

ONE HUNDRED YEARS AND COUNTING

WITH A PROCESS THAT DATES BACK TO THE EARLY 1900S, THE ART OF MAKING CORRUGATED BOARD STILL USES PAPER, STEAM AND STARCH. BUT CAN WE GET MORE EFFICIENT WITH THE USE OF STEAM NEEDED IN THE PROCESS?

A REPORT BY WILBERT STREEFLAND

Steam pressure might be one of the oldest forces used in the corrugated industry, yet innovation is still possible today. Apart from using steam to get things moving, it is also an efficient energy carrier and distributor.

Let's look in the past first to make the link to corrugated packaging before discussing the new CorrSteam system developed by L.A. Consulting.

13th June 1903 - Camille Thiébaud was living in Paris and filed a patent in France for corrugated board. 7th June 1904, he did the same in UK with the title 'An Improved Article of Manufacture Composed of Corrugated Paper Board'. The patent describes single face and corrugated board, but not the production process or the machine to make it.

Camille Thiébaud's patent was the the oldest patent we could find on the EPO website; the second oldest was from John N. Hahn in Cleveland, USA, who filed a patent in the USA on 16th June 1904 called 'Corrugated-Paper-Board Apparatus'. The EPO web site only shows the patents and does not provide any historical information about a possible relation between Thiébaud and Hahn nor if they were competitors fighting each other or supporting each other in solving a problem.

The Problem

John Hahn describes clearly in his patent how to produce corrugated board. He also indicates that using steam in the hot plate section for drying the board is the best option. Some 116 years later, we still do the same - but are we using steam in the most efficient way? Have we learned how to distribute the steam and collect the condensate in the most efficient way in the past 116 years?

From text books on steam, we learn that the condensation phase and collection of condensate are the most complicated parts where most energy gets lost. The first steam engines did not use the condensate after the steam had moved a cylinder it, was evacuated to the atmosphere.

Correctly designing of a steam system on a corrugator today is a skill that seems to disappear and yet when done correctly it can significantly reduce the use of energy and water. This is a 'hot' topic today, certainly for an industry which embraces sustainability.

Possible Results

How is a corrugator steam system best designed? Key during the production of corrugated board is that we keep the paper temperature below the boiling point of water. We don't want to 'cook' the water out of the paper - we need to keep the paper temperature below 90°C.

Crucial for a corrugator steam system is to have full temperature control, by controlling steam supply on all sections of the corrugator, starting with pre-heaters, single facer(s) and the double backer and hot plate section.

The other important factor is the steam pressure used. Many corrugators today run at relatively high steam pressure resulting in 'overheated' machines, which have difficulty in running board compositions consisting of modern light weight and/or coated papers.

LOW PRESSURE STEAM IS ESSENTIAL TO ACHIEVE ENERGY SAVINGS AND BETTER PROCESS CONTROL ON THE CORRUGATOR

To understand this better, we need to look at the properties of saturated steam. This is best explained in the following four steps:

- We all know that the temperature of saturated steam increases as steam pressure increases;
- However, the total energy capacity captured in steam doesn't change much with an increasing temperature (or pressure);
- At the same time, the latent energy (exchangeable part or the part that we use for heat transfer) in steam decreases at higher temperatures or higher pressures;
- Since only the latent part of steam can be used, it is important to make use of low-pressure steam for energy exchange and transportation to have the most efficient energy exchange.

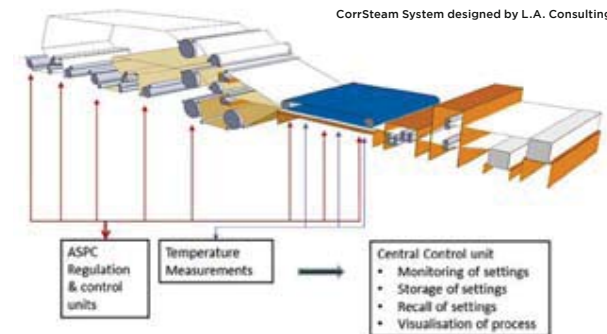
Designed by L.A. Consulting, CorrSteam is a steam system design that maximises the use of the latent steam energy by using a low steam pressure. We will use it as an example on how you could optimise the energy efficiency of a steam system.

A steam system design is best based on dividing the steam system in multiple zones, one for each steam consumer in the corrugator. This will allow control of the steam temperature and pressure in each zone individually. Dividing in 'small' zones results in that each zone also has a relatively low energy content, which allows it to quickly respond when changing the temperature and pressure settings.

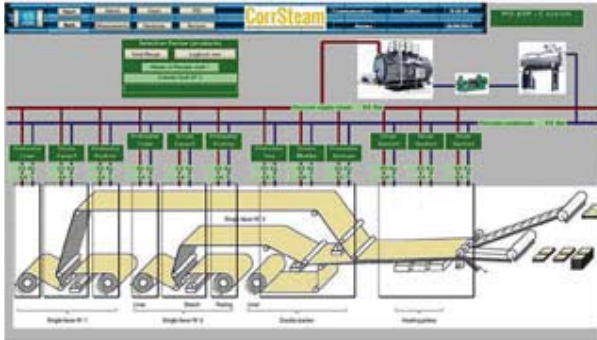
At the same time, the steam system design has to include an adequate removal of condensate in all circumstances. Therefore, it is crucial to include in the design a steam system the boiler house to make sure that you arrive at a total balanced steam system for the plant. The engine in your car is only fuel efficient if it is in relation to the size and weight of your car. In other words, the boiler should not be under or over-powered in relation to the corrugator steam needed.

The following images show the basic layout of a CorrSteam steam system, where the first images show schematically what is controlled and where, to give you a clear view on what is included in the steam system design.

CorrSteam System designed by L.A. Consulting



The next image shows a screen shot of the CorrSteam system control display with all individual pressure and temperature settings by zone that need individual control.



CorrSteam: Centralised Control Center

The display design is relatively easy to understand despite the complexity of a corrugator steam system. The individual sections are recognisable on the display

showing the temperature and pressure setting. The operator has a good overview of the corrugator process and the current steam system settings.

For the operator, it is now possible to find the optimum temperature and pressure settings for the individual zones in relation to the board grade produced. The software allows operators to memorise and recall the settings once the optimum settings are found for a specific board grade or board grade family.

The learning capacity imbedded in the software (one could call this Best Practices) ensures that when changing board grade during production that the system automatically optimises the temperature settings over the full corrugator (all individual zones) for that grade. There is a quick system response on a settings change as the individual zones have a relatively low energy content. The result is a significant energy saving, but also board waste reduction due to the short response time of the control system before the optimum settings for the new board grade is reached.



Proven Concept

The proof is clear, as validated by a leading industry player. Using low pressure steam results in an energy reduction between 25-40% and a significant reduction of the boiler water consumption was confirmed by DS Smith in Gent, Belgium, who installed the system on a new Mitsubishi corrugator. The users of CorrSteam also report a better process control resulting in lower waste figures and a broader employability of the corrugator line.

So there we have it! It is still possible to innovate technology that is over 100 years old, with a steam system resulting in significant energy savings and better corrugator efficiency. Corrugated board will likely still be produced in 2100 and use steam to control the temperature during production; so why not make it more efficient today? ■



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