Tracking mass variations
Measure with ODIN – forget barring

Hello, dear papermakers!
Many of us know of it – nobody likes it: barring. Unwelcome irregularities that are sometimes only visible during end processing. As a rule, such abnormalities are the result of mass variations. This is a problem that is frequently only identified in the laboratory because on-machine diagnostic systems are not able to measure with sufficient frequency. Or, to put it more precisely: they are unable to detect MD mass variations in the paper sheet. This is where ODIN comes in – a special measuring fork with an appropriately higher scanning frequency.

I recently participated in a round table discussion of experts on the subject of barring and took copious notes. So today I am drawing from our "in-house" practical experience for your best practice. My colleague Janek Schiefer, who inspects paper machines for TASK on a regular basis, began by showing an illustration which you can see in fig. 1.

Tracking density

This is not a real-life photograph; it is a computer-aided visualisation that helps to illustrate the core problem in the plan view. This is because, when we **speak of "mass variations" we mean a change in density.** In the image these differences are simplified, with the white areas indicating increased density. In order to obtain such findings it is invariably necessary to use the ODIN system, as scanners installed on paper machines are usually only able to measure or scan up to a maximum of 100 Hz – compared to the **measuring fork used with ODIN, which is capable of scanning up to 3,000 Hz!** Let's illustrate these figures by means of an example: A paper machine runs at 1,200 m/min; the distance between MD variations is 150 mm.

Values prove facts

The scanner measures 100 times per second (100 Hz), **ODIN records 3,000 measurements in the same time period:** "In order to detect a fluctuation at all you must measure at least 2.1 times per barring period", Janek emphasises. In our case study we are dealing with 150 mm; **therefore a value must be obtained at least every 70 mm.** The on-line scanning equipment cannot achieve this since its scanner only samples at a distance of 200 mm (corresponding to 100 Hz). By contrast, ODIN collects data every 6.6 mm (3,000 Hz). It is immediately obvious that the frequency of the on-line

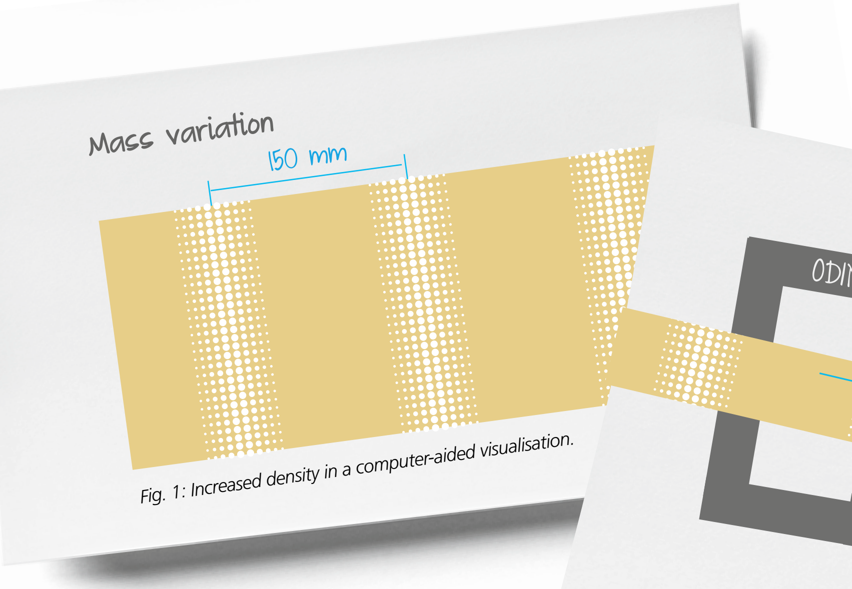

Fig. 1: Increased density in a computer-aided visualisation.

