

Curtain Coater as Air Knife Replacement

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ABSTRACT

In June of 2010 a curtain coater had started up on a board machine in Frohnleiten, Austria. It replaced an air knife coater which has been operating in this position. Shortly after start-up the curtain coater showed significantly better quality and runnability than the previous set-up. This paper will discuss quality improvement and energy savings due to reduced drying requirements and improved runnability of the machine.

1 INTRODUCTION

Sustainability is becoming increasingly important in the world's societies and, thus, also in industrial production. The pulp paper industry has been faced with the issue of sustainability for decades. Compared to other industries, the pulp and paper industry is already on a good level of sustainability, since its main raw material - wood - is renewable rather than fossil-based. The same is true for the energy supply of pulp mills.

Nevertheless, the pressure on the pulp and paper industry to further improve its sustainability remains high. Three areas will be of main focus in the future: further reduction of the energy demand, increase in the use of recycled fibers and reduction of the fresh water consumption (Fig. 1).

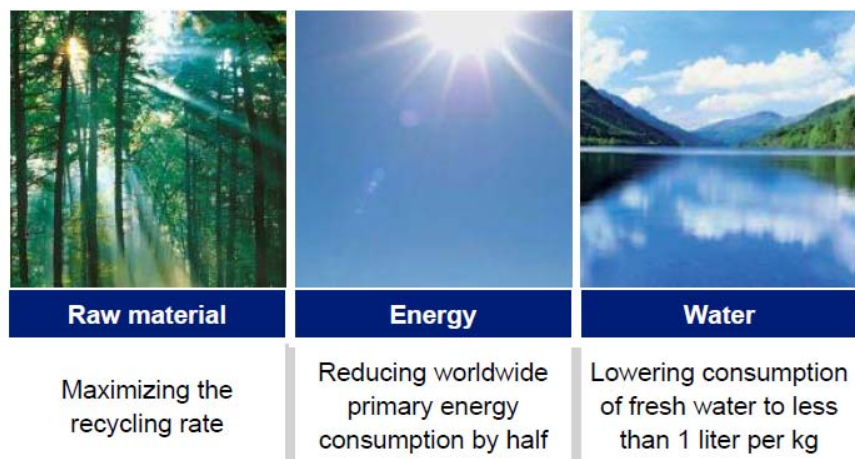


Fig. 1: Sustainability – Future trends in the paper industry

2 AIR KNIFE COATER

The board industry uses the air knife coater on coated board grades to cover their brown base sheet. This method provides a fairly good coverage due to its contour coating. Until recently it was the preferred equipment for the manufacturing of these grades. The air knife coater and its operation are limited by many factors:

- Speed limitations
- Coating color solids
- Application amount limited
- Frequent cleaning required (with double nozzles this can be done without stop of the machine)
- Poor runnability
- Noisy operation

3 CURTAIN COATING

The curtain coater provides the required characteristics of the air knife coater without its limitations.

Characteristics	Benefits
▶ Perfect coverage ▶ Excellent runnability ▶ High solids contents ▶ Ease of operation ▶ High efficiency ▶ No wear parts ▶ Excellent handling ▶ Optimum CD and MD coat weight profiles	▶ Improved printability ▶ Less break time ▶ Reduced drying energy ▶ Lower coat weight ▶ Higher content of recycled fibers

Fig. 2: Characteristics and benefits of curtain coating

4 CURTAIN COATER AS AIR KNIFE REPLACEMENT

4.1 Situation before Rebuild

The Frohnleiten mill in Austria produces several coated board grades. The coating is done online in the machine. For the middle coat an air knife coater was used (Fig. 3). This unit was the bottleneck of the machine due to the above mentioned limitations of this type of coater.

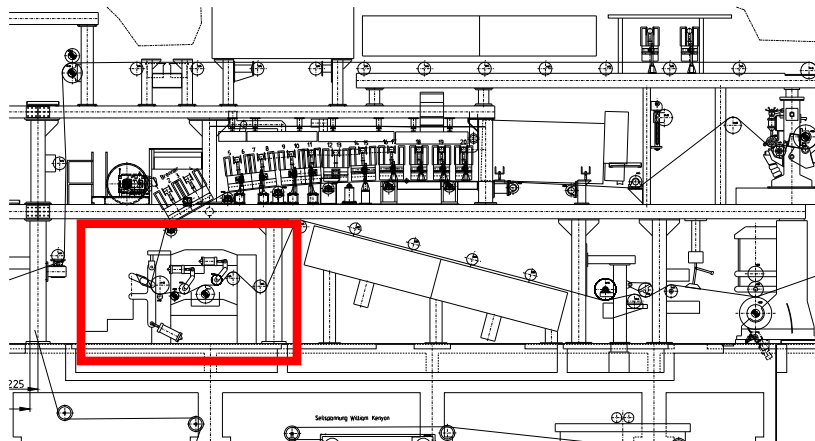


Fig. 3: Machine with air knife

Products: several board grades
 Basis weight: 230...390 g/m²
 Machine speed: 370...550 m/min
 Coat application: 12 g/m² pigment coat in the middle coat
 Solids content: 42 %
 Width: 4850 mm



