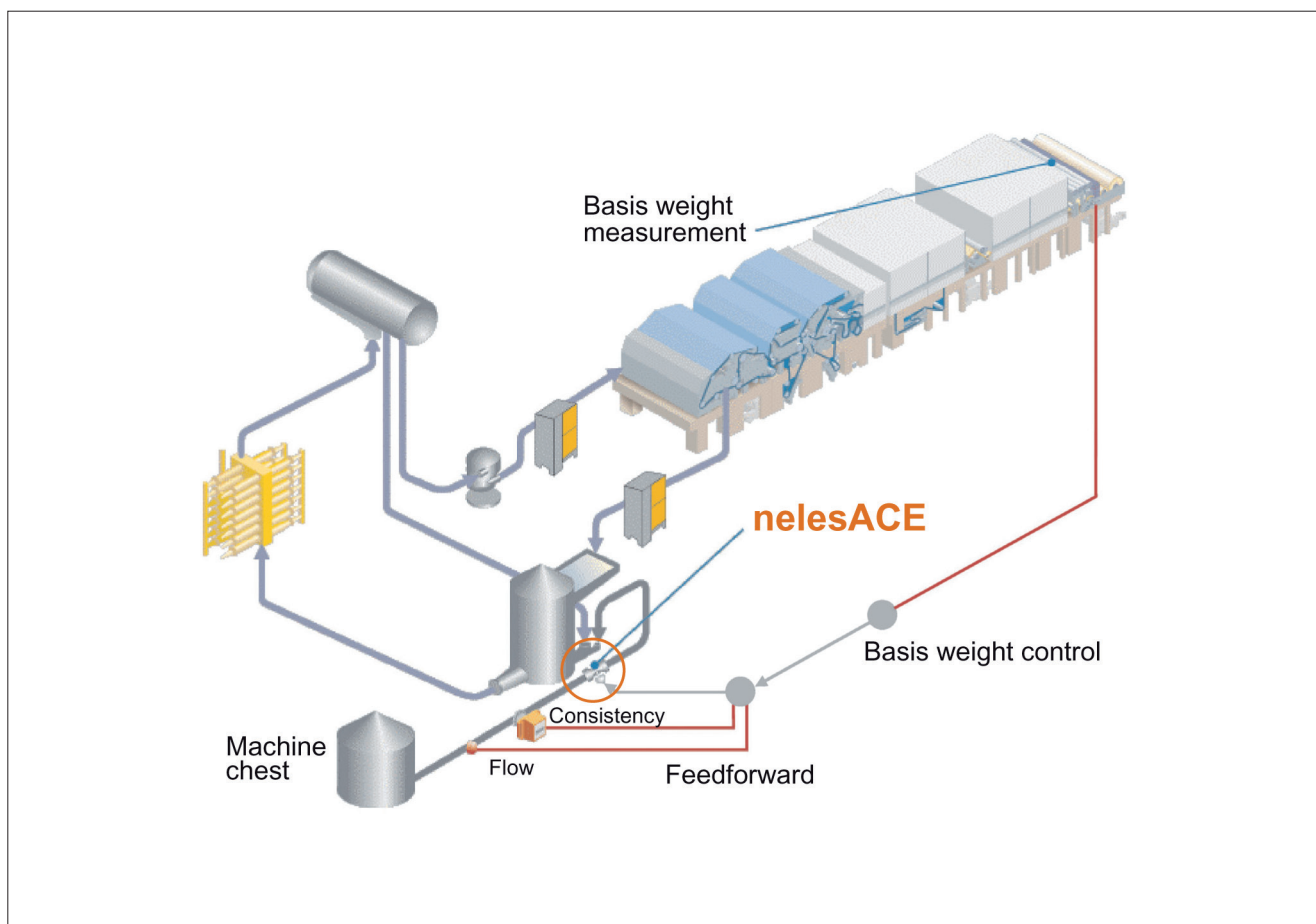


## nelesACE™ improves efficiency of a paperboard machine



### Background

Requirements for paperboard quality are getting higher all the time. This relates with the need of improving the board making process. One of the main devices in the process is the basis weight valve.

Basis weight control is based on the measured basis weight, machine speed, stock flow and stock consistency. It is rather complicated control system, which is affected also by headbox flow, wire speed and moisture measurements.

Precise and stable basis weight control is an important part of a paper machine's quality control system. In order to keep the process running steadily, it is vital to have a basis weight valve that operates accurately and reliably. Depending on a process situation, a valve has to respond quickly with large position changes or sensitively with fine precision. nelesACE is the ideal valve for stabilizing paper quality in all situations with its selectable speed of response and high positional accuracy.

