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Condition Monitoring at Norske Skog, Skogn Mill, Norway.

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Condition monitoring at Norske Skog, Skogn in Norway

Presentation by Halfdan Jonsson, Maintenance Manager, Mechanical Department

Halfdan Jonsson with his Icelandic Horses.

Halfdan Jonsson lives in the small coast town of Skogn north of Trondheim in Norway, where Norske Skog is located with one of its paper and pulp mills. Born in Island Halfdan studied as Engineer in the technical university in Island and at Trondheim TIH where he graduated.

Halfdan started at the Skogn mill in 1984 as design engineer and moved to become maintenance engineer in 1986. In 1990 Halfdan was appointed as Maintenance Manager, mechanical department.
In the department there are 68 persons in total where three work with direct condition monitoring and they are supported by three additional engineers.
Halfdan has a long experience from implementing successful condition monitoring programs using on- and off line solutions and combining several condition monitoring techniques.

Norske Skog Skogn presentation of the plant

Norske Skog in Skogn was established in 1961 nearby the cost town of Trondheim by the Nordic sea. Today the company covers:

Employees	520
Production capasity	600.000 tonnes
Operating revenue	2000 mill. NOK

PM1	170,000 tonnes/year	1,150 m/min	6,7 m
PM2	185,000 tonnes/year	1,250 m/min	6,7 m
PM3	245,000 tonnes/year	1,300 m/min	8,5 m

Pulp production is TMP and DIP
Number of refiners: 18
Installed effects: 320 MW
Biofuel 335 GWh/y
Heat recovery 500 GWh/y

Norske Skog is the largest newsprint manufacturer in the world and has factories in China (2) Korea (2), Thailand (1), Australia (3) , Europe (9), South America (2) and 30% share in NorskeCanada(5) and Malaysia (1).

History in Condition Monitoring

The first instruments for Condition Monitoring at Norske Skogn were purchased in 1971. Today we are using instrumentation of the 8th generation. We can see that each generation has given us an opportunity to improve the reliability of the CM program.
In 1973 we got the first portable Shock Pulse analyser 21A from SPM for our section of PM2. In 1987 we made the next major upgrading to an online BMS Bearing Monitoring System and installed permanent shock pulse transducers in the paper machine to enable continuous measurements during normal operation.

A collection of CM instruments since 1974

When selecting the measuring technology we had to consider who was going to carry out the CM. In the eighties we decided to use older experienced Mechanics that new the machines well but not had the same physical strength as younger colleagues. Bearing problems were our major concern so the shock pulse method was selected as it is fast to learn and easy to use.
We got confirmation that we made the right choice of CM program when the result after two years was that we had no unscheduled stops due to bearing damages on PM1. This can be compared with the sister machine PM 2 that had 70 hours unplanned stop time during the same period.
In early nineties we had expanded the program to include 3000 measuring points in the entire factory. This included 300 continuous monitoring points in PM1. There was a sentiment in maintenance that we needed an independent authority to confirm the results we could see also for ourselves. We had a research institute Sintef (linked to the Technical University in Trondheim) evaluate the CM effort up until that time and they concluded that the pay back was 2 years on the investment of the PM program. The report helped us to show the importance of CM and sell the concept also outside the department.

Measuring with Leonova

1987-8 was historic for Norske Skog in Skogn. Two of our Stone rollers broke down within a couple of months. These problems also occurred in Sweden at the same time but unfortunately with injuries of personal as well.
In a relative short period of time (less then a year) the press section was reengineered and rebuilt. The supplier of the press section Valmet installed the section and included a vibration monitoring system called Sensodec. The system was intended to be managed by the operators and was modular in its setup. At that time we did not include the part for full analyses on bearings but it opened a new chapter in the CM development.
The system was never used properly at Skogn and never got the attention it required so we never were able to conclude its merits. Today the system has been further developed by the supplier and is sold as an integrated solution with new paper machines. When purchasing new machines the CM solution therefore is included as an integrated part of the project.
It is our experience that when machines are only partly rebuilt and modernised it is more of a battle to get the resources for modern CM systems. It is hard to get the CM equipment included in the always tight investment budgets. There is no automatic inclusion and happy smiles for CM investments even if the importance of CM is clearly stated in the well written maintenance strategy.
It is quite common that CM is neglected in the over-all strategy for the company when smaller projects and rebuilds are effectuated. We can also see that these investments often are shifted towards more obvious production investments. This constant battle is and has been a challenge for the maintenance organisation in Skogn.

