THE RETURN ON INVESTMENT OF A ROLLER ALIGNMENT SURVEY

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Roll alignment is at the core of good predictive maintenance in all converting, paper and packaging processes. Ensuring proper roll alignment allows for better production planning and cost-effectiveness, especially in regards to downtime. For many reasons, there is an even greater need for well-aligned rolls. On one hand, precisely aligned rolls are a vital prerequisite for producing product of consistently high quality. On the other hand, consumables such as adhesives and solvents are used up much faster when rolls are misaligned, resulting in tremendous costs for more frequent replacement.

Conventionally, the alignment of rolls has been performed almost exclusively using optical equipment. When measuring with devices such as theodolites, intervisibility between the baseline and the rolls is vital. For using sticks and tape measures for the alignment of rolls, access between the rolls is necessary. Enclosed areas of machines pose a higher problem, thus further compounding issues concerning alignment. In addition to traditional ways of measuring alignment, a great amount of time is required to perform the measurements.

PARALIGN® (Figure 1) is a completely new technology for the alignment of rolls that contains highly accurate ring laser gyroscopes, which have a so-called ‘inertia’. With three gyroscopes (Figure 2) in the same housing, it is possible to make the device “capable of learning”. If a point in Cartesian space is specified as a reference point (i.e. as the ideal point), the device can then specify every other point in the same space with respect to its deviation from the horizontal and vertical planes. (In other words: an “ideal” roller within the machine is identified and used as a reference). It stores and ‘remembers’ its relative position and compares it to each subsequent roller that is being measured. Their relative angular position is memorized, displayed and automatically processed in the software.

Figure 1 – PARALIGN® 3rd Generation

There are no optical limitations (Figure 3) and the results do not rely on any subjective human interpretation. The benefits are unlimited from the standpoint of speed, precision, and simplicity. The time for roll alignment during new installations, rebuilds, and shutdowns are all greatly reduced. The time saved directly translates into money saved by the customer.