Fig. 4: Board produced with air knife

4.2 Proof of Concept

For the produced, grades superior coverage of the brown base sheet is essential. The only other coating technology besides the air knife that can provide similar coverage is the curtain coater.

To prove the concept an extended trial program was run on our pilot coater. A sample of the results can be found in Fig. 5 - 7. In addition the formula for the coating color had to be developed. This was another major task which was essential during the pilot trials.



Fig. 5: Coverage with curtain coater on brown substrate

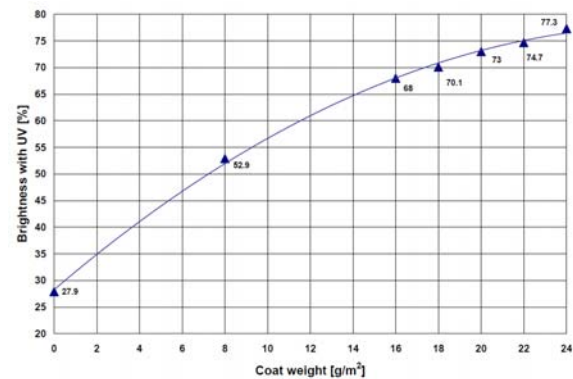


Fig. 6: Brightness vs. coat weight with curtain coater

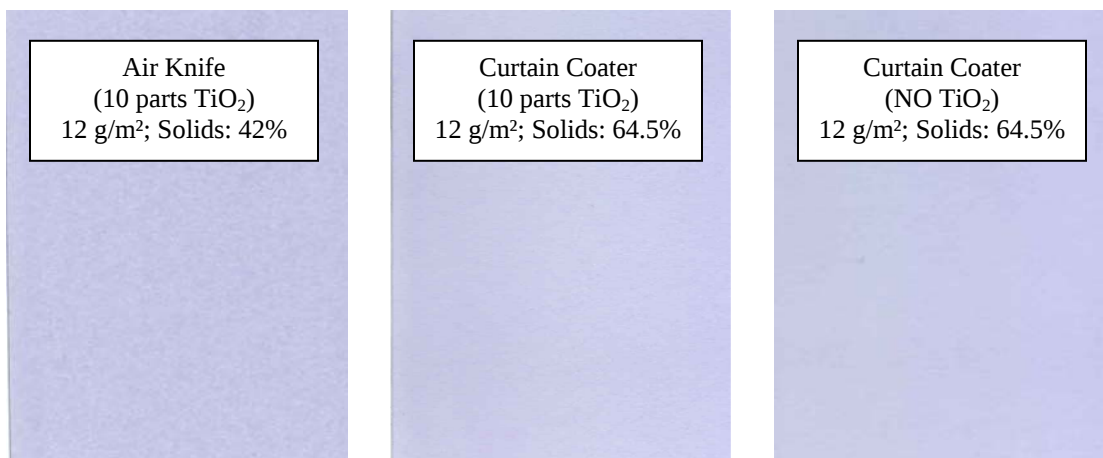


Fig. 7: Comparison coverage air knife - curtain coater

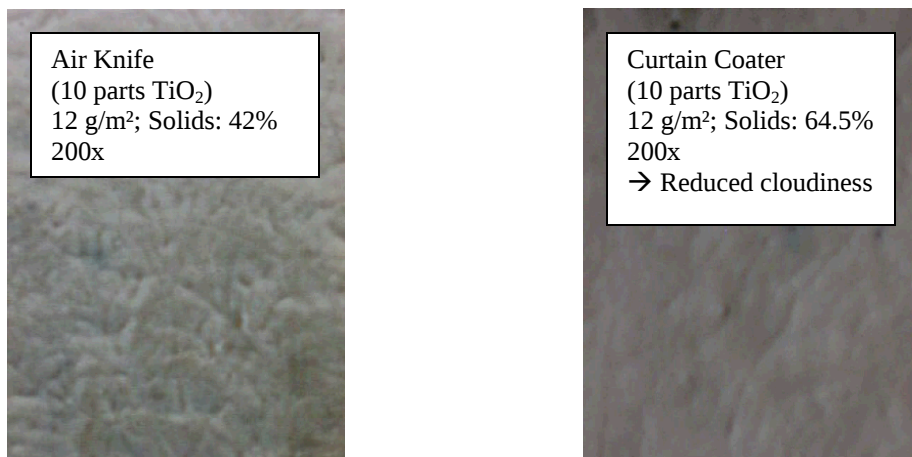


Fig. 8: Samples air knife - curtain coater

4.3 Rebuild Solution

The rebuild order for the machine was placed before all the trial work was finished. It was assumed that the remaining minor issues could be solved during the project phase before the machine was rebuilt.