## Description of the solution

Accuracy of the basis weight depends greatly on performance of the basis weight valve. Minimum variation in the basis weight is possible with the new nelesACE, which performs precise changes in valve position with high repeatability and resolution.

The valve unit consists of a segment valve and high resolution step-motor-driven rotary actuator.

nelesACE can be operated at four different speed and accuracy settings. It is possible to attain up to 28 200 discrete repeatable positions using ¼ step mode through a 90 degree operation range to compensate for fluctuations in stock flow.

## Description of the application

This board machine is equipped with three headboxes producing three-layer paperboard. It is 3,4 m wide operating between 180 and 270 m/min depending on the grade. The basis weight range is 230-350 g/m<sup>2</sup>. Production rate is approximately 8 t/h, which means 65 000 t annual production. nelesACE basis weight valve was installed to control the middle layer stock flow.

The special control logic of nelesACE is used e.g. in grade changes. The step motor is controlled by pulses. One pulse means 2 steps, one step, one half step or one fourth step depending on the error value between measured value and set point. Pulse frequency is lowered also while steps are getting smaller. These two things together determine the speed for valve moving. Near set point the valve is controlled accurately. Correspondingly the valve is driven fast, when the error value is high.

An example of flow set point change from 350 l/s to 340 l/s is shown in the figure 1. The controller was on automation mode and flow rate was steady when set point change was made.

## Results and benefits

Stock flow measurements are shown in figure 2. The upper one is flow measurement with previous basis weight valve. Flow measurement varies a lot. The smallest flow change is 1 l/s, which means 2 g/m<sup>2</sup> change in the basis weight of the paperboard. The stock flow measurement with the new nelesACE is shown in the lower part of the picture. Stock flow can be adjusted precisely. With nelesACE the smallest change in the basis weight of the paperboard is 0,1 g/m<sup>2</sup>. These results show the accuracy of the nelesACE.

The board machine might have several grade changes per day. Grade changes weaken the stability of the process and therefore increase the risk of breaks. The objective is to change the grade as quickly as possible from one acceptable quality level to another while avoiding breaks. While the board machine is running, board produced between grades that does not conform to quality standards is rejected and recycled into the process. When the quality level required for a new grade has been reached, the reelers begin again to accumulate paperboard.

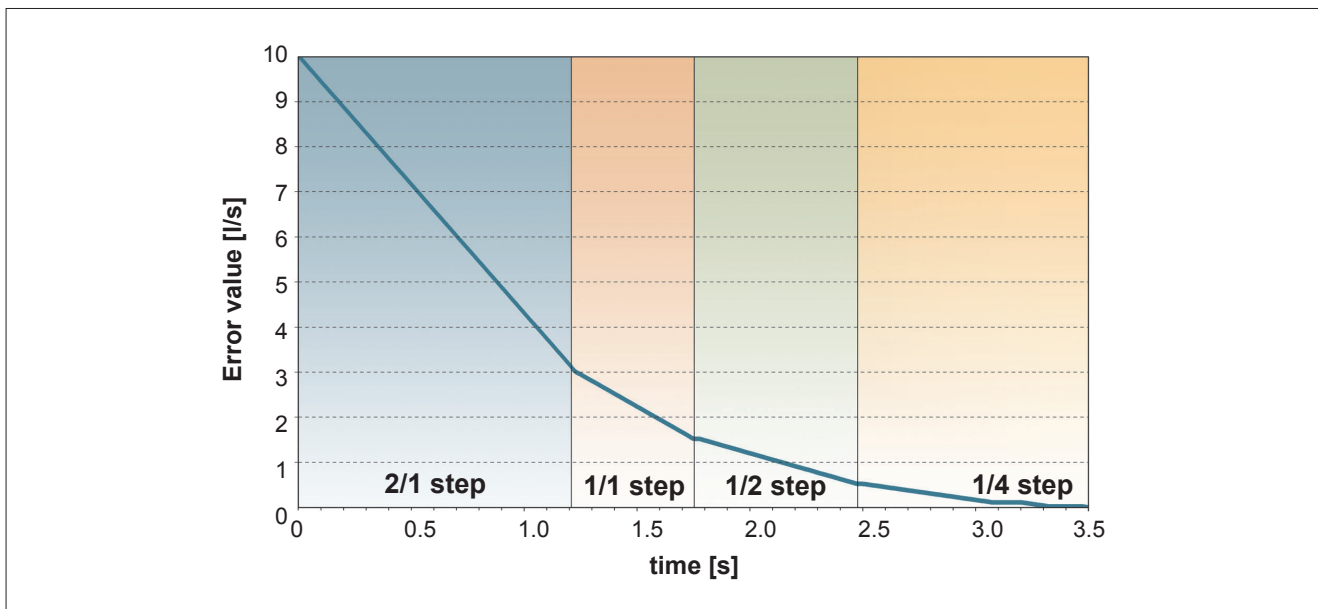


Fig. 1. Valve control logic in the flow set point change from 350 l/s to 340 l/s.

