Large UK Food Manufacturer

Exhaust Fan Unbalance

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What components are at fault & fault description

Vibration data collected from the fan Non-Drive End (NDE) began to increase steadily over a period of 6 months until finally breaching the high warning threshold, early analysis of the spectra data showed a dominant peak at 1x running speed in the radial and axial velocity readings, this indicates unbalance in the impeller of an overhung fan. In figure 2 we can see the spectrum for the fan NDE horizontal velocity reading, the spectrum is dominated by a peak at 28.2Hz (1692 RPM), this peak is the unbalance component in that spectrum. Over this period of 6 months, we saw some slight increases in the acceleration readings in the fan bearings indicating that the extra forces acting upon them from the unbalance had not yet damaged the bearings, but the forces were beginning to cause strain. Subjecting bearings to prolonged exposure to the forces generated by unbalance will lead to catastrophic failure of the bearings and other components. Rotating unbalance is defined as the uneven distribution of mass around an axis of rotation, in basic terms this is a heavy or light spot on the fan impeller usually a build-up of product / dirt on the blades or damage to the impeller. As fans are balanced dynamically prior to being installed it was decided to inspect the impeller and clean it using a combination of scrapers and high-pressure jetting, this would return the impeller back to a condition it was prior to being installed & should reduce to the vibration amplitude enough to continue long term operation of the fan without needing a trim balance, and as we can see in the latest reading in figure 1 this proved to to be the case.

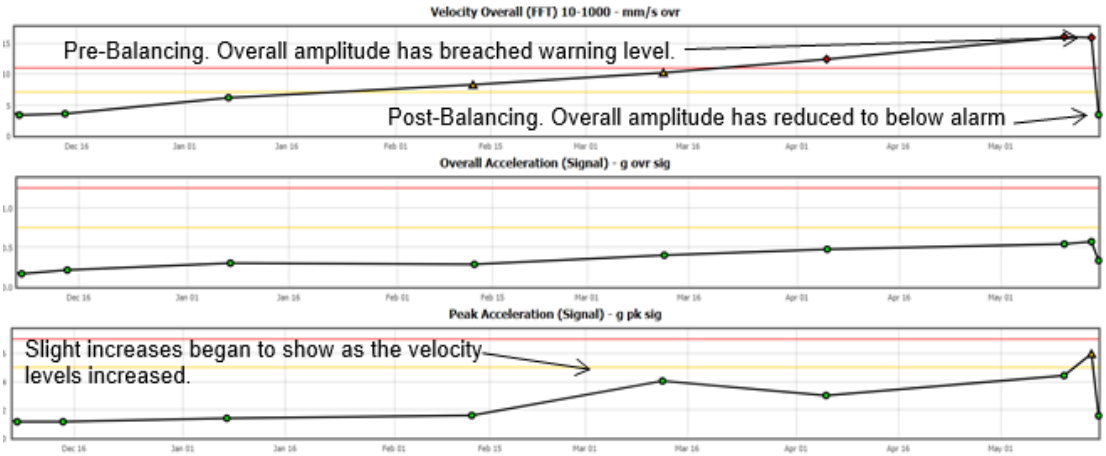

Figure 1: Fan NDE horizontal vibration trend over 6 months

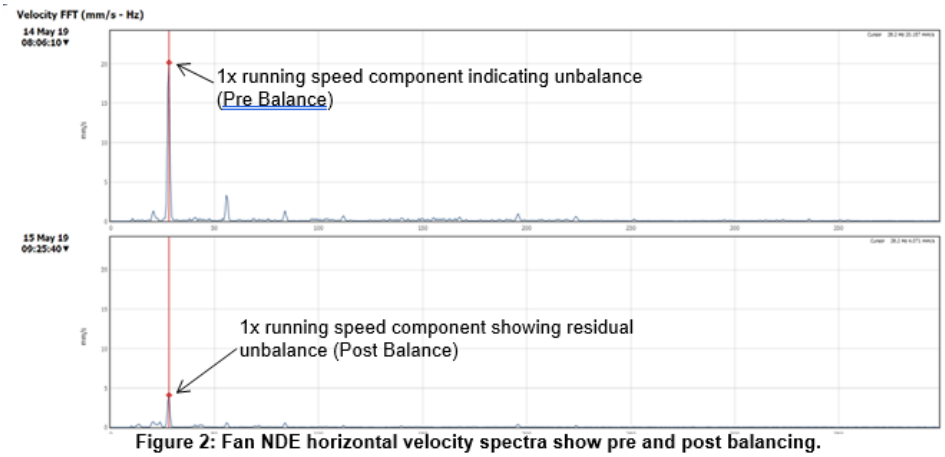

Figure 2: Fan NDE horizontal velocity spectra show pre and post balancing.

	Pre Balance (velocity mm/s)	Post Balance (velocity mm/s)
Motor NDE Horizontal	9.92	2.56
Motor DE Horizontal	12.91	4.20
Fan DE Horizontal	18.35	3.25
Fan NDE Horizontal	15.90	3.39

Table 1: Velocity readings pre and post balance

In the table above, we can see that the all velocity readings were in alarm, following the balancing of the impeller all levels reduced significantly and are below alarm.

What would the short- and long-term impacts be if not diagnosed and repaired?

Due to the increased centrifugal forces generated by the uneven distribution of mass around the impeller the already strong forces acting on the bearing races and rolling elements can become so extreme that the bearing catastrophically fails. When there is catastrophic failure of the fan bearings other components within the drive train can be damaged, if the motor is mounted on the same frame, then there is a high chance that the vibration from the unbalance will begin to influence the motor bearings. The prolonged exposure to the high levels of vibration will cause fixings to become loose and the extra stress acting on welds around the frame will cause them to crack. It is important to resolve the unbalance as early as possible, due to the higher centrifugal forces from the impeller, the shaft is being forced outwards within the bearing effectively forcing it into the outer race, as this is happening the clearances within the bearing are taken up and this can dampen acceleration readings.

What was concluded from the investigation?

The fan impeller was inspected and found to have build-up of product on the impeller; this would have been the main contributing factor to the high vibration readings. The fan was cleaned and then jetted using high- pressure water to remove the build-up of product from the fan blades. Once the impeller was, clean all velocity levels reduced to be below alarm and no trim balancing was required

What are the cost benefits of this fault?

Because this asset is monitored on, a monthly basis we were able to plan in when the work could be carried out, by doing this no unplanned down time and site labour was used which avoided any additional costs. If the asset had catastrophically failed there would have been considerable down time while a replacement fan was sourced and installed, the price of a new fan, motor and frame would have run into tens of thousands with the plant downtime being a six figure cost.