The requirement for the curtain coater was it had to fit into the machine without the removal of the existing air knife. This was required by the mill due to the fact that the curtain technology had not been used in an online application (until now the curtain coater was mainly used in off machine coaters).

The location of the new curtain coater is directly above the air knife. The rebuild concept is based on the much higher solids content of the coating color for the curtain coater and it requires less drying. This reduced drying results in less drying equipment. This was enough space for the curtain coater (see Fig. 9).

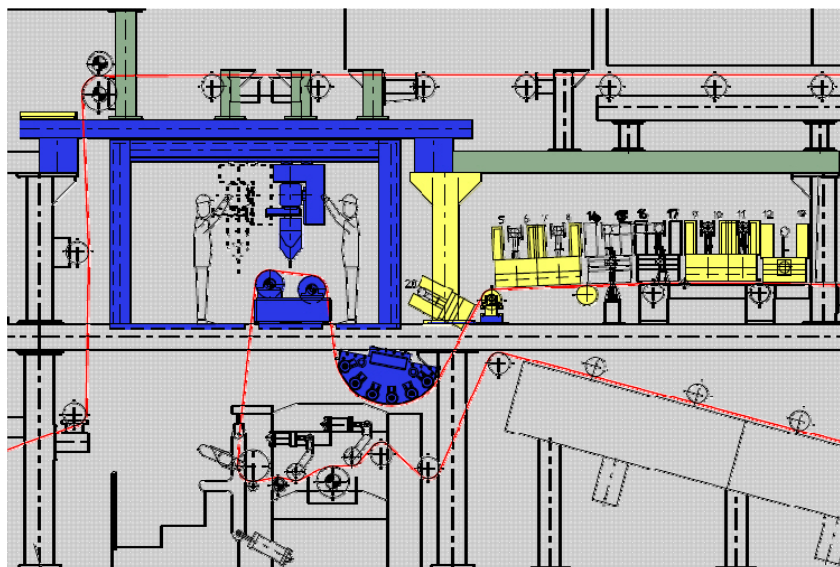


Fig. 9: Rebuild machine with curtain coater

The curtain technology has higher demands for the deaeration of the coating color than traditional coating techniques. Entrained air causes defects in the coating layer.

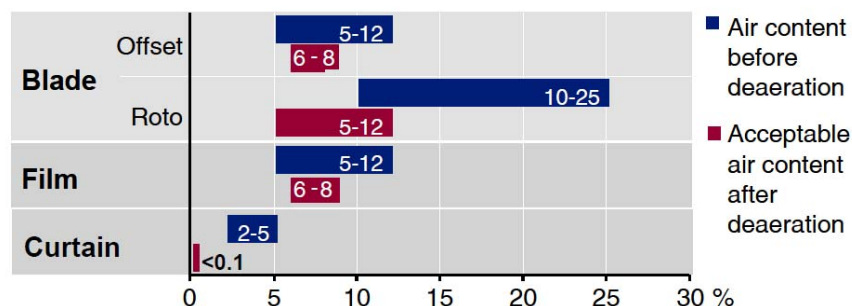


Fig. 10: Coating color air content for different coating techniques

This was addressed with a new mechanical vacuum deaerator which was installed together with the new coater. The new deaerator functions also as the working tank for the color supply of the curtain coater. This is possible due to the low required flows to the curtain nozzle.



Fig. 11: Coating color on a glass plate - Visualization of air before and after deaeration (no magnification)

4.4 Operation Mode

The nozzle of the curtain coater is approximately 300 mm wider than the web width of the machine (See fig. 10 and 11). This operation mode is called “overboard”. The amount of overflow color is small compared to the overall flow. It is collected in a catch pan and recirculated into the color system.



Fig. 11: “Overboard” mode for curtain coater: Curtain wider than web

5 RESULTS

5.1 Machine

The rebuilt machine with the curtain coater started up on June 16, 2010.

It started with 550 m/min (the former maximum speed) and a basis weight of 250 g/m². The next speed target will be 700 m/min and is expected to be reached soon.