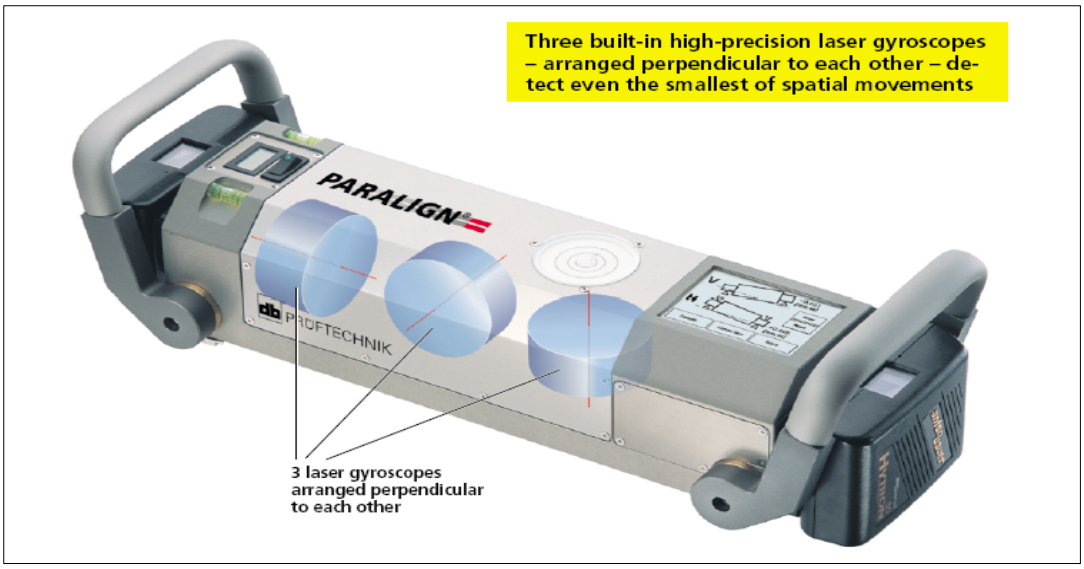

Figure 2 – Ring Laser Gyroscopes

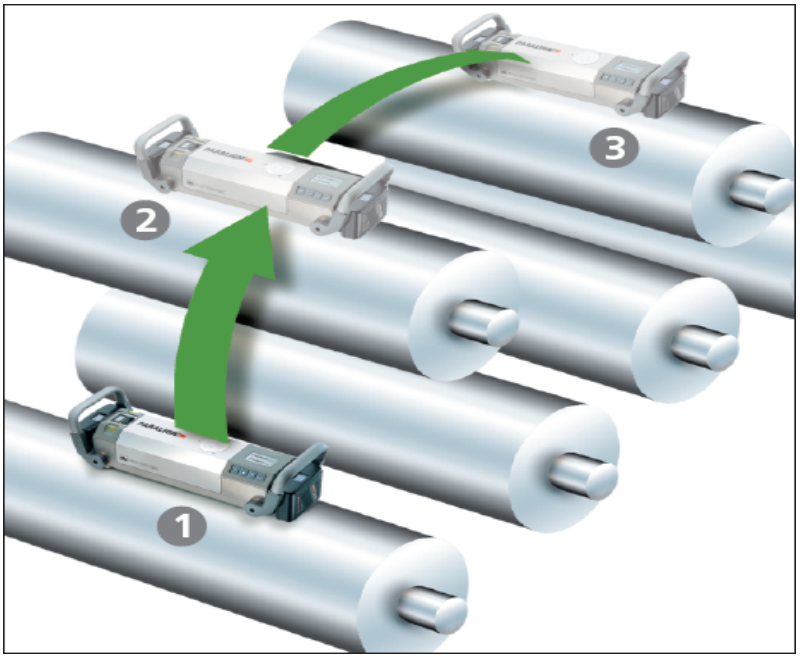

Figure 3 - No Line-of-Sight Measurement

CASE STUDIES

This paper presents two case studies demonstrating the advantages of using the new space-aged technology over conventional methods. The first case relates to a Biaxially Oriented Film production process and the second case focuses on a flexible packaging process.

Biaxially Oriented Film :

Company ABC (name withheld due to confidentiality reasons) is in the business of production of BOPET (Biaxially Oriented PolyEthelene Terephthalate) and BOPP (Biaxially Oriented PolyPropylene). Films such as these have many applications due to their good barrier properties, relative low weight and cost, toughness and ability to form transparent films. Company ABC's primary market was flexible packaging and converting.

In this particular example the customer was facing certain production issues such as poor product quality, namely wrinkles, rippling, and telescoping. Having eliminated other likely causes, misalignment was determined to be the leading reason for the problems. The constraints were that of accessibility to the rolls and time available to stop production.

Figure 4 illustrates a typical casting line. The alignment of rolls was critical in the LSM (Longitudinal Stretching Machine) area which is comprised of two to four sections of highly polished hard chrome plated rolls, ceramic rolls, and rubber rolls.