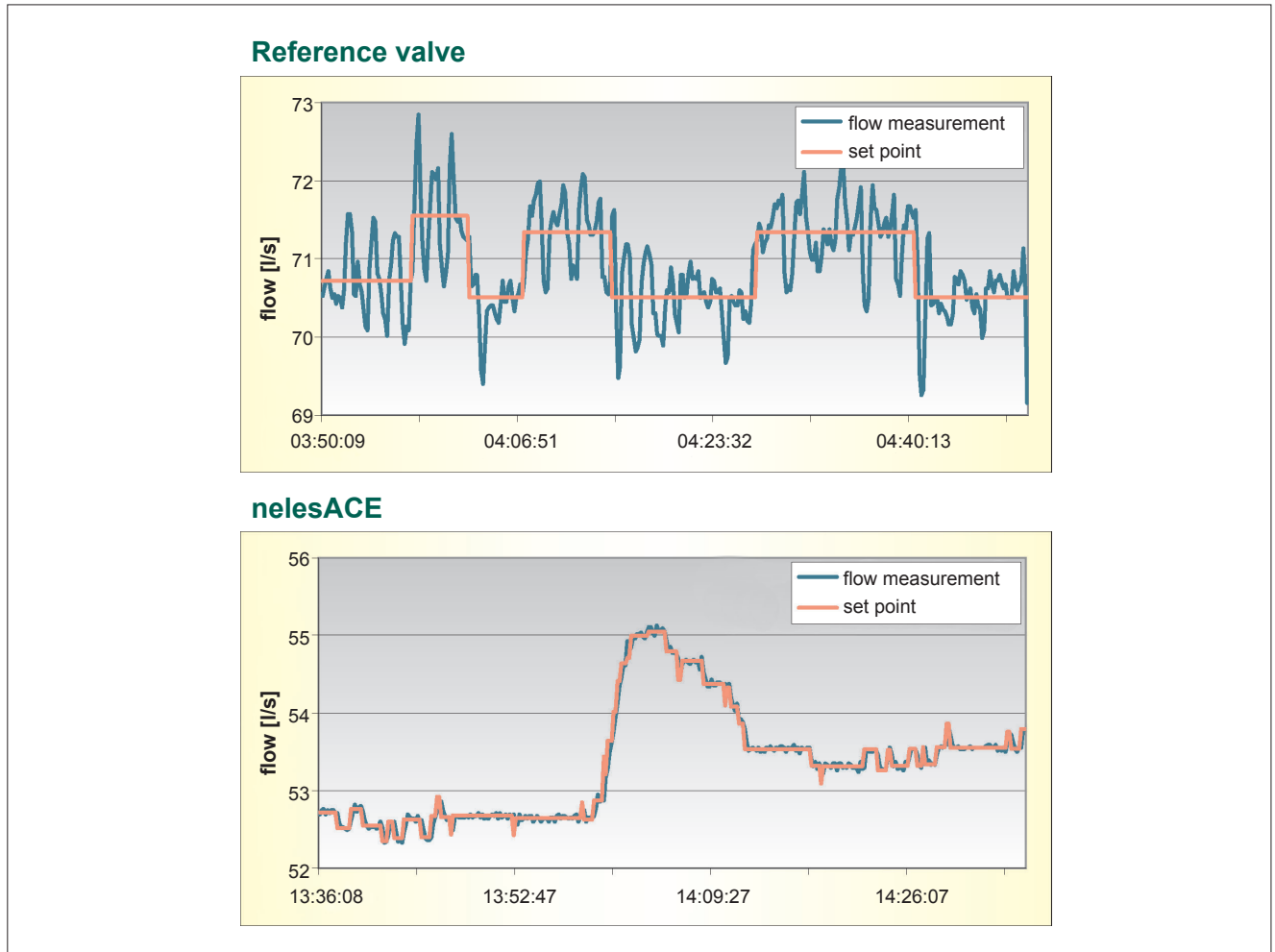


Fig. 2. Stock flow measurements with the nelesACE and the reference valve.

nelesACE can be driven at variable speeds during a grade change. That enables faster and more accurate grade change with a minimum amount of broke. With the nelesACE, the mill saved two minutes per grade change. That means one additional production hour in a month and over 86 000 € annual increase of income!