The amount of energy used for drying is reduced considerably due to the much higher solids content. The increase of the coating color solids content from 42% with the air knife to 62% results in a drying energy reduction of approximately 50% (at the same speed).

In addition, enhanced flatness ensures excellent runnability and a higher productivity of the machine. With the air knife in place it was necessary to “pre curl” the paper in the main dryer section. After the rebuild this practice could be stopped. This effect was not expected but very welcome. It increases the capacity of the main drying significantly.

Before the rebuild the machine averaged 60 - 80 web breaks per month.

After the rebuild this average dropped to 20 - 30 web breaks per month.

There was no web break in the curtain coater since the start-up in June 2010.

The coating color formulation which is presently used is still the one developed during the pilot trials. There is only one color recipe used for all grades.

5.2 Board properties

The board produced was of superior, salable quality right from the first parent roll.

All the project targets were met from the start, resulting in a higher quality thanks to improved and homogeneous coverage (see Fig. 12 and 13). The coat weight could be reduced from 12 g/m² to 9 g/m².



Fig. 12: Scanning electron microscopy of samples coated with air knife.



Fig. 13: Scanning electron microscopy of samples coated with curtain coater.

In Fig. 14 the gloss before and after the rebuild is shown. For all grades the gloss is higher compared to the air knife.

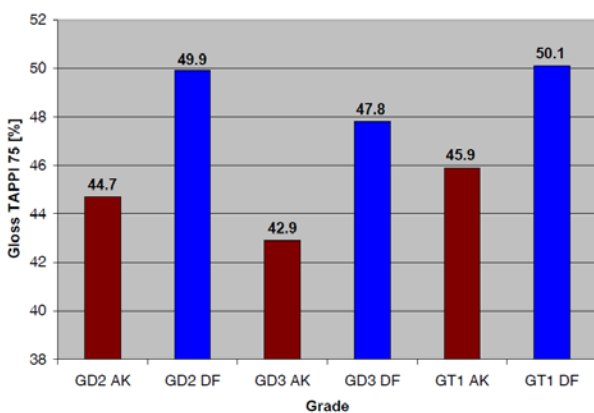


Fig. 14: Gloss before and after rebuild for different grades.

In Fig. 15 the smoothness before and after the rebuild is shown. For all grades the smoothness is slightly lower compared to the air knife.

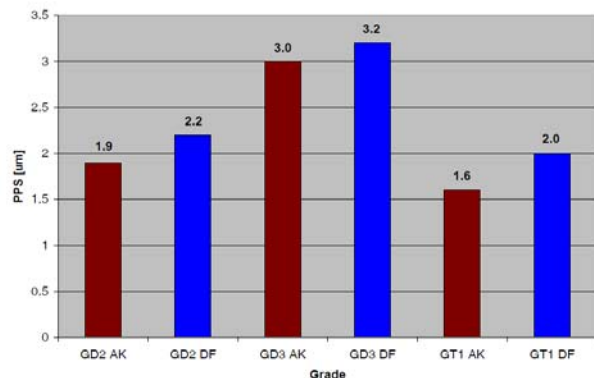


Fig. 15: Smoothness before and after rebuild for different grades.

The printability of the board is better than before the rebuild. Previously existing mottling does not exist in today's product.

6 OUTLOOK

The curtain coater in Frohnleiten is the first to replace an air knife in a board machine. It is considered a big success by the mill but there are many optimization opportunities which have to be developed further.

→ The machine is no longer speed limited in the coating section. After reaching the 700 m/min speed goal there will be room for even faster speeds. The curtain coater was run in pilot trials to speeds of up to 2200 m/min.

→ As described before the initial coating formulation is still run on the machine. With further optimization there is a huge potential of reducing costs while maintaining quality due to superior coverage of the coating (e.g. less TiO₂).

→ Future furnish cost reduction by replacing DIP by mixed waste paper

7 CONCLUSION

The curtain coater is the perfect replacement for existing air knife coaters. It fits into the existing machine configurations, sometimes even with leaving the air knife in place as a fall back solution.

It shows multiple benefits to the paper and board producers. These benefits include:

- Perfect coverage
- Excellent runnability
- Reduced drying energy
- Ease of operation
- High efficiency
- No wear parts
- Excellent handling
- Optimum CD and MD coat weight profiles
- Profilability
- System-integrated working station
- Compact high-efficiency deaeration unit

Curtain coating contributes significantly to enhancing the sustainability of paper and board production. I have shown examples that the use of curtain coating yields energy savings by increasing the machine efficiency and reducing the drying requirements. Additionally curtain coating helps to increase the use of recycled fibers by improved machine runnability and due to the improved coating coverage.

Therefore, curtain coating can truly be called a “Green Technology”.