DME3051 Mechanical Design
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Summary: Wear

1. Wear may be defined as the undesirable removal of material from rubbing surfaces. It can cause much surface damage. Wear can be classified into four major categories: abrasive, adhesive, contact-stress fatigue, and corrosive wear.

2. Abrasive wear occurs when hard particles slide or roll under pressure across a surface, or when a hard surface rubs across another surface. An example is a journal-bearing assembly. Surface projections in the harder object tend to scratch or gouge the softer material. Such wear usually is minimized or prevented by hardening the journal so that dirt particles cannot readily cut its surface. A bearing having better embeddability of foreign particles also can be used.

3. Adhesive wear (also called scoring, galling, seizing or scuffing) results when microscopic projections at the sliding interface between two mating parts weld together under very high local pressure and temperature. After welding occurs, sliding forces tear the metal from one or both surfaces. The result is a minute cavity on one surface and a projection on the other that can cause further damage. Adhesive wear is eliminated by preventing metal-to-metal contact. This can be accomplished by using a suitable lubricant.

4. Contact-stress fatigue causes pits to form in the surface of metals subjected to repetitive compressive stresses. Fatigue origins may be at the surface, slightly below the surface, or below the case, depending upon relative motion, geometry, and metallurgical characteristics of the parts involved. Cavitation-pitting fatigue may also result from repetitive collapse of low-pressure cavities in a liquid onto a metal surface.

5. Friction is an important factor in wear, but deals more with the mathematical relationship of the forces between two sliding surfaces. The forces are influenced primarily by the materials, surface configuration, and lubrication.

6. Lubrication, whether by liquