

Use your senses to monitor enclosed gear drives

Larry Thibault

Periodic inspection of gear boxes is an important step in preventing unexpected shutdowns and production losses. A lot can be learned just by using your basic senses.

The first and easiest sense to use is hearing. Listen while the drive is operating. Everyone associated with plant operations should be encouraged to listen for and report any change in the sound of a gear drive. Each gearbox has a different noise level and set of predominant frequencies. If a change occurs, further investigation is in order.

Sight is another inspection tool to help diagnose a gear drive problem.

Gear teeth exhibit two distinct types of distress caused by two different situations. The most common type of distress is surface deterioration stemming from compressive forces at the tooth mesh. This distress can take the form of pitting, spalling, scoring, ridging, rippling, or other visible signs of deterioration. These signs are not all alike and do not necessarily have a common cause. Knowing their peculiarities can therefore give a hint as to what corrective action should be taken.

For example, pitting generally indicates an overload situation. However, this doesn't always mean more torque than anticipated. It could mean less tooth area is carrying the load, indicating improper housing support or bearing float settings that are incorrect. Or it could mean a variable load whose average value is within the motor rating but which has peaks and valleys substantially exceeding the average. A variable load situation is usually cyclic in nature and its predominant frequency can often lead to the source. The excitation might be from the driven equipment or from the gears themselves.

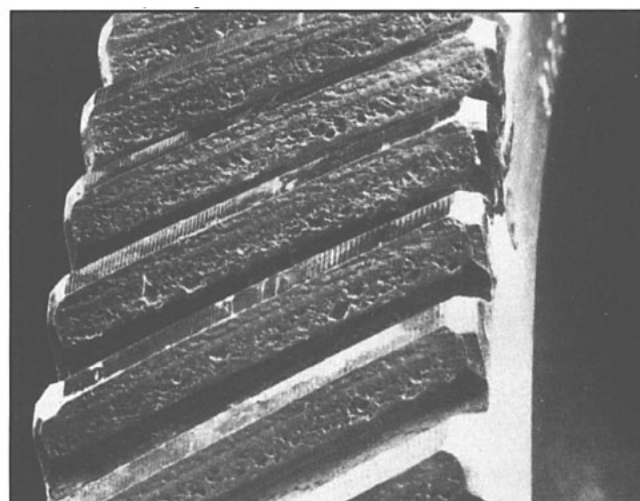
Visual inspections of reduction gears should include the shaft seals. All contact seals will eventually wear and begin to leak. Abrasive atmospheres hasten the wearing process. Seals must then be replaced to prevent the loss of lubricant, and damage to the gears and bearings.

Noncontact seals, with grease purge capabilities, will last for the life of the gearbox. The only maintenance necessary is to periodically purge with fresh grease.

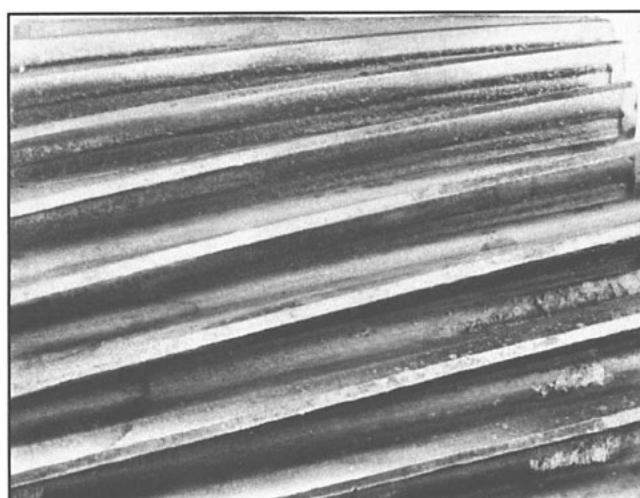
Poor lubrication also leads to gear teeth distress

Inadequate lubrication can often be diagnosed by tell-tale lines up and down the tooth. Discoloration of gearing or bearings almost always indicates lack of lubrication.

1. Advanced spalling



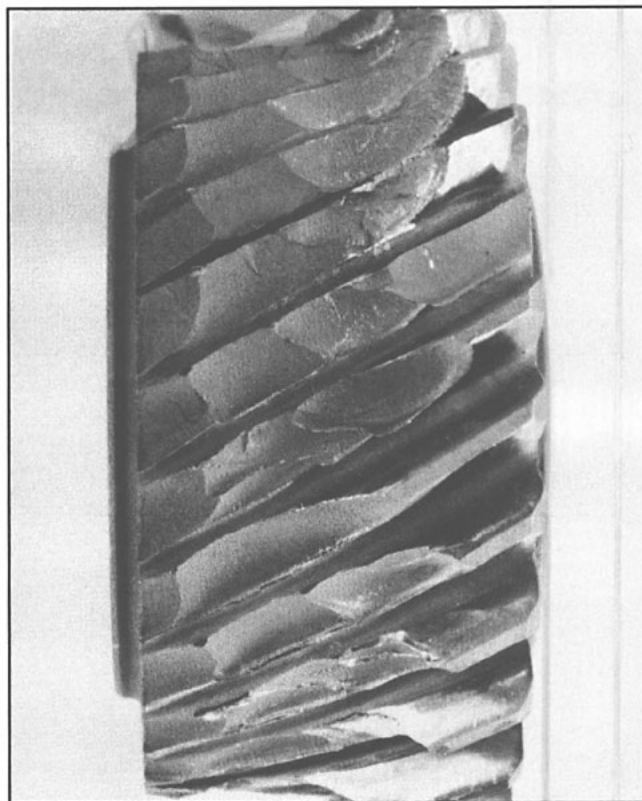
2. Pitting across the gear tooth face



Marginal lubrication can also result in pitting because oil film does not spread the contact (cushion) over a sufficiently wide area. This can result in metal-to-metal contact in the load zone.

Surface-hardened gearing exhibits its own peculiar distress signals, usually associated with a shucking of the hardened layer.

3. Tooth fracture caused by bearing failure



Tooth breakage is a situation almost always associated with an overload. It may be high shock loads which cause portions of a tooth to break out after relatively few cycles. A loose tooth going through the mesh often results in a catastrophic failure.

Sometimes a repeated overload of lower magnitude or light shock will create a fatigue crack. This type of break usually shows semicircular markings which indicate progress of the crack from its origin as a pit, scratch, inclusion, or machining tear mark.

Usually sound and sight are all that is needed to indicate a problem and point the way to its relief. But sometimes sense of feel can be used to detect surface roughness or waviness of gear teeth, which is usually the result of a severe cyclical disturbance in load cycle. A wire edge is sometimes drawn up at the tip of the tooth, which can be felt even though it is difficult to see. Generally, sense of touch only confirms what has been seen.

Gear drives are not the most glamorous pieces of equipment in pulp and paper mills, but they are essential to keeping processing operations up and running. Coupled with an effective maintenance program focusing on support, alignment, lubrication and inspection, these basic techniques will go a long way toward keeping gear drives rolling along in good operating condition. ■

Thibault is manager, Field Services, The Falk Corp., Milwaukee, WI 53201.