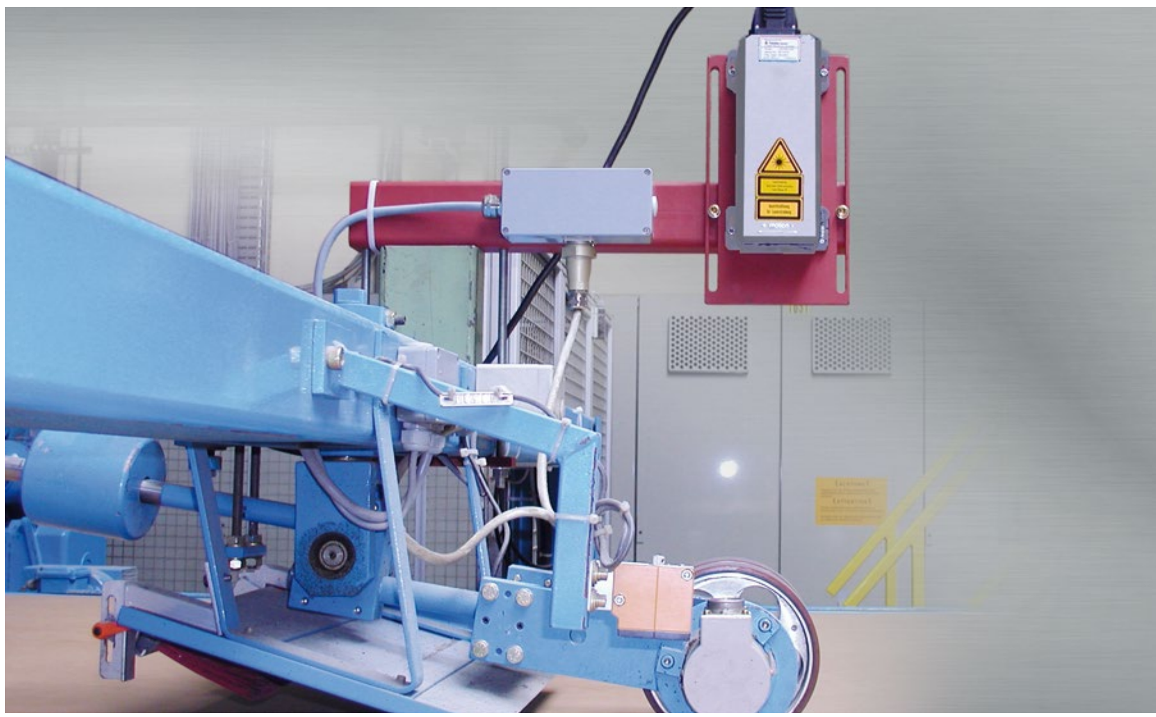


Speed matching in paper mills

Non-contact measuring for continuous paper production

Application note

In order to reduce downtime during splicing operations on continuous coaters, paper mills use highly precise LSV Laser Surface Velocimeters.

1
Paper machine (photo: Metso Paper Inc.)

Integrating a Laser Surface Velocimeter (LSV) in the process control allows unwind velocities to be adapted with a precision of up to ±0,1 %. Reducing the tension during splicing by using an LSV has proven to be a key factor in attaining higher efficiency of the splicing process.

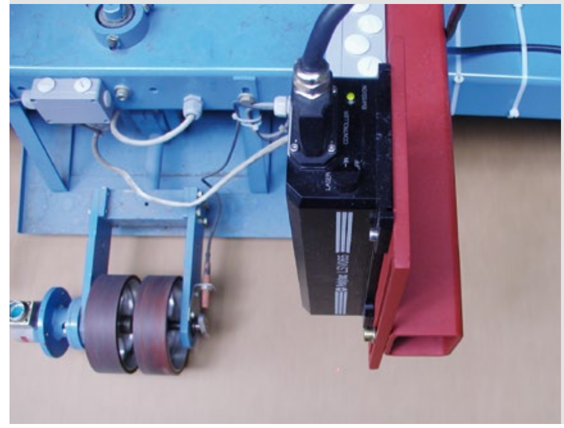
Flying splice

In paper production, a flying splice is a method of switching from one paper roll to another by joining the beginning of one roll to the end of the other roll, thus avoiding machine stoppage. With high speed paper unwinds continually pushing higher speeds, speed matching of the parent reel to the expiring reel has become more critical. At these high speeds, typical methods of calculating speed may not suffice.