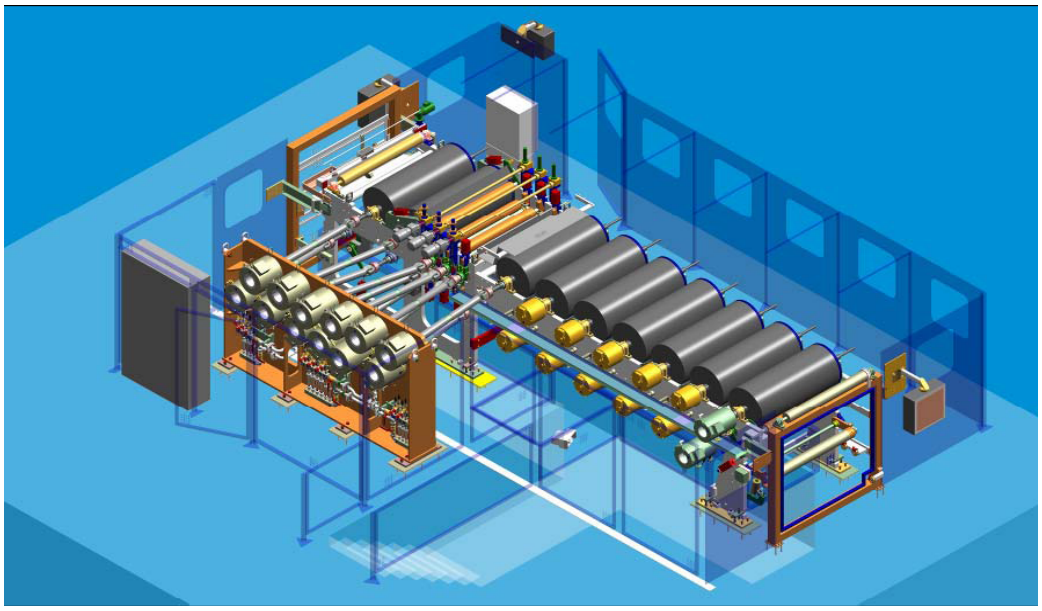

Figure 4: Longitudinal Stretching Machine (LSM)

One important thing to note is that the rolls within the LSM section move at different speeds to facilitate uniform stretching in the machine direction for orienting the film molecules. Therefore any misalignment in rolls only gets magnified in this process and can lead to poor quality in production.

PRUFTECHNIK Service Inc. was called in specifically to present an overall schematic of the machine. Due to market demand, only one day was allocated for maintenance. The whole line was measured by two engineers within an eight hour day and Figure 5 represents the complete results obtained. The green color represents the operator/tenting side and the red represents the drive/machine side. The reference roll chosen by the customer in this situation was the very first entry roll in the LSM Section.

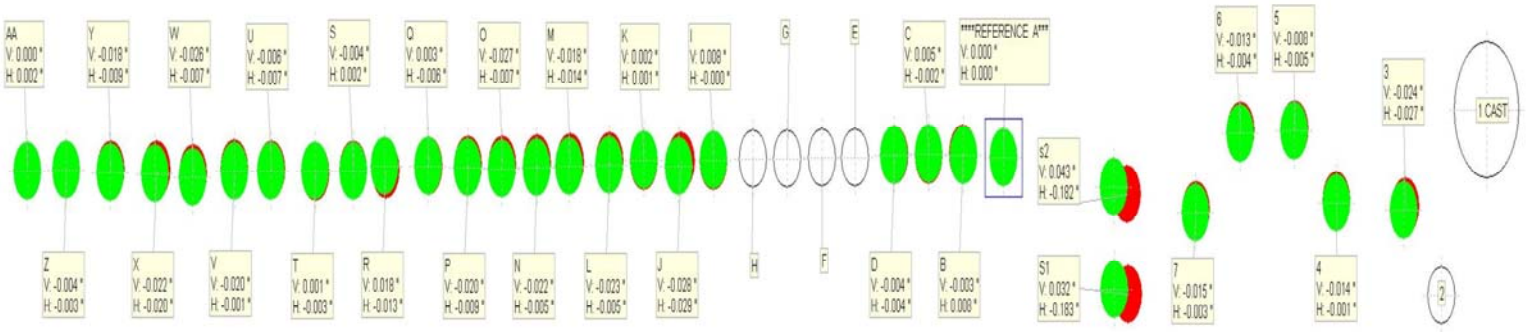

Figure 5 – Complete Results

Figure 6 shows the initial measurements of the LSM section indicating vertical and horizontal offsets as high as 0.027". In a process like this, the target alignment in both planes should be less than 0.010". The customer was having problems in the section of rolls between I and O. This is evident in the data shown because all of the rolls seem to be low on the operator side. This was causing the material to track off to the drive side and eventually leading to downtime and excess energy consumption. The customer was able to correct the rolls within their specified tolerance and the final readings are shown in Figure 7.

