Paper Machine Clothing As A Key Contributor For Energy Savings In Paper And Board Machines

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ABSTRACT

Paper machine clothing (PMC) contributes only 2% of the costs of operating a paper machine but key energy performance drivers such as process water consumption, heat, steam, drive energy and vacuum are directly linked to PMC and contribute much more to the costs of operating a paper mpphine. This paper will investigate simple best practice in controlling cost and efficiency, look at specific trends seen in PMC over the past few years, discuss paper machine monitoring and improvements in analyzing PMC performance and look at the importance of

- A focus on what we can control
- Advice that matters and best practice
- The need for data, data and more data….

Introduction

Energy costs have increased consistently over the past few years and show no sign of settling in the coming decade. As the nature of the paper industry changes, its focus on efficiency moves and energy costs continue to rise, the role of suppliers has changed in many ways. Companies now have to find more innovative ways of providing value to customers through product and service and analyse in more detail the impact products have on a customer's process.

The Role of Paper machine Clothing

PMC suppliers have increasingly focused their development efforts in the past few years, changing from a mode where ever more complex structures (TSS, 4 layer press fabrics) were introduced to an approach which looks at solving a key papermaking parameters through product characteristics. This approach has provided several breakthroughs which we will discuss here.

Figure 1 describes the relative cost of removing water in different areas of the paper machine. Though the cost to remove water in the drying section is 5 times that of the press section, the focus on improvement and solutions in removing water is almost always in the press section, this needs to change.

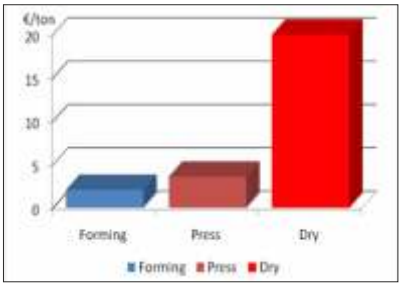

Figure 1; Cost of Water Removal

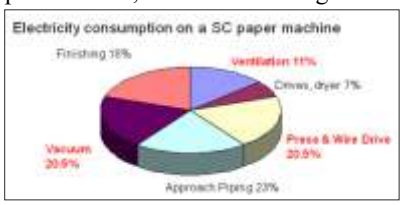

Figure 2; Power consumption on a paper machine (PMC impact in red)

Another feature commonly overlooked when looking into energy efficiency is the influence PMC can have on electrical energy through vacuum, drive or ventilation. These areas can have a huge impact on paper machine costs, far in excess of that of direct PMC costs and we will also investigate this.

Case Histories

Lets look at key ways in which forming, press, dryer fabrics and Process belts can influence these areas. Firstly forming fabrics.

In work completed on pilot machines it has been shown that on a modern machine vacuum element performance and therefore paper machine dryness ex couch can be influenced greatly by forming fabric caliper. Traditionally forming fabric design has moved to finer structures with more water handling capacity and wear potential (SSB styles with coarse open wear side combined with fine top surface later becoming the dominant style in use) and has not focused on caliper.

Thinner fabrics are obviously needed to optimize sheet dryness and vacuum use from the forming section. Recent developments have allowed the development of finer fabrics with the thinner constructions required without the loss of life potential.

Figure 4 demonstrates the effect of finer fabrics on power consumption on a wide high speed LWC machine. Note that as caliper decreases not only does sheet dryness improve but in this case the power consumption of the paper machine decreases dramatically also. Savings solutions in drive load are direct and repeatable; dryness