Tension control by Polytec LSV

An U.S. based paper mill had a significant number of breaks during splicing operations (average one break per day) on a continuous coater, causing a significant loss of production. The mill believed that a high percentage of the breaks were due to mismatched speeds between the parent reel and the expiring reel, and thus installed a Polytec LSV Laser Surface Velocimeter on the high speed paper unwind (5,200 ft min^{-1}) supplied by Metso Paper.

Since the initial installation, online data from the velocimeter have supported the mill's analysis. A significant reduction in sheet breaks has clearly illustrated that precise matching of speeds during the unwind operation becomes more critical as paper machine speeds increase. Controlling tension during splicing with the use of a Laser Velocimeter has proved to be a key factor in attaining higher efficiency at the unwind station.



2
LSV Laser Sensor Head and encoder wheels measuring the surface speed of paperboard

Control loop integration

The mill's existing control loop was based on measuring the diameter of the parent reel at very slow speeds with an ultrasonic sensor. Final surface speed, at the time of splicing, was calculated based on this initial diameter measurement and the RPM of the reel at speed. However, in practice, the mill found that at higher speeds the actual diameter of the parent reel increased with increasing speed due to centrifugal force. The result was an error in calculated surface speed at the time of splicing.

The LSV verified these errors to be as great as 20 - 30 ft min^{-1}. Although the mill attempted online measurements of real diameter with several sensors, including ultrasound and lasers, they found that the readings were too unstable for controlling the drives. Initially, the LSV was installed as a monitoring device to measure the true surface speed of the parent reel, with the quadrature encoder output integrated into the control system for future use as a possible feedback device. Review of the data after one week of operation showed a noticeable difference between the calculated speed and the true surface speed, as measured by the LSV, demonstrating the correlation between surface speed and the tension variations during splicing. This data enabled the mill to predict when a break would occur due to mismatched speeds.

These results encouraged the mill to integrate the LSV into the control loop as a trim device that finetuned the final speed of the parent reel before splicing. It has utilized this outer feedback loop ever since. The new control loop measures the parent reel diameter at slow speeds and uses this value as the initial input for ramping the drive system roughly to the specified speed. However, once in range, the measurement from the LSV is used to precisely match the parent reel with the expiring reel just before splicing. By integrating the surface speed signal into the control loop, the mill now consistently matches parent reel speeds to within ±5 ft min^{-1} at about 5,000 ft min^{-1} (±0.1 %). The result was a significant reduction in tension variation during the splice, which eliminated breaks due to mismatched speeds.

Project justification

A missed splice can cost a mill from $500 to $8,500. These costs cover various recovery operations and processes, downtime, and equipment. In addition, matching of the reel speeds also minimizes mechanical shock and stress to the machinery resulting from the splicing event, which might reduce maintenance costs in the long run. By analyzing the total cost per missed splice and the number of missed splices related to mismatched speeds or tension, a mill can determine if a justification exists for such an upgrade. The ROI from the installation at the mill discussed in this article was less than one year.

Summary

The LSV Laser Surface Velocimeter directly measures surface speed, thus providing an accurate, repeatable, and reliable method of determining the true surface speed of the parent reel before splicing. The result is elimination of breaks due to mismatched reel speeds. Other applications of LSV technology include:

- Precision length verification at the paper machine and winders
- Differential sheet speed for stretch or draw calculations
- Speed matching of turn-up roll and sheet speed at paper mills
- FFT analysis of velocity variations on sheet, felts, drums, etc.

