Pulsation study with the FiberScan

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Paper machines are complicated mechanical systems which are susceptible to a large number of problems, some of which can affect the quality of the paper which is being produced.

Perspective

Looked at from one perspective, a paper machine can be thought of as a gigantic multi-channel tape recorder. The effects of mechanical vibrations, pulsations, control loop faults, non-uniform consistency of the pulp, together with a number of smaller scale random variations all get written into the paper web. If not kept within bounds, they can affect the efficiency of the manufacturing process as well as the paper quality.

The FiberScan™

The technology partners of Feltest Equipment invested many years in the development of the new measuring instrument FiberScan™ that would replace the well-known 'gamma gauge'. The FiberScan™ has two important advantages on old 'gamma gauge'. First it uses harmless microwave technology, compared to the radioactive backscattering technology with all its downsides on safety, transport and accuracy.

Second, the FiberScan™ can measure with a very high frequency and this countless number of measuring values is used for a mathematical algorithm (FFT) to create a "amplitude-frequency-histogram". By means of this method it is possible to find periodical variations (pulsations) in the forming section. With this instrument it is possible to make pulsation studies very quick and uncomplicated.

To introduce the possibilities of this measuring instrument, we turn to a case study.

At one of the board machines of an Austrian mill an unknown phenomenon regularly occurs. It comes up suddenly and is uncontrollable. It leads to un-sellable paper quality and many sheet breaks, hence much production loss.

As shown in illustration 1, the problem is unstable streaks, meaning variations of mass, moisture and caliper in the paper web. These streaks are fluctuations of high and low basis weight in machine direction and are completely parallel over the full sheet width.

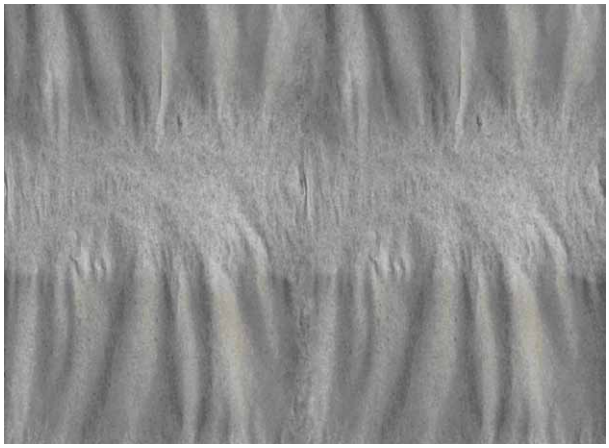

Illustration 1 - unstable streaks

At the darker parts there is a higher basis weight than at the lighter parts. This leads to different paper characteristics in relation to basis weight, thickness andmoisture. The mass and moisture variations in machine direction point towards pulsations; the cause can be in periodically or continuously working machines (e.g., mixing pump: flapping of wings of the traversing wheel, pressure sorter, rotor frequency), raw turbulence, mechanical oscillations, aerial inclusions or foil and/or vacuum oscillations.

After several experiments like air in the approach flow system and in the de-foamer, attempts with the cleaner facility and its surroundings, the vertical sorter, head box, diffuser blocks and jet angles it was still unclear whether the variations were caused by the approach flow system or at the forming section. As there was no defined frequency which could be used to continue the search, the cause of the streaks remained unknown.

Now it was believed that the new high speed measuring technology of the FiberScan™ could shed some light on this problem. The task was to find out if the variations already existed in the approach flow system or if are formed in the forming section by meaning of undesirable foil angles and distances and /or the vacuum system.

Also the question “do the stripes get amplified by the vacuum system” needed to be answered.

When the pulsations appeared, immediately FiberScan™ measurements were carried out. First a pulsation measurement (FFT) and immediately after that the standard drainage measurement, to assure that the conditions during the measurements are known for the pulsation study. Also it can be investigated if the drainage behaviour influences the pulsations.

As shown in illustration 2 it was possible to measure at the positions 1-5. To be as accurate as possible, white-water consistency probes were taken from every possible element A-C which were analysed in the wet lab of the mill.