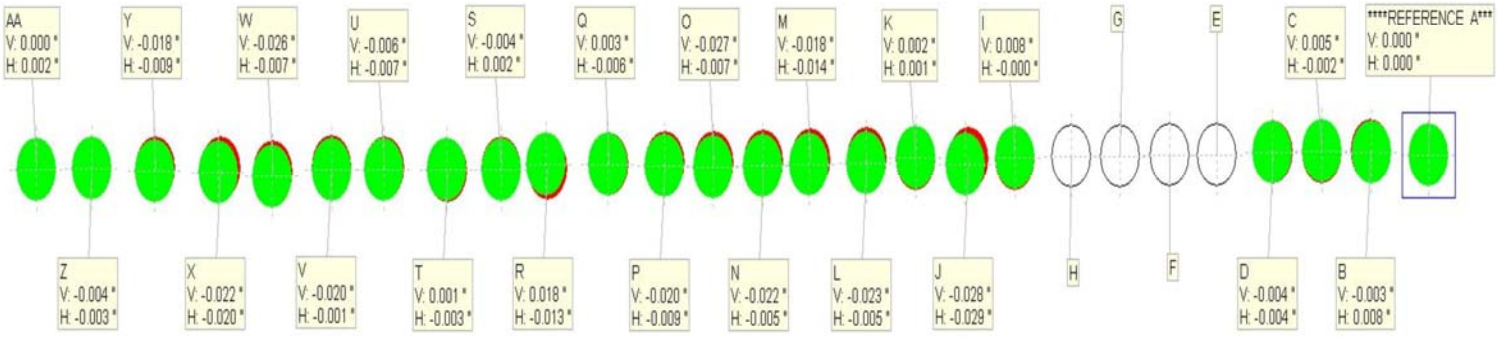

Figure 6: Initial Measurements in LSM Section

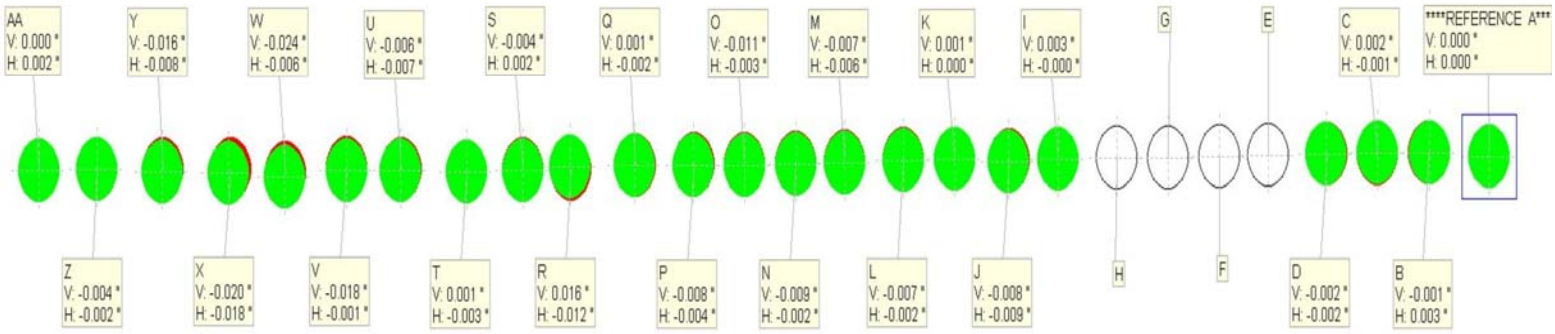

Figure 7: Measurements after making movements and corrections

Flexible Packaging Converter:

Company XYZ is an integrated flexible packaging converter (name withheld due to confidentiality reasons). It operates seven color rotogravure presses and one solvent-less laminator. In each machine, the vast majority of the rollers were enclosed within the printing stations. The lack of line-of-sight made the measurements of the enclosed rollers nearly impossible for conventional methods. For one of the presses, Company XYZ was facing problems with the press registration from the first print station onwards. The web was tracking severely between the 3rd and the 4th station. The production was losing both in increased scrap as well as increased consumption of solvents, inks, doctor blades, etc. Frequent adjustments to insure product quality were adding to the unplanned downtime of the press.