For more information about Polytec Laser Surface Velocimeters please contact your local Polytec sales/application engineer or visit our web pages **www.velocimeter.us** or **www.velocimeter.co.uk**

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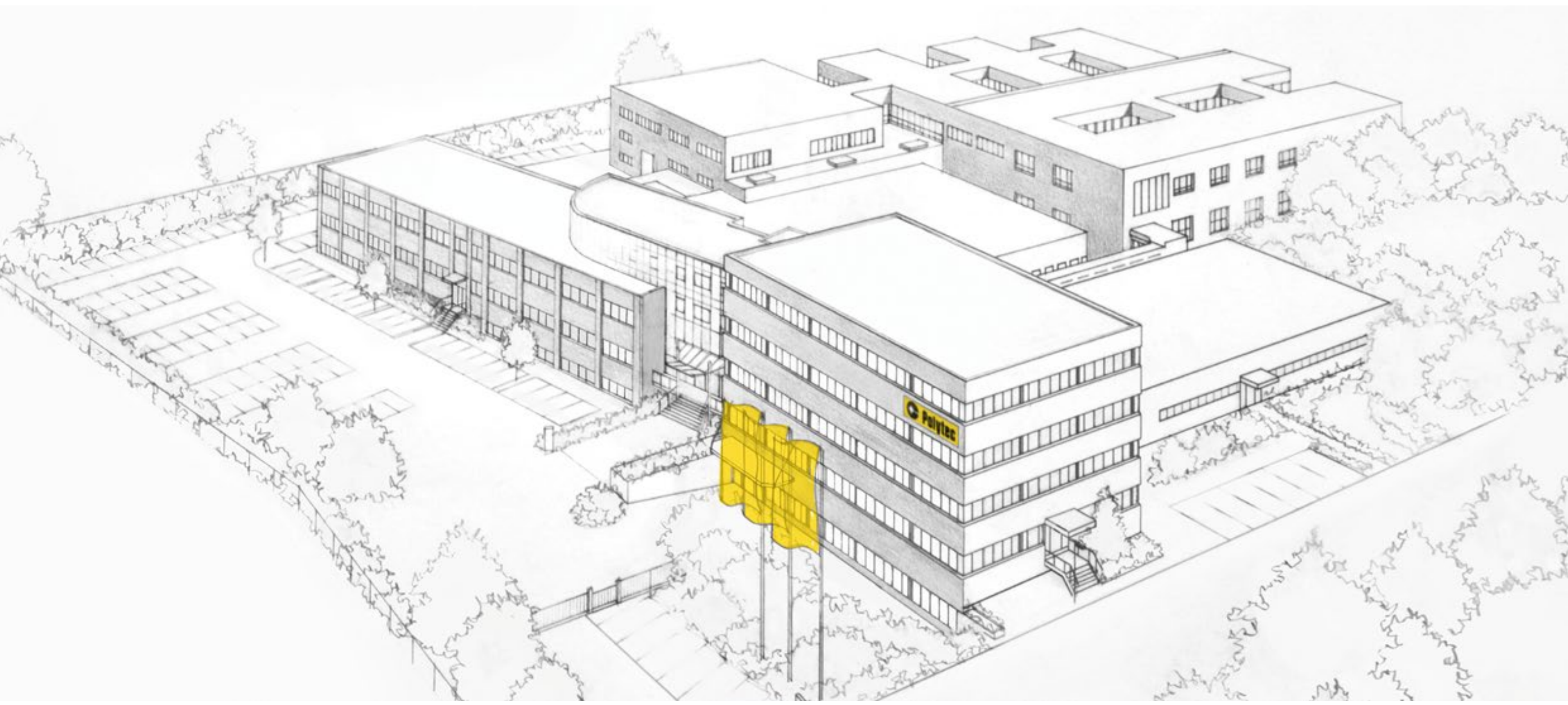

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2018/05 - Technical specifications are subject to change without notice.