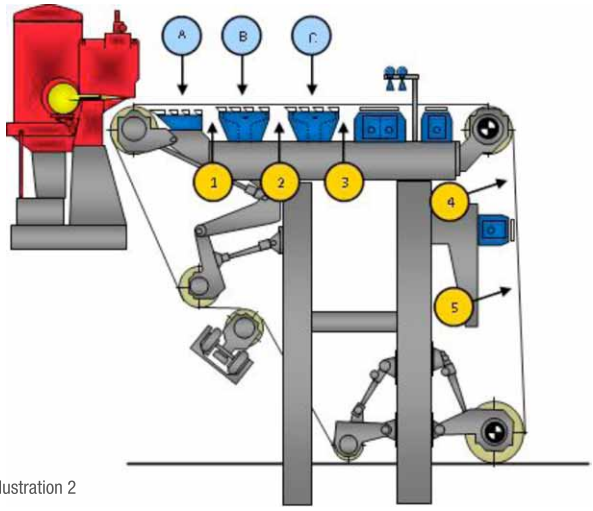

Illustration 2

Result

Already at the first measuring point – immediately after the forming board – a dominant frequency of 26.27 Hz with a high amplitude appeared (illustration 3). This reinforced itself with the help of the Varioline boxes up to an amplitude of more than 150 dB (illustration 4). After the divert roll the amplitude is substantially weaker (illustration 5 and 6, beware of the scale on the Y-axis) but is still clearly obvious.

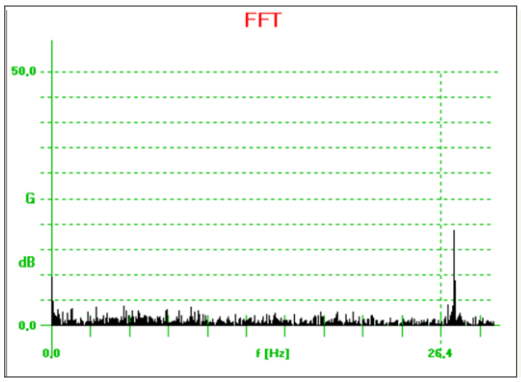

Illustration 3

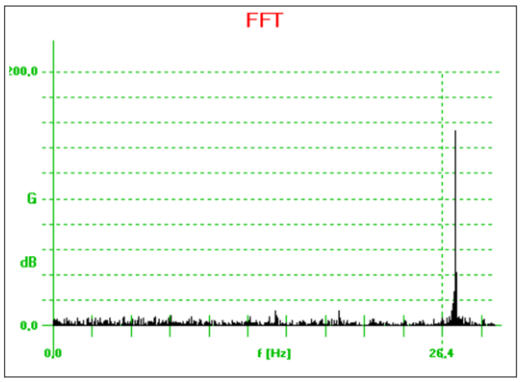

Illustration 4

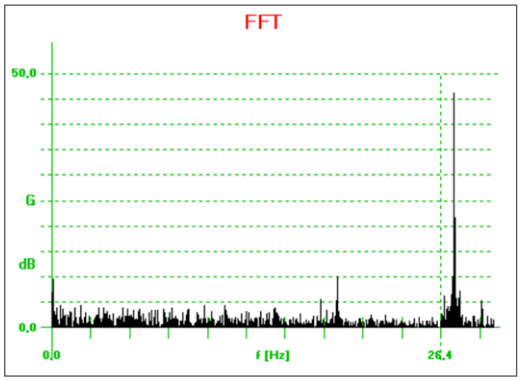

Illustration 5

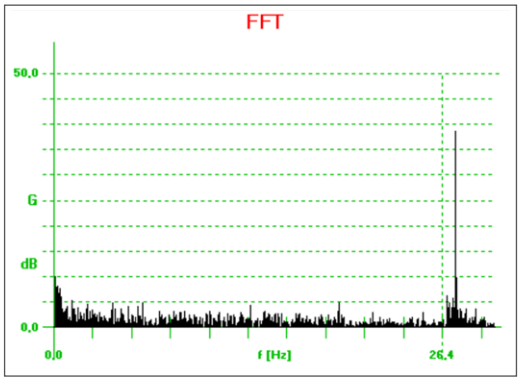

Illustration 6

With help of the FiberScan™ measurements it was possible to define the frequency and to limit the search area for the cause to the approach flow system. Clearly, the question if the vacuum system amplified the streaks could be answered with a yes.

Summary

In the past to find out pulsation frequencies required a large number of diagnostic and measurement tools, time and money. The FiberScan™ is a measuring instrument which allows quick and easy pulsation studies in the forming section. It gives an accurate frequency analysis (FFT) which helps to limit the search for these kinds of defects.