The CM specialists

This is an overview of our investments during the last few years

Year	Area	No. of measuring points	Investment thousand USD	Method
1999	PM1 VP	60	45	Shock Pulse
1999	PM1 PP	67	120	Vibration/Shock Pulse
2000	PM3 VP-PP, Sulzer, DIP	95	200	Vibration/Shock Pulse
2001	PM2 VP-PP	80	120	Vibration
2002	New Leonova & Microlog	Portable	20	Vibration
2003	PM3 Drying Cylinder and Glaser	140	275	Vibration
2004	PM2 Drying cylinder and Glaser	142	275	Vibration
2005	PM1 Drying cylinder	49	70	Shock Pulse Spectrum
2005	PM1-2 Pumps in Short circulation.	8	15	Vibration
	Smaller installations		30	Vibration/Shock Pulse
	Total	640	1190	

The average investment over this period is 170.000 USD per year.

Continues monitoring of Shock Pulse

Organisation of Preventive Maintenance

Condition monitoring is a wide area but if we limit it to vibration technology we have three full time specialists at the moment. They use equipment from two suppliers SPM and SKF and we believe that they complement each other.
They report to a supervisor that also is responsible for the lubrication program and five engineers on shift. This can be called the preventive/predictive group although I don't like to limit that word to this group as that work is a greater task involving many of the staff.
In addition we have two maintenance engineers assigned to support these systems together with the supervisor.
The CM specialists do the manual measurements and are responsible for our online systems. They maintain the hardware and configure the software from the systems to optimise the results. They analyse the results and send reports to respective section responsible for the planning and effectuating the maintenance work.

The management team

Economy

In order to put the maintenance into perspective we calculate that 1% of improvement in availability represents 15-20% of the total maintenance costs. If we improve availability 1% we gain approximately 1 million Dollars in contribution margin. Unplanned stops represent some 2 - 2.5% of available time while paper break and engineering time has the double impact with 5%. This underlines that CM with the correct focus in more then one way is very important to achieve further improvements in efficiency.

I claim that plants that achieve 90 % Overall Equipment Efficiency (OEE) not will be able to sustain these numbers without a substantial ongoing program for Condition Monitoring. To defend and even improve this level in small steps there is no option but to continue the investments in equipment for vibration and bearing analyses.

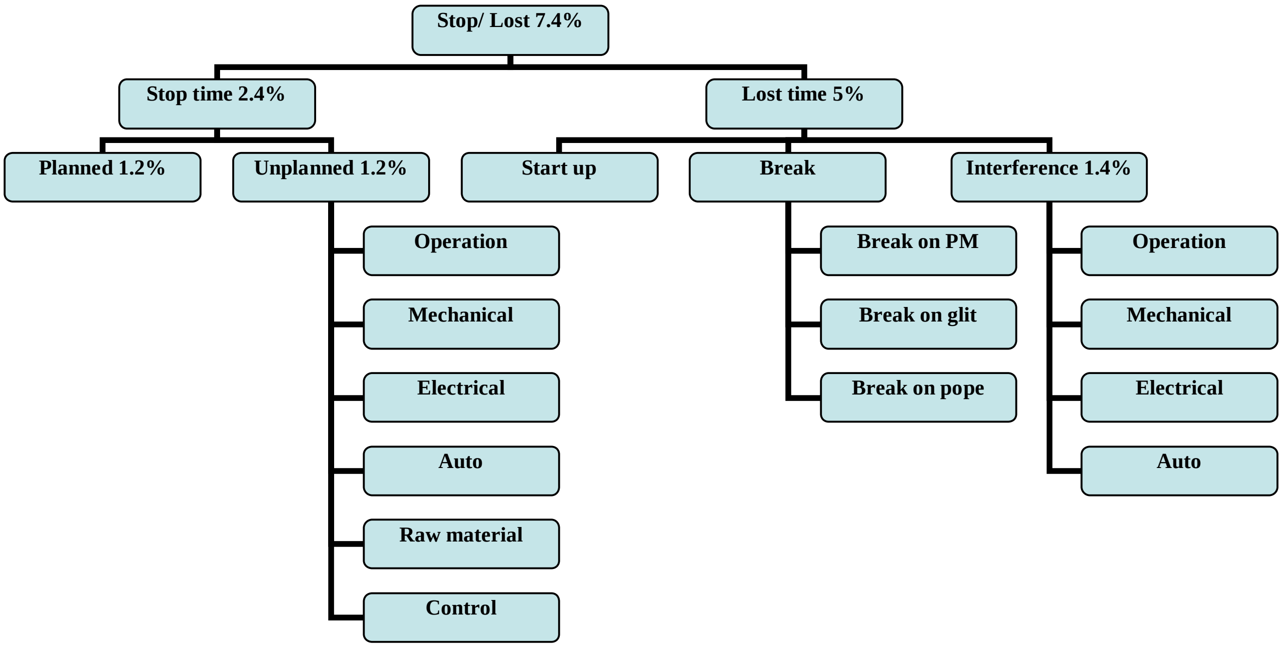
To measure the effect of the CM program we can make a study of last year. In 2004 we had 30 planned bearing replacements on our three paper machines that all contributed to maintaining the OEE. We can estimate that the average saving of a planned as opposed to an unplanned replacement saves at least 4 hours. That represents an increased production of 120 hours or 2880 tons at a value of 850.000 USD. In addition we had two unplanned replacements but no catastrophic failures.

