



Brüel & Kjær Vibro



Application Note

Robust monitoring strategy for decanter centrifuges



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ABSTRACT

Decanter centrifuges are used extensively in many different industries throughout the world for separating solids and liquids. These machines however are subject to continuous stress, which causes premature failures and unplanned downtime. The condition of these machines is not typically monitored with online equipment, so it was decided to investigate if a condition monitoring strategy was feasible for continuously assessing the health of the machines.

What was required was a field mounted condition monitoring system that could detect developing faults early at all operating conditions and automatically determine the fault severity without the need for a condition monitoring specialist. Brüel & Kjær Vibro's portfolio of condition monitoring solutions includes the equipment, application software and expertise required for the implementation of a condition monitoring solution for decanter centrifuges, both as a retrofit to existing machines in the field and on new machines as an OEM solution.

Machine Design and Operation

Decanter centrifuges are critical machines that are heavily loaded and operate under variable process conditions. These machines are typically maintained at fixed intervals despite the fact that machine component wear is not very predictable under variable load.

By evaluating the maintenance history of a number of machines over a period of time, the following potential failure modes have been determined to be relevant (these are not listed in any particular order):

- Rolling-element bearings faults
- Gearbox faults
- Drive belt faults
- Mechanical looseness
- Unbalance

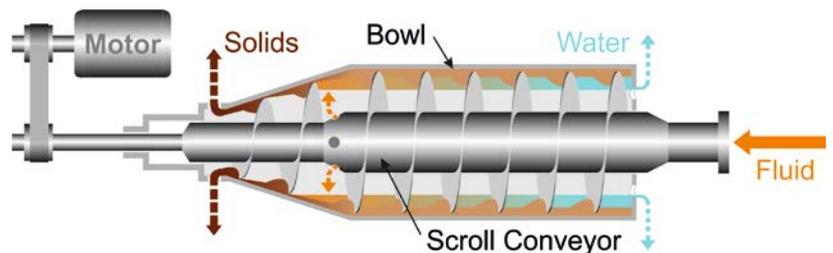


Figure 1. Picture of a typical decanter centrifuge. Separation is done by centrifugal force, which can range between 1000 to 4000 times the normal gravitational force, thus dramatically reducing the settling time needed for separating the solids suspended in the fluid.

Monitoring System – Alarm Management Function

Brüel & Kjær Vibro's 16-channel VDAU-6000 (Vibration Data Acquisition Unit) field monitor was specifically selected for the monitoring task because it was designed for monitoring individual, isolated machines, such as the centrifuge.

Another reason is the unique built-in monitoring expertise functionality that is incorporated in the system. This includes a wide range of specialized measurements, the ability to monitor the machines under varying operating regimes, and an intelligent alarm management system.

The unique alarm management functionality accurately determines



the type and severity of a developing fault by looking at several different measurements, filtering out spurious alarms and reducing the number of alarms for a single fault into a single alarm. This type of functionality is especially important for monitoring machines that have a compact construction like the centrifuge. There are many measurements from several sensors and many of these can go in an alarm state for a single fault and consequently confuse or overload the user with superfluous alarm information. With this system, there is a single alarm for a single fault. The severity is determined by a proprietary algorithm that takes into account many years of Brüel & Kjær Vibro monitoring experience. For the majority of machine faults, the operator gets actionable information for planning maintenance without delay and without having to be a vibration analyst or relying on third party specialist. For more specialized faults, scalar measurements and

time signals can be sent to the Brüel & Kjær Vibro Surveillance and Diagnostic Service Centre for further analysis as a service.

Monitoring System – Sensors

A number of sensors were required for the monitoring strategy, as shown in Figure 2. The bearings are the primary component in the centrifuge to be monitored. In general, the bearings located at each end of the conveyor, do not wear out as fast as the other bearings because of their sturdier construction. When a defect is detected in the bowl or electric motor bearings, the conveyor bearings could be inspected and replaced as necessary.

Monitoring System – Configuration

Conditioned vibration signals and

alarm information are processed in the VDAU-6000 to reduce data and alarms. This data can then be sent to the customer's distributed control system (DCS) or Supervisory control and data acquisition (SCADA) system for display and trending. This allows an operator without specialized vibration analysis skills to interpret the results and take action depending on the severity of the alarm situation. The same conditioned and reduced data may also be sent to the Brüel & Kjær Vibro Surveillance and Diagnostic Service Centre, together with the time signals and imported process parameters, for post-processing analysis and detailed diagnostics by Brüel & Kjær Vibro specialists, if required. By analyzing this data, the Brüel & Kjær Vibro specialists are able to diagnose the type of fault, identify its precise location and estimate the remaining life time of the component under various operating conditions. This enables Brüel & Kjær Vibro to alert the user about potential failures developing and its level of severity.

