

Extreme Slow-Speed Bearing Condition Monitoring with Ultrasound

Slow-rotating assets are notoriously difficult to diagnose with vibration analysis and other predictive technologies. The low energy output of slow-rotating assets greatly increases the margin for error when detecting defects with vibration analysis.

It is not impossible to detect defects on slow-speed rotating assets with vibration analysis, but it does require highly skilled, experienced, and qualified vibration analysts.

Ultrasound condition monitoring differs by precisely measuring, trending, and analyzing friction and impacting levels – which are always present, regardless of rotational speed.

Take the following case for example; a slow-speed wastewater decanter at a Pulp & Paper Processing Plant.

SDT Ultrasound Solutions' Partnered Ultrasound Team was brought to the facility under suspicion that either the pinion (2.95rpm) or bull gear (0.1rpm) of this asset was operating in a failed state.

Thanks to the 10-minute acquisition time capability of the SDT340, reliability technicians were able to capture at least one full rotation of the asset. (SDT's Recommendation for accurate repeatable data is at least 3 full rotations, but this was a unique circumstance).

Based on the data in the Time Wave Form (Figure 1), and the FFT (Figure 3) below, we suspect there is a broken tooth on this slow-speed assets pinion.

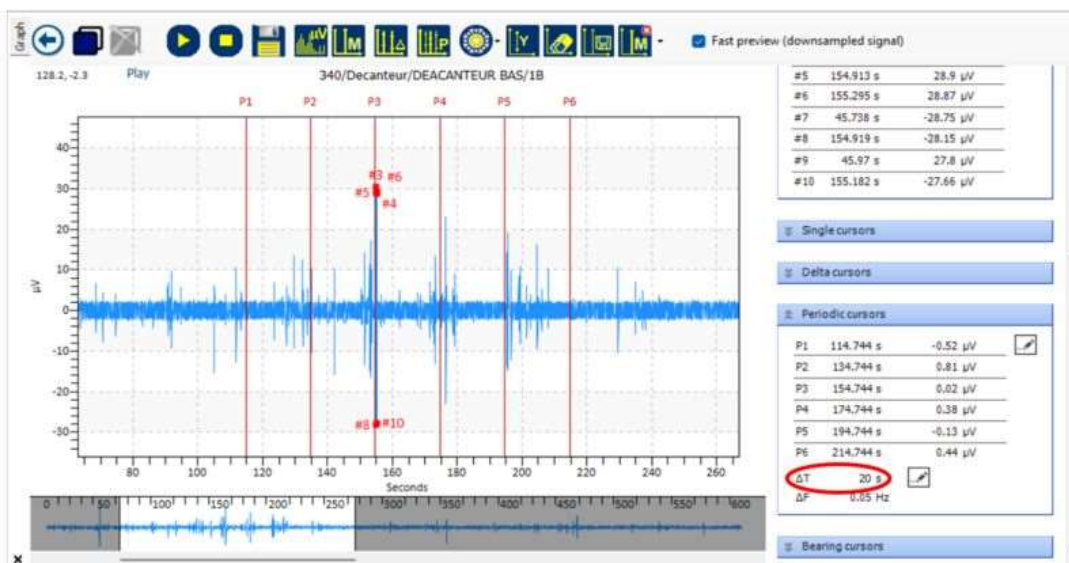


Figure 1: Time Wave Form Recorded using the SDT340, Analyzed in UAS3

The motor powering the wastewater decanter is turning at 1785 RPM. The first reduction through a belt and planetary gearbox is 52.1 to 1. ($1785/52.1=34.26$).

The second reduction is at a ratio of 11.6 to 1. ($34.26/11.6 = 2.95$). Giving us the speed of the pinion.

Cracked and broken teeth generate high levels of ultrasound at 1 x RPM in the time waveform. Figure 2 depicts what a typical time waveform looks like when dealing with a cracked or broken tooth.

Observed in Figure 1, we can see a similar pattern to that in Figure 2. There is a pronounced spike every time the problem tooth tries to mesh with the teeth of the bull gear. The time between impacts corresponds to 1/RPM of the gear with the tooth problem.

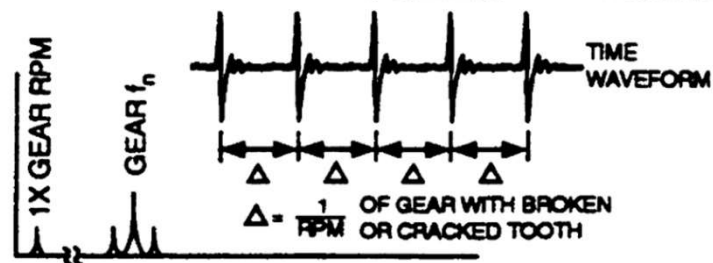


Figure 2: Vibration Analysis Textbook – 1/RPM of Gear with Broken or Cracked Tooth

As observed in the pinion's FFT (Figure 3), it can be seen that high levels of ultrasound above the sound floor are appearing at 1 X RPM indicating a broken tooth on the pinion.

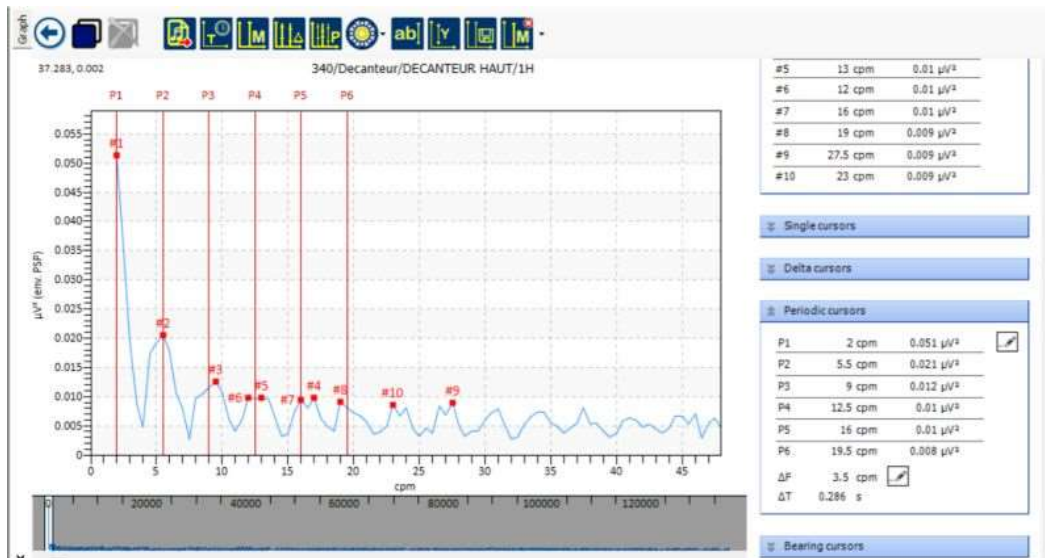


Figure 3: FFT Recorded with SDT340 and Analyzed using UAS3

SDT's Partnered Ultrasound Team was able to accurately diagnose that there was a broken tooth on the 2.95rpm pinion using ultrasound condition monitoring.