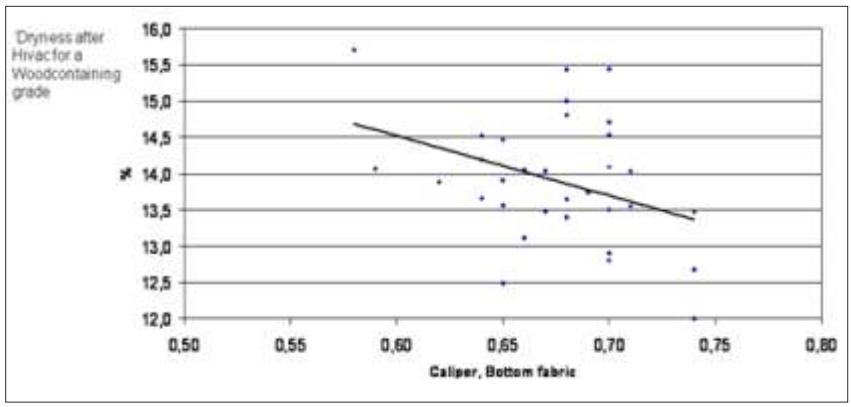

Figure 3; Effect on fabric Caliper on sheet dryness

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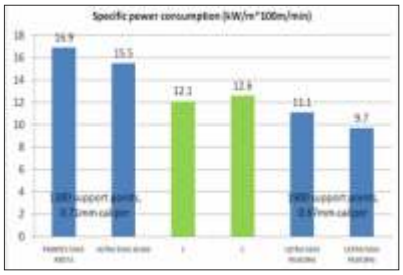

Figure 4; Lower Caliper of fabrics lead to lower power consumption

improvement in a paper sheet at the couch can easily be lost later on the machine if a system approach to running and tuning the paper machine is not taken.

In the press section there is always a discussion on the merits of nip or Uhle box dewatering. Nip dewatering should always be favored as this is the most cost effective way of removing water as energy to generate vacuum contributes 20% of the electrical cost of a modern paper machine. As machine speeds increase this becomes even more critical, dwell times in the nip or over a vacuum box decrease and less time is available to remove water with vacuum.

First we will deal with the issue of nip dewatering. For shoe press belts, much time has been spent recently in developing a type of belt which can optimize water flow in the machine direction of a shoe press nip. A phenomenon called "Ingoing nip spray" (INS) has been seen as grooved belts have come to dominate application of shoe press belts. This phenomenon occurs on heavier weights in particular and can lead to loss in sheet dryness and sheet quality issues in extreme cases. Belts with engineered voids were developed to address this issue. Figure 5 demonstrates how such a structure works.

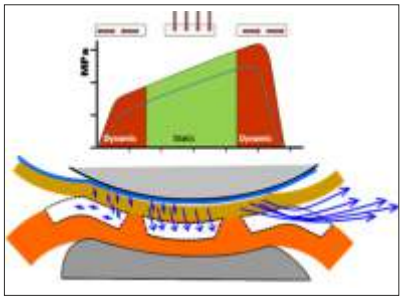

Figure 5; Model of Engineered Void belt

The discontinuous groove has dynamic behavior where it vents to the atmosphere but elsewhere in the nip it behaves in a static fashion. Hydraulic pressure builds up quickly and is maintained at a high level and the venting at nip exit promotes a positive hydraulic pressure in the paper sheet. There have been many cases where this

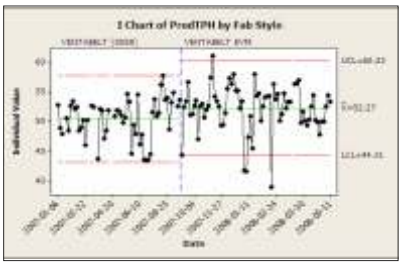

Figure 6; Increase in tonnage, 200gsm liner machine

design has lead to increased machine production. Figure 6 demonstrates just one outcome and also demonstrates an issue we will return to later, the use of data. In this example simple statistical analysis on a machine producing heavy weights showed an increase in tonnage of 1.8 tonnes per hour when making 200gsm liner

As can be seen above, increased nip dewatering can lead to dramatic solution, an improvement in machine capacity. More development in press fabrics is being focused to press fabric designs which promote nip dewatering. Figure 7 demonstrates one example of the benefits seen from such designs, a non woven press fabric. The 30% increase in nip dewatering seen could lead to the reduction in use of one vacuum box in a press section, leading to significant savings in power consumption. To remove one vacuum box from a press fabric would seem counter intuitive to most papermakers but this is now feasible as new PMC

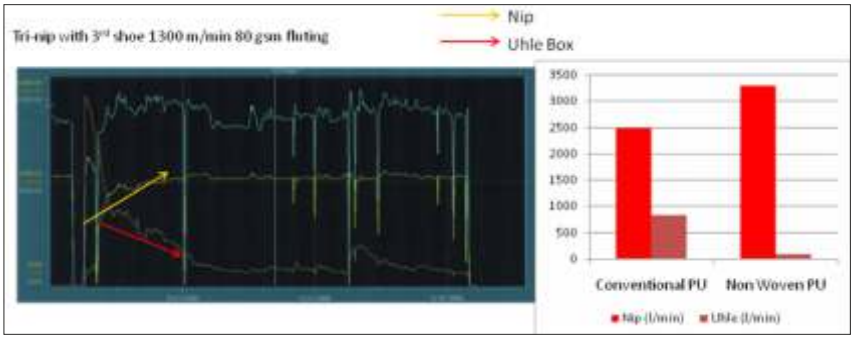

Figure 7; Balance of nip vs Vacuum dewatering, press section

technology becomes more widespread and operating philosophies change on paper machines as energy costs rise.