Basis weight variation in the machine direction is shown in the figure 3. The upper one is with previous basis weight control solution and the lower one is with the nelesACE. The grade is 215 g/m<sup>2</sup> in both cases.

The value “2 sigma” (2  $\sigma$ ) is a measure of the spread in the data series. 2  $\sigma$  in basis weight has decreased by 27 % with the new nelesACE. With lower flow variation the flow set point can also be reduced. This results in direct savings in the consumption of pulp stock.

2  $\sigma$  is also decreased in moisture content, thickness and dry weight, which means more uniform quality of paperboard and better runnability in the machine.

Grade change with previous basis weight valve	7 min
Grade change with nelesACE	5 min
Time saving with nelesACE per grade change	2 min
Changes per day	1 / day
Total time saving	60 min / month
Production	8 tons / hour
Production increase	96 tons / year
Price of paperboard	900 € / ton
Increase of income	86 400 € / year

### Conclusions

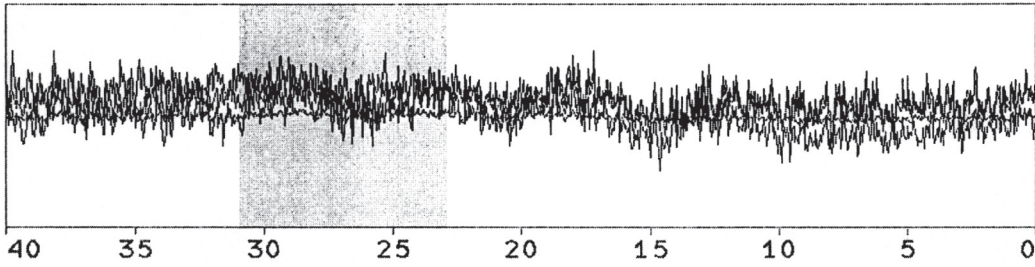
Basis weight control is one of the most critical applications for valves used in the board machine. Almost all sheet properties depend on the basis weight.

Grade changes were faster and more accurate with the nelesACE than with the previous basis weight control solution.

The mill is very satisfied also with the higher paperboard quality. They achieved more stable basis weight due to more accurate and stable stock flow.

## Reference valve

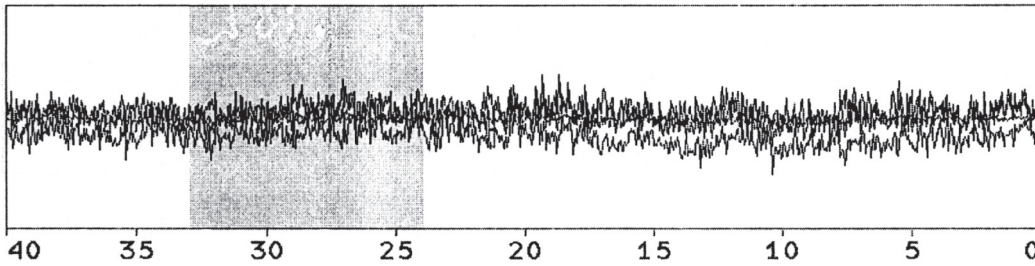
### Trend



Basis weight		Moisture		Thickness		Dry weight	
Max	225.1	Max	17.85	Max	304.3	Max	208.0
Average	220.2	Average	16.69	Average	299.7	Average	203.5
Min	213.4	Min	15.16	Min	292.5	Min	197.8
2-sig	4.36	2-sig	1.06	2-sig	4.95	2-sig	3.65
Slope	0.946	Slope	0.811	Slope	1.048	Slope	
OffSET	10.1	OffSET	1.4	OffSET	-5.0	OffSET	

## nelesACE

### Trend



Basis weight		Moisture		Thickness		Dry weight	
Max	220.2	Max	17.39	Max	300.0	Max	204.2
Average	216.2	Average	16.11	Average	296.4	Average	200.2
Min	211.6	Min	15.05	Min	291.6	Min	195.9
2-sig	3.18	2-sig	0.91	2-sig	3.12	2-sig	2.76
Slope	0.941	Slope	0.802	Slope	1.033	Slope	
OffSET	10.7	OffSET	0.7	OffSET	-1.0	OffSET	

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