
Andy Pearson

Good Vibrations?

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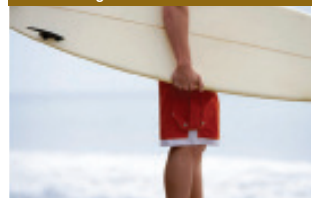
Last month, we thought about noise. Now, it is vibration's turn. Vibration is caused by movement and, with the exception of solid-state Peltier effect semiconductors, all refrigeration systems depend on something moving. It might be the components of the compressor, or a pump or fan, or it could be the turbulent flow of gas or liquid.

However, the key question is whether the resultant vibration fits The Beach Boys' description or causes problems. The problem might be damage to the equipment, or to the adjacent building structure or could appear as an unwelcome noise at a distance from the refrigeration plant.


Brian told the boss he was off to measure some good vibrations.

Equipment damage includes the premature failure of bearings but also can include cracks in pipes, especially at welds. The latter are often associated with resonance: the unfortunate condition where the natural bounciness of part of the system matches the operating speed and so the vibration movement is far higher than would otherwise be expected. Bearings can fail due to overload in operation caused by vibration, or by being subject to external vibration coming into the machine when it is not operating, for example, in a standby compressor located next to a pack that operates much more frequently. For this reason, it is beneficial to ensure that standby equipment gets at least a couple of minutes of running each week, and that shelf spare motors and compressors are turned by hand regularly to ensure that the bearings don't sit on the same spot for months.

If the pipes are resonating and causing stuff to bounce more than it should there are several strategies to reduce the risk of failure. Changing the natural response of the pipe is one way—most commonly by adding more weight to it, which lowers the resonant frequency. Adding brackets can have this effect, too, but sometimes adding a bracket to a part of the system that moves freely, but is in no danger, can make things look better. But it actually just transfers the damaging vibration load to a more susceptible part of the system.

In a few cases it is possible to add a tuned damper—like a pendulum that is designed to respond to the natural frequency and thus absorbs the extra energy. However, these are less effective with high frequencies so are not so beneficial for screw compressors. If the compressor runs at variable speed then the chances of hitting a resonance in the pipework is greatly increased, but most drives enable skip frequencies to be programmed and the effect of these on performance is often negligible.

The effect of vibration depends on the frequency at which the thing vibrates and the distance that it moves. They determine how much energy is in the vibration. Low frequency vibrations can move quite far to carry energy. At higher frequencies the movement can be quite small but still carries a lot of energy. Vibration guys talk about displacement for the amount that the thing moves, velocity for the speed it moves at and acceleration for, well, the acceleration. The three are connected by the frequency of vibration; knowing any one of them and the frequency allows the other two to be calculated.

So what about good vibrations? Knowing the vibration "fingerprint" of your equipment and checking it on a regular basis, say once a month, can help to identify early changes, particularly in the condition of roller bearings. With a bit of care and insider knowledge, that is, knowledge of the size and shape of the bearings inside the machine, it is even possible to spot what type of failure is occurring; whether the rollers are worn or the ballrace is damaged or the cage is damaged. This kind of bearing analysis could potentially save thousands of dollars in machine repair, downtime and lost production. Sounds good to me! ■

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