For many years dryer fabrics have not been seen to be capable of promoting such huge improvements in sheet dryness/energy reduction. That is also changing now with a new generation of "Active" dryer fabrics. Remember (Figure 1)in terms of energy consumption the dryer section is 5 times as expensive to remove water as elsewhere on the paper machine. Solutions in the dryer section have to be very creative. Figure 8 demonstrates the effect of using an active dryer fabric. Such fabrics work by the use of "spoilers" on the inside of the dryer fabric which create under pressure and increase the rate of air flow (and moisture removal) through the dryer fabric. This case is from a Copy paper machine running at 700 metres per minute (m/min) which had high absolute moisture in the 1st Top and bottom dryer group due to bad pocket ventilation and was thus dryer limited. The active fabric improved ventilation and absolute humidity fell by 50%, this solution allowed the machine to run with increased speed (+20 m/min) and reduced steam consumption. (-2%).

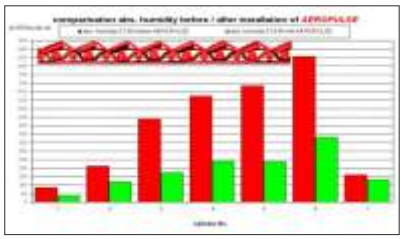

Figure 8; Active drying increases drying rate

Best Practice and Data Analysis

Though this seems a daunting subject there are in fact simple ways in which this approach can be applied, though the approach requires much more openness between suppliers and customers. There are a great variety of different ways in which updates in best practices can be accomplished, through web based forums, through reporting but mainly through the application of standard operating procedures and condition monitoring in mills. Suppliers play an increasing role in this area.