The program also covers auxiliary equipment were we had 17 planned and 7 unplanned stops as well as two catastrophic failures. The contribution of CM varies considerably depending on the application but we know that the catastrophic failures can increase the costs at least 10.000 USD per failure. If we avoid 10 failures as a conservative estimate that gives an annual contribution of 100.000 USD.

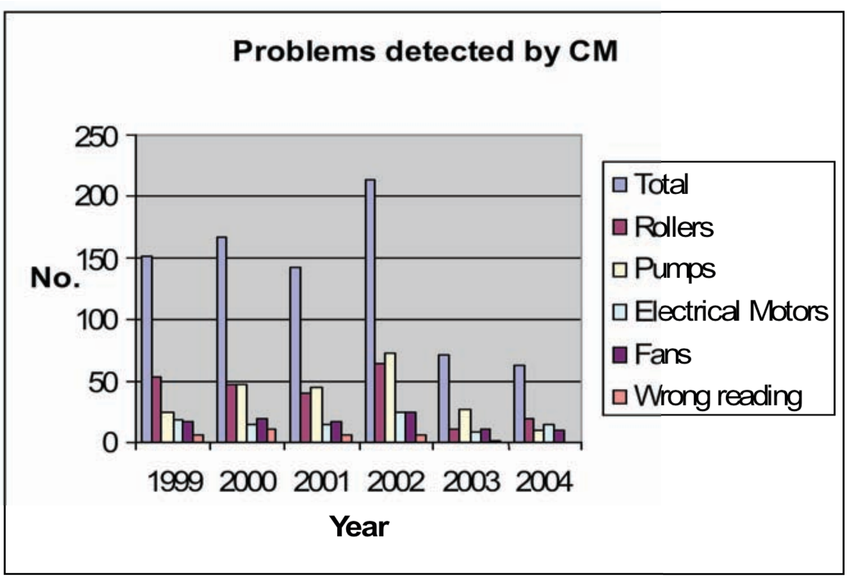
The repair costs for the incidents in 2004 were approx 100.000 USD and are measured regularly and included in the maintenance costs but it is easy to neglect the contribution of the CM program.

Typical OEE figures for a plant like Skogn

In addition to effects on availability (fig.) there are losses in speed and quality.
Actual efficiency varies between 91 – 93%.