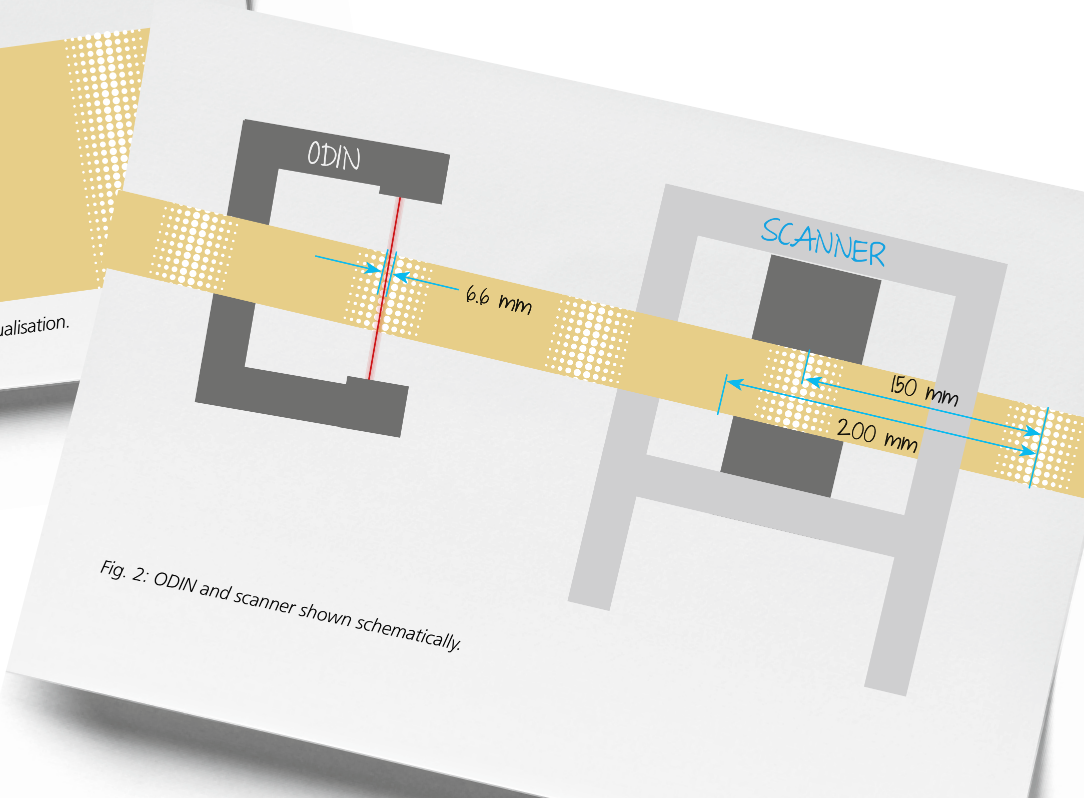

Fig. 2: ODIN and scanner shown schematically.

measuring system is not sufficient, while the ODIN system can be regarded as a guarantor of precise measuring (see fig. 2). **These facts are crucial for papermakers** when customer satisfaction is paramount.

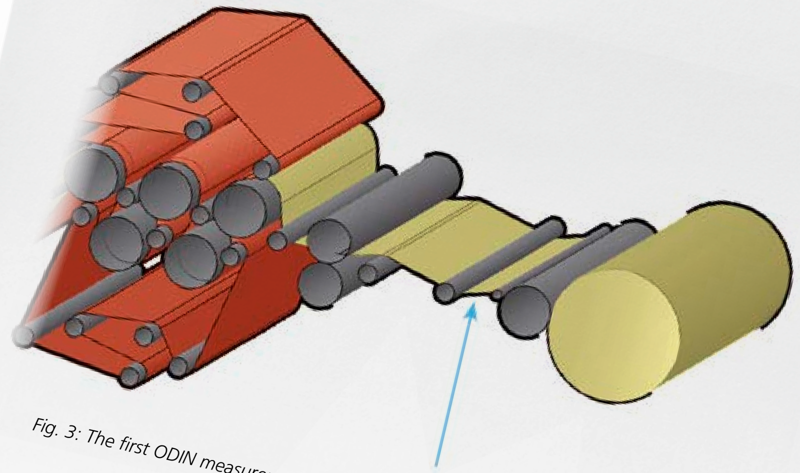

Fig. 3: The first ODIN measurement is always taken directly before the reel.

Suitable for every paper grade

The type of paper you produce, whether graphic, tissue or packaging, is irrelevant for the test – it makes no difference. In general, however, there are a few prerequisites that have to be met **in order to make measuring possible at all.** During the entire process the machine speed must remain constant. Furthermore the paper web must not be too opaque! After all, ODIN transmits a light beam through the paper sheet in order to achieve results – in some cases this might mean that filler material or the density of a particular paper grade may preclude the use of ODIN. **This is, however, not very often the case** – as Janek summarises: "As a rule paper webs of up to 140g/m^2 can be scanned." Below this threshold sheets are nearly always sufficiently translucent to permit successful measurement.

Process logic decides

Let's now take a look at the actual process. As always the following applies: start at the front, finish at the end. At this point, however, we should be clear that, when determining periodic MD mass variations, "front" actually means "end" since **the first measurement must always be carried out just before the reel-up** (see fig. 3). Why do we begin at the end? Because we know for sure that at this point the actual faults already exist and therefore can be detected by measurement. Here several barring frequencies (or just one) can be recorded in order to start searching for the precise location of the origin of the problem. **This is done against the machine direction by a process of elimination.** Simply put each barring has one – or several – sources which must be spatially located. It is exactly this localisation that is an important element of the ODIN measuring process.

