 3: *Vacuum level control principles.*

Both the LRP (Liquid Ring Pump) and blower systems can drift outside a good operation area. Typically, totally new design and control philosophies have to be utilized to improve the efficiency of the existing systems.

In any case, it is important to notice that the most important issue is always the selection of appropriate felts, after which the vacuum system efficiency can only be optimized.

7. Online Estimation of Felt Air Permeability

An on-line air flow estimation system was also installed to a few machines, and the MFP was calculated online based on the measured data.

The MFP variation at different machines and in different suction box positions can be seen in the trends. Also the felt startup curves during the first few operation days could be clearly seen, but estimating the felt age on the basis of MFP seems to be difficult, or even impossible (felt aging and plugging).

8. Conclusions

Although several paper machines (producing low basis weight products) currently operate totally without felt conditioners, there seems to be a high number of machines where felt conditioning and Uhle boxes are still required.

The near future will show how the online estimation of MFP can be utilized in practice. In any case, the possibility to estimate felt permeability more accurately helps during the engineering phase of new lines, as well as in the work to improve energy efficiency at the existing mills.

Due to the felt development, the energy saving potential in the vacuum systems of the existing paper machines is high. Several efficiency studies have been carried out at the European paper mills, and typically the payback time of the required vacuum system rebuild is less than one year.

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Related Articles:

1. O. Kaapa, 18-19 / 2009 Wochenblatt für papierfabrikation: Drastische Einsparungen in der Pressenpartie mit Auswirkungen in die Trockenparite.

2. Edward F. DeCrosta, TAPPI May 1980, Vol 63 No. 5: Air flow requirements for conditioning press felts at suction pipes.

3. Kari U Kokkonen, Results pulp&paper No 1/2011: Energy savings through a new vacuum system consept.

4. Kari U Kokkonen, Results pulp&paper No 2/2012: Curbing energy costs through a blower system rebuild.