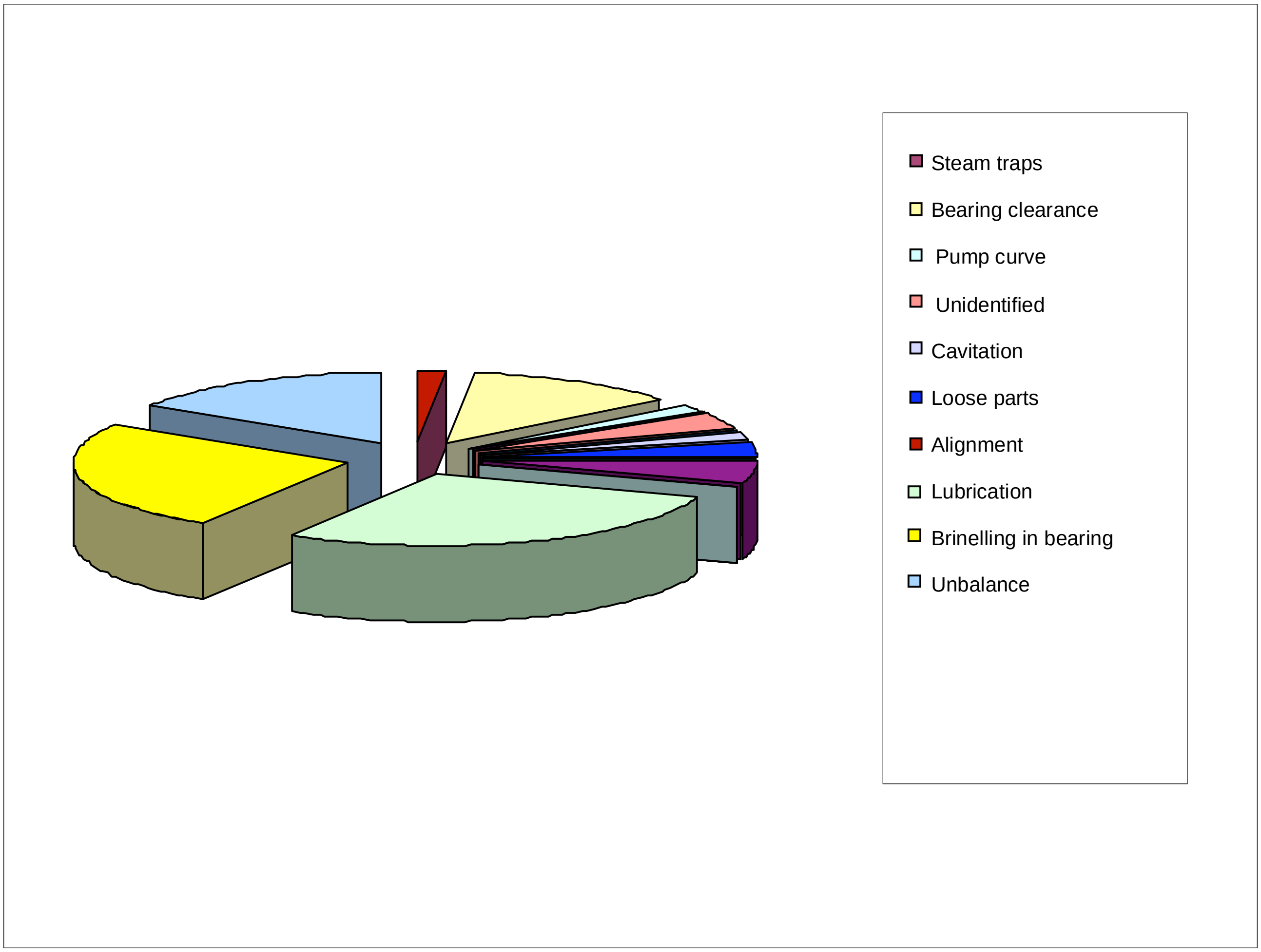
Results from the CM program



By monitoring the problems detected by the CM program we can also follow how effective the program is. Wrong readings are used as a key performance indicator to also focus on the use of the right technology and the right training of personal.
In 2002 we got a considerable drop in the total number of reported incidents that we contribute to the implementation of shock pulse spectrum that better enabled us to also verify the type of damage in a bearing or if we had a disturbance from an other signal source.