Precise and reliable

Once the source of the barring is known the cause can be identified. This is done either by vibration measurement or by recording the speed of a rotating element (such as roll, pump, separator). In our case study fig. 4 shows the result. **At exactly 150mm, the mass densification is present.**

This value corresponds to a barring frequency of 133.33 Hz. Please bear in mind: The diagram **could** also show 2, 3 or more variations. This would mean having to find several sources of faults, about which we will not go into detail here. The key here is finding the **one original** factor that is responsible for the disturbance that we identified at 133.33 Hz. ➔

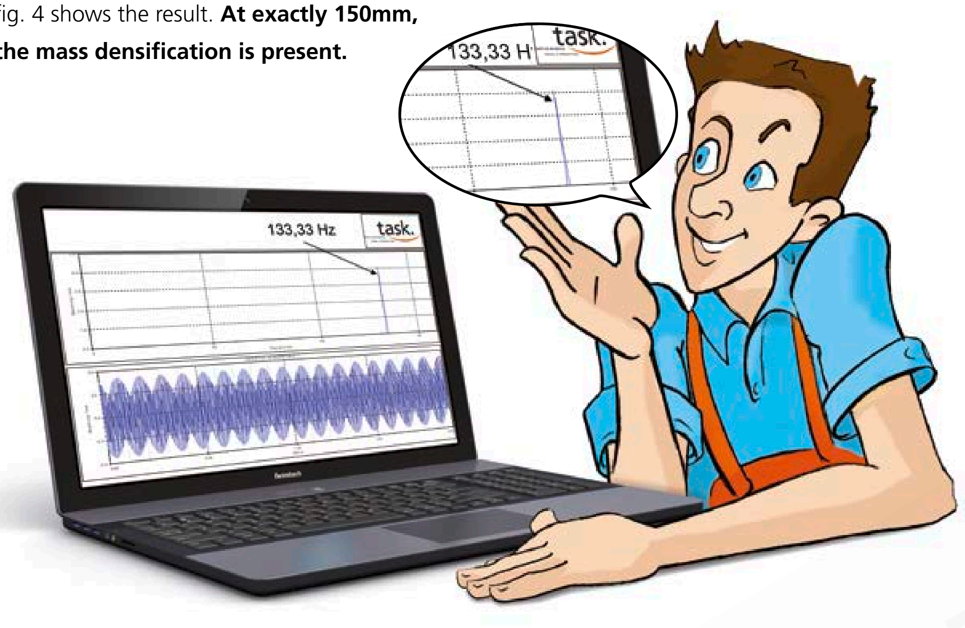

Fig. 4: Clear peak – clear fault, at 133.33 Hz.

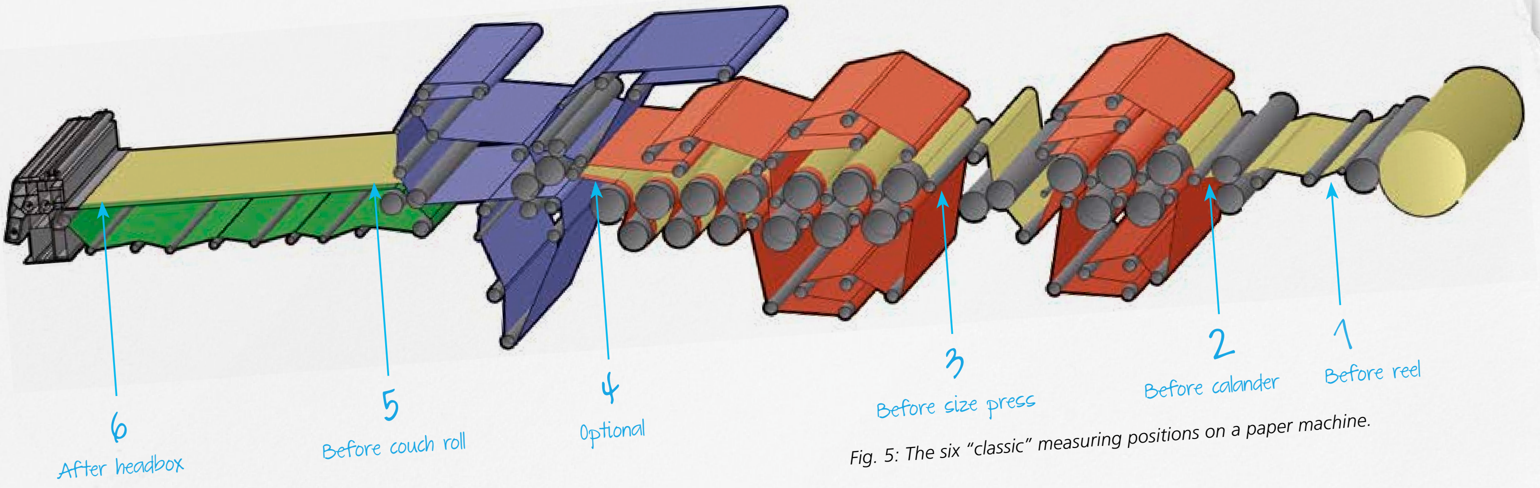

Fig. 5: The six "classic" measuring positions on a paper machine.