A case study done on Company XYZ that has eight machines operating twenty-four hours a day, 365 days a year. A total of one day's worth of scheduled maintenance is typically required each month per machine. Due to other run-ability issues such as electrical, mechanical, and web break delays, the machine has unplanned downtime.

These unscheduled outages lead to extremely high costs and loss of profit for a company. Some of these costs were determined to greatly reduce by using PRUFTECHNIK Service Inc. to check and correct the roller parallelism of a particular machine.

Capital Required

In order for the alignment measurement to take place, two qualified engineers are required to be onsite. The service costs approximately $7,500 for eight hours of work where 100-250 rolls can be measured. Company XYZ called PRUFTECHNIK engineers for two of its shutdowns in 2007. The first shutdown was simply to get an overall roll alignment schematic of the entire process. The data was analyzed by Company XYZ and a plan of action was decided on. In the second shutdown, rolls were adjusted by millwrights and re-measured. The total capital requirement was $15,000.

Financial Benefit and Return on Investment

An in-house audit of the production process revealed that Company XYZ was theoretically supposed to have a total of 67,800 hours of running time on all of its machines in 2007. Due to unscheduled delays, only about 62,370 hours were actually achieved. This equated to an 8% production loss or $2,700,000 last year. Approximately 53% was a result of web break delays whereas 47% was due to electrical and mechanical delays. Since roll alignment has a direct correlation to web breaking, the financial benefit would be enormous if every machine was properly aligned. For the following reasons, mechanical and electrical issues can also be correlated to poor roll alignment:

1. Stresses placed on the bearings, roll surfaces, and machine frames
2. Machine vibration
3. Frequent control and drive changes/modifications

Below is a table that shows the relationship between the reduction of unplanned downtime and the return on investment that could be attained for a single machine.

Table 1 - Percent of R.O.I. for One Machine at Company XYZ

% Decrease in Unplanned Downtime	Capital Requirement for 2 days of PARALIGN Service	Financial Benefit	Percent Return on Investment
5%	$ 15,000	$ 16,950	13%
10%	$ 15,000	$ 33,900	126%
20%	$ 15,000	$ 67,800	352%
30%	$ 15,000	$ 101,700	578%
40%	$ 15,000	$ 135,600	804%
50%	$ 15,000	$ 169,500	1030%

Since there are many factors involved in any given process, it is difficult to place an exact value on the rate of return by using the space age technology to align rollers. The range above gives an idea of what the financial potential of using the technology is, being that every roll in a process can now be checked regardless of any optical limitations in a very short period of time. PRUFTECHNIK's customers have the potential of experiencing these returns.

Conclusion:

In both cases, the constraints faced by the clients ranged from line of sight issues, lack of time to high requirement of accuracy. Therefore, the no line-of-sight method was the logical choice. After the alignment survey, the necessary corrections were implemented by the maintenance team. Upon recommencing production Company ABC noticed significant improvements in product quality and reductions in wrinkles and ripples. Company XYZ too noticed a meaningful reduction in scrap, time taken to achieve press registration, consumables wastage and measurable progress in product quality. Based on the cost-benefit analysis, Company XYZ is planning on correcting their other machines in the near future.

Since there are many factors involved in any given process, it is difficult to place an exact value on the rate of return by using the new technology to align rollers. The range in Table 1 gives an idea of what the financial potential is, being that every roll in a process can now be checked regardless of any optical limitations in a very short period of time. Customers like ABC and XYZ have the potential of experiencing these returns.