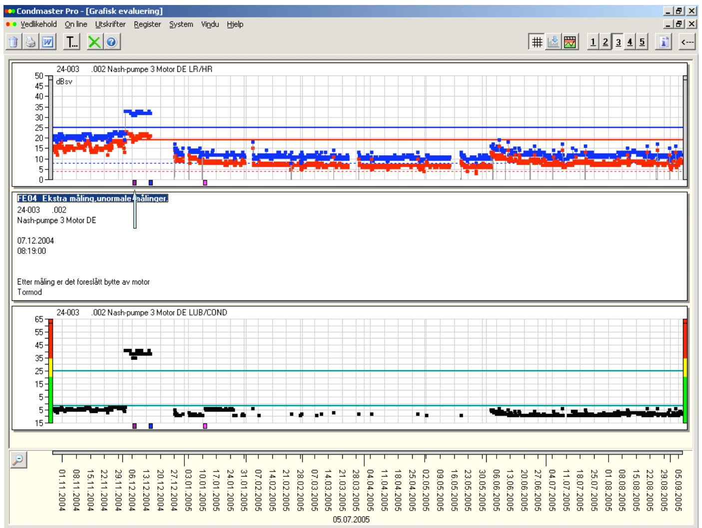
The Root Cause

The incidents are classified to identify the route cause of the problem. This statistics help us to eliminate that the same problems reoccur.

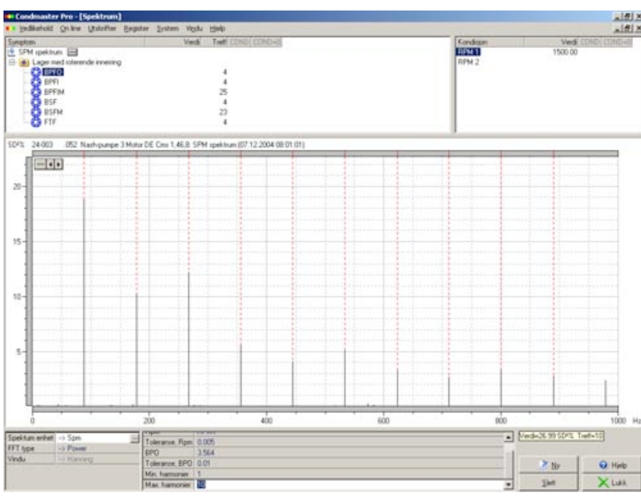


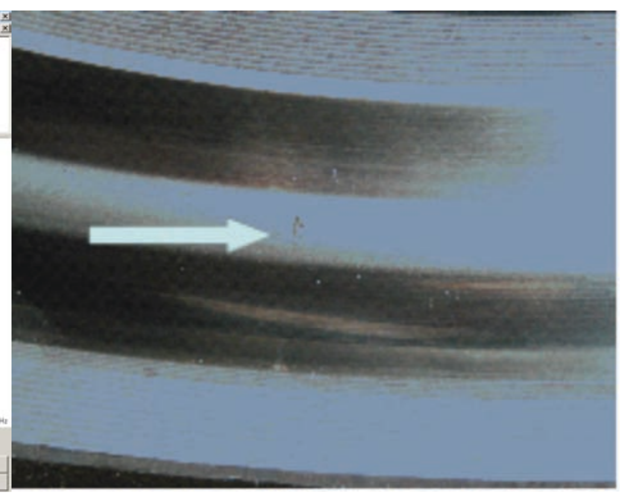
Case story on Nash Pump bearing.

The graph shows an increase of the reading on a Nash Pump and how the reading dropped after the replacement of the bearing. The reading was already high when jumping into the red zone. After the replacement the bearing has been maintained to run with a low shock value.



In this case the Shock pulse spectrum was also taken to verify the damage that had a mach on an outer ring defect that also was verified on inspection, see photo.





Future plans

At Skogn we will put even more effort into CM in the future. We are convinced that we must implement the most advanced measuring technologies to find potential problems in the earliest stages of development. This is essential to avoid any negative effects on the production through unplanned events. Early warning of reduction in component life or reduced performance must be used to plan our resources in an optimum way. In addition to this we must also invest in systems that reduce man hours for using the systems. There is also a demand that personal in production will be able to understand the data from the CM system so operators can act on the information from the system.
It is important to integrate the CM system as a natural part of the process system and configure the system so that no specialists are required to interpret the system.

Quality alignment of machines and an ongoing fight against high vibrations must stand in the centre of our future factory where all personal, operators and maintenance personal all take an active part. Operators and maintenance personal must identify themselves as part of the production process. Their focus must be to optimise the process including the coating, reduce the pulsation and vibrations caused by different sources. The personal must be responsible to handle any type of alarm and make sure the correct information gets to the personal that can eliminate the route cause of the alarm.
To be successful in our effort we have to use good arguments and get a general acceptance for our investments and the profit they bring.
The management team must speak with one voice and we must build better communication lines between operation and maintenance.