The same applies for data analysis. If a paper machine uses a data historian

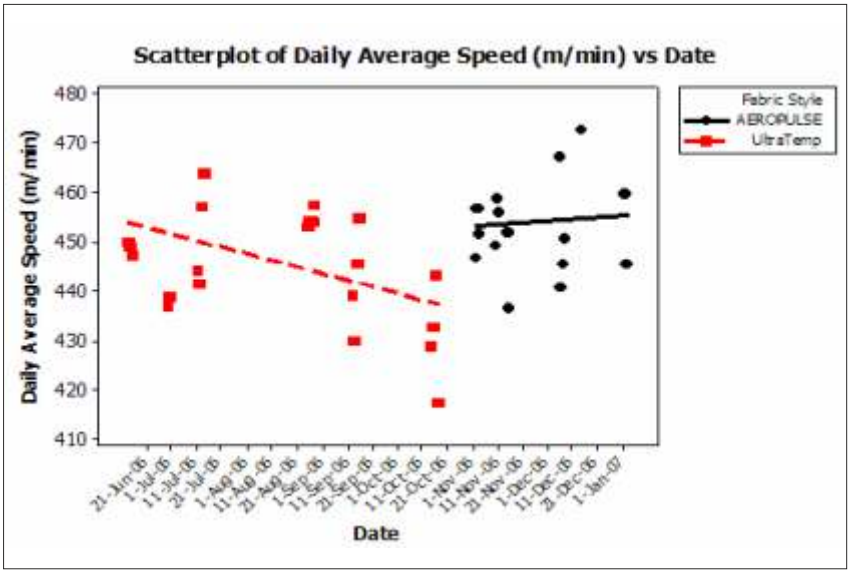

Figure 9; Simple scatter plot

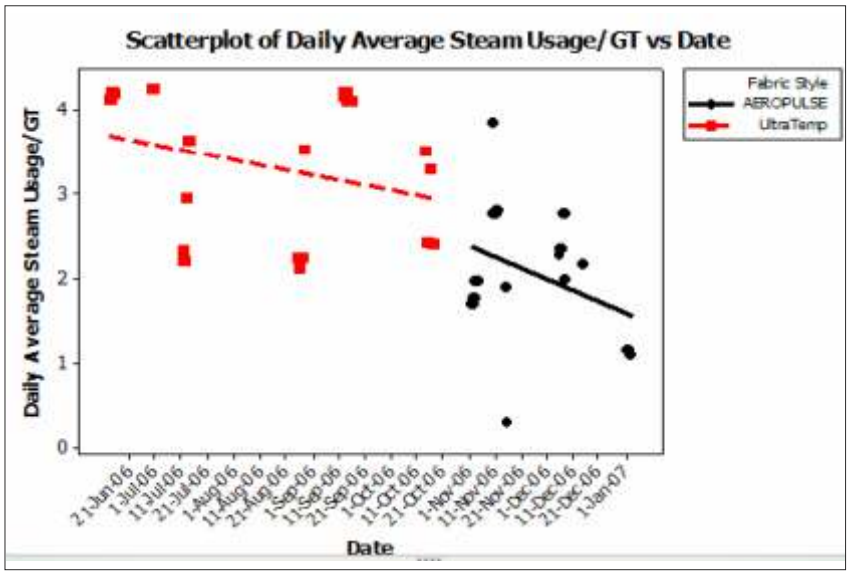

Figure 10; Steam flow data for same period

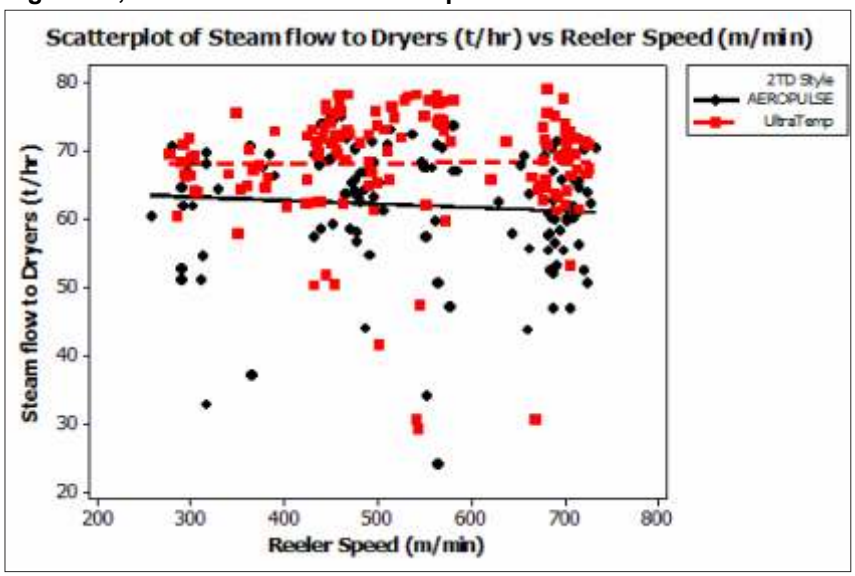

Figure 11; Steam flow vs reel speed for different styles

which stores thousands of pieces of data every second, detailed multi variate data analysis can be completed. However, even with a simple data stream recorded daily (in writing if needs be) for trial monitoring can allow the use of simple six sigma statistical analysis and can be extremely rewarding.

Figure 9 shows why data analysis is so important. In this simple case history two dryer fabric styles were being compared. As can be seen the average daily speed of the paper machine was monitored. Note there are few data points used here, only 36 daily speed average points were used. At first glance the active dryer fabric did give a higher value but as mentioned, this was for a small data set and of course machine speed can be influenced by many variables. However the analyst did notice an interesting effect in that the average machine speed seemed to be increasing with the active dryer through life but had been decreasing over the life of the standard dryer. Further data was then collected in more detail. Figure 10 shows steam flow data for the same period. Again, despite their being few data points a clear trend is emerging with the steam usage significantly down for the active dryer fabric.

Finally to confirm these in initial findings and to "Normalise" the data against machine speed steam flow was plotted against reel speed for the separate time periods both dryer fabrics were on the machine. Here the statistical significance and the performance of the machine with the active dryer fabric is confirmed.

Conclusions

Energy savings are driven by a focus on what we can control, in terms of development of PMC. Reductions in energy consumption will come from advice that matters and a better understanding of solutions but most importantly data, data and more data to allow us a better understanding of performance.