Point by point

Let's take a look at the entire paper machine, limited for the purposes of this article to the path from headbox to reel (fig. 5). **The classic measuring points are numbered from one to six.** Let's consider the other five, after having found at position one what the status of the fault was just prior to sheet reel-up. Measuring point number two is before the calender. Should the "133.33 Hz fault" **disappear at this point** we would know: One or more of the calendar rolls are the cause of the barring, which we would then be able to verify by means of vibration measurement. However, since measuring shows the same fault at this point we proceed step by step. At point number three we carry out our measurements **before the size press.**

Everything is relevant

The fourth measurement is taken between the **press and the dryer sections,** though this is optional as it can sometimes be difficult to obtain access here. ODIN's fifth measurement is at the **end of the forming section** (near the couch roll, photo 1). The sixth and last of these "classic" measuring positions is located directly after the headbox. Everything must be looked at, and nothing must be missed; **every single component with direct influence on the paper sheet must be considered as a causal factor** – vacuum pumps for example. In addition, water circulation, filler content, chemistry can have an effect – the list of possible sources of barring is long.

Beyond the machine

In principle, everything concerned with air, stock and vacuum systems requires special attention. As Janek states, **"Rolls rarely act as triggers, pumps much more often".** Also, any sizing process, screening system, suction boxes or forming fabric vibrations come into consideration. And, we have to admit, clothing can also occasionally be a cause. Anyway, back to our Case Study. Our "133.33 Hz problem" was still with us at the forming table – **leading us on to the upstream process.** We needed to look at the stock approach of the machine, for which the same applies as before: If an irregularity is present here already this can still sometimes be preserved all the way to the reel.

Small unit – big effect

In some instances, the paper machine itself can actually be helpful, as several inconsistencies that could be responsible for barring may even **be "ironed out" on the machine**. This term is very fitting – our TASK colleagues regularly discover that different machine parts are able to offset a large part of the barring that occurs. This did not, however, apply to our case, and we were forced to look elsewhere. How, then, to find the fault? Quite simply we **moved the testing to the stock approach unit just behind the last measuring position** – where we had a positive result, which brought the pressure screens into focus. Here, where the screens transport the stock through the pulsation dampeners to the headbox, we found a frequency of 33.33 Hz. **Source of fault identified.** Why? Because the screen has a rotor with 4 blades, and 4 x 33.33 = 133.33 (see photograph 2).

Clarity for all involved

Wear and tear had taken place in this component – quite normal once standard lifetime had been achieved. The result of this advanced wear was greater pressure fluctuations, which the dampener was no longer able to cushion sufficiently. The screen was therefore also responsible for the barring seen in the finished sheet. Now that the cause was known, maintenance personnel could check and repair blades, basket, blade distances and slot widths as necessary. The process of elimination has worked again – with the ODIN measuring fork. A tool, by the way, that was specifically developed for such applications. It is made of high-strength carbon and weighs only two kilos.

A true “lightweight” that allows you to accomplish heavyweight work.

Fast facts

Previously heavy metal devices were the rule – backbreaking work! **It’s good that nowadays everything is high tech,** which applies not only to ODIN but also its various “partners”: The data is transmitted via a measuring amplifier to a telemetry system, and recorded wirelessly by a laptop (see photo 3). The high performance software of the computer then performs a Fast Fourier Transform (FFT) and breaks the time signal of the measurement down into individual frequencies – **the facts are now available.** A complete ODIN measurement including evaluation usually takes a day: ”In the case of particularly complex machine peripherals evaluation of the individual components will of course take longer”, states Janek.

Forward-looking actions

But even if it needs a little patience now and then until certainty is established: In the end it is you, dear customers, who always benefit from the measurement of possible mass variations. This is not only the case when barring is already visible – preventative measures also pay off in the end. Damage to units or machine elements can also be verified before barring occurs, with subsequent prevention of production losses. Through this kind of regular maintenance paper quality is kept at a consistently high level. Furthermore, and once faults have been located, paper technologists have access to important – and valid – information to allow them to efficiently plan repair stoppages.

All the best,

Your Paper Pete

Photo 1: Measuring point 5 before couch roll.

Photo 2: Vertical screen with four-blade rotor.

Photo 3: The ODIN measuring device.