Technical topic

Mobil™

Micropitting can lead to macro problems

What is micropitting?

Micropitting is a surface fatigue phenomenon mainly observed in gears, which can also occur in rolling element bearings. Micropitting causes destructive wear that can occur within the first few hours of operation. If left uncontrolled, significant equipment failures may occur. While many factors can contribute to the generation of micropitting, surface roughness and lubricant selection are key factors.Micropitting is not a new phenomenon. It has become much more prominent as gearbox design has evolved with the use of case-hardened or carburized gears. Gearbox technology has achieved significant reduction in the size of gearboxes while increasing power throughput capability. This has required all design components, including the gear oil, to improve their performance capabilities

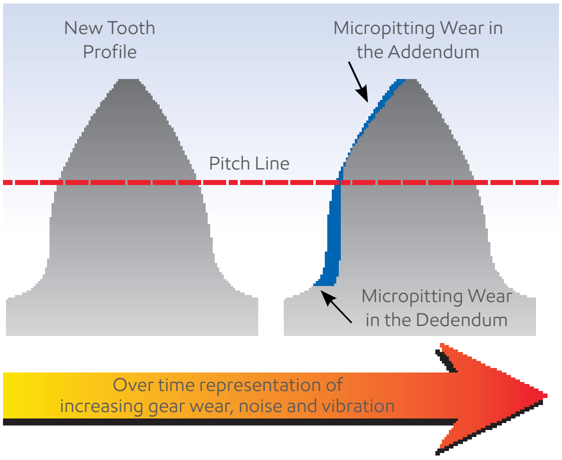

Figure A:
Gear tooth wear progression through micropitting

What problems can micropitting lead to?

Micropitting on gears may lead to problems with gears, bearings, and seals. The main problem caused by micropitting in gears is the wearing of the gear tooth. This wear changes the shape of the gear tooth.

When micropitting wear occurs on gears, the gear tooth shape is altered and this concentrates the load over a smaller area and affects the accuracy of the gears as they move through mesh. As illustrated in Figure A, this can lead to vibrations, noise, misalignment, and an increased chance of fatigue failure. Micropitting can also lead to significant gear- tooth wear called macropitting, as illustrated in Figure B, which shows a series of macropits emanating from a micropitted area of a gear tooth.

Figure B:
Micropitting leading to macropitting

When gears wear, the wear metal becomes a contaminant in the oil. As these particles are circulated in a gearbox, they can become impacted on gear and bearing surfaces. Known as "debris dents," they can alter the surface on bearing rolling elements and races that, in turn, can lead to spalling.

Figure C shows the arrowhead of a spall starting at a debris dent. Through debris denting and subsequent fatigue failures, the metal particles created from micropitting can shorten the life expectancy of the associated bearings used in a gearbox.

Micropitting can lead to macro problems

Based on current bearing-life theory and data developed by ExxonMobil scientists, the hard debris particles generated by micropitting on gear teeth could potentially decrease the life of a bearing by more than 20 percent. Even with filtration, much of the debris denting and related damage is caused before the wear particles can be removed from the oil. In addition, this debris can cause abrasive damage to seals, leading to leaks and contamination ingress.

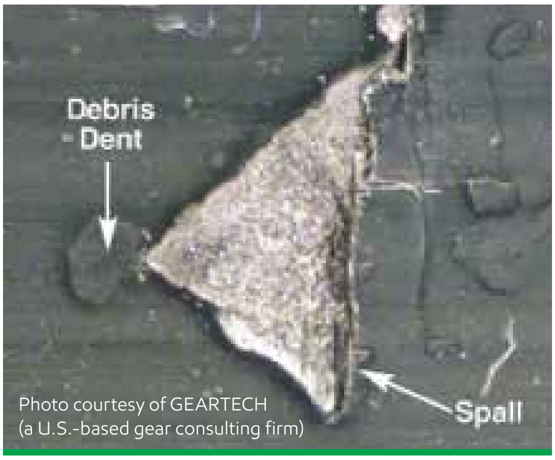

Figure C:
Debris dent leading to macropit

How do I identify micropitting?

Individual micropits are not visible to the unaided eye; however, many micropits normally appear together resulting in a dull matted area.

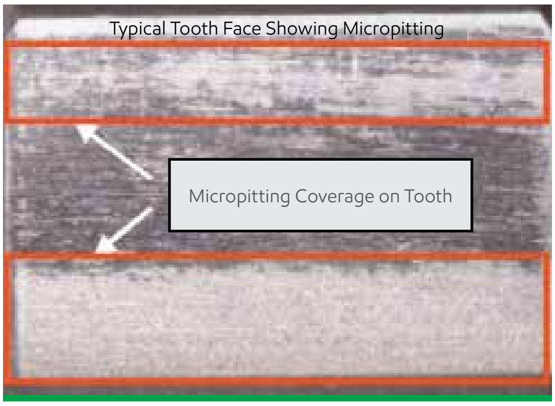

Figure D:
Observation of micropitting

On gear teeth, the tooth surface often must be illuminated from various angles to observe micropitting. It is best to use intense direct lighting rather than diffuse fluorescent lighting. Figure D shows an example of a gear tooth with micropitting.

How can I stop micropitting?

To control micropitting, end users can use gears and bearings with very smooth or "superfinished" surfaces, change equipment operating conditions, or select a lubricant designed to inhibit micropitting. Typically, the use of superfinished gearbox components is reserved for only the most critical of industrial operations. Changing operating conditions is often not a possibility. However, focusing on lube oil viscosity and lubricant formulation is a practical approach.

The selection of the appropriate viscosity grade is the first and most important step in choosing a lubricant for any application. Simply increasing the ISO viscosity grade of the oil is not necessarily preferred. Rather, selecting an oil with a higher viscosity index, lower traction coefficient, or both, should be considered. The higher viscosity index can provide a thicker lubricant film under operating conditions. The lower traction coefficient can help to reduce surface fatigue. Because of the high viscosity index and low traction coefficient, moving to a synthetic gear oil such as Mobil SHC Gear™ Series can help control micropitting.

In addition to viscosity and traction, the additive chemistry in finished lubricants can have a dramatic effect on micropitting performance. For instance, it has been shown that certain additives, especially conventional EP additives, can have a negative effect on micropitting performance. Choosing an oil, such as Mobilgear™ 600 XP Series or Mobil SHC Gear Series, which are specifically designed to give micropitting protection, will reduce the risk of micropitting.

Micropitting is clearly a major concern, especially for modern gear systems. However, it is important to choose a lubricating oil that does not address micropitting at the expense of other properties. The oil must protect against micropitting while still giving good wear and scuffing protection, good water separation, foam control, and corrosion protection, while also maintaining compatibility with common seal materials. Lubricants such as Mobilgear 600 XP Series and Mobil SHC Gear Series have been designed to protect against micropitting while balancing the formulations for long oil life and equipment durability, so users can increase their productivity.