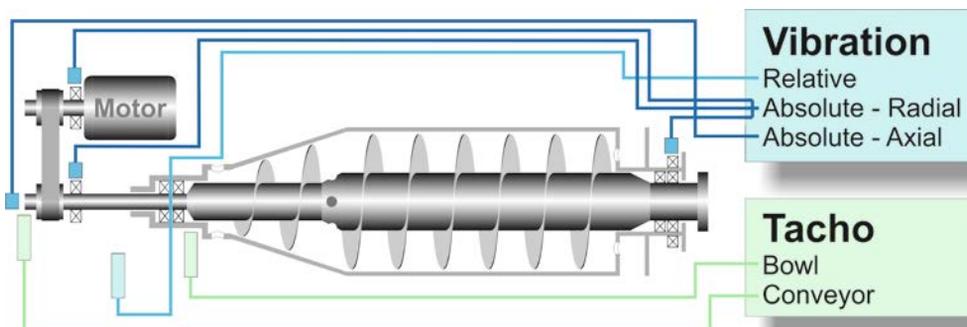


Figure 2. Sensor installation on the decanter centrifuge.



Conclusion and Benefits

Many end-users have realized that the current unplanned downtime for their machines in the field is unacceptable, so a specific condition monitoring strategy for the centrifuge was developed by Brüel & Kjær Vibro to address this issue. The monitoring solution provided by VDAU-6000 offers many benefits to this application:

- **Alarm management function** – The operator will not be flooded by alarms for a single fault, and does not have to be a vibration specialist to read the monitoring data and take action

- **Versatile monitoring techniques** – A wide range of specialized measurements are used for early fault detection such as narrow band bandpass measurements for specific gear and bearing fault frequencies and time signal for root cause analysis. Early, reliable fault detection gives more lead-time for planning maintenance.
- **Advanced diagnostics** – As an option, VibroSuite can be used for detailed remote analysis and severity evaluation of detected faults.
- **Remotely assessable monitoring data server** – As

an option, Brüel & Kjær Vibro specialists at the Surveillance and Diagnostic Service Centre can post-process the data for root cause analysis. This relieves the customer of the burden of having to find specialists to contract

- **Extensive site interfacing capability** – VDAU-6000 uses a number of different data communication protocols, namely Modbus, OPC and HTTP. These industry standards make it easier to connect to a wide range of process, control and display systems, such as the DCS, PLC and SCADA systems. Modbus is particularly useful for importing process parameters from the process control system for correlation purposes
- **Varying operating conditions** – Early fault detection and alarming can be done for individual operating conditions for more reliable monitoring. This means earlier fault detection with less risk for false alarms

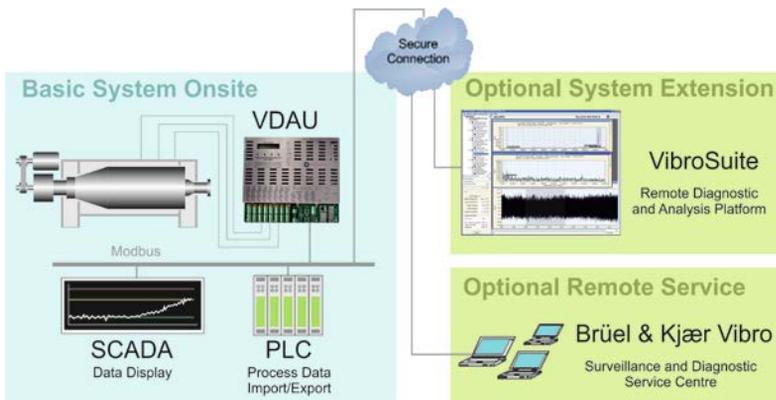


Figure 3. Typical monitoring system topology. VibroSuite, shown on the upper right, is used for remote diagnostics. The Brüel & Kjær Vibro Surveillance and Diagnostic Service Centre, shown on the bottom right, acts as a back-up for performing difficult root cause analysis or diagnostics, as the need arises. The same Service Centre can also provide fault detection, long-term trending of data and reporting for several thousand machines.

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BAN 0078-EN-11
 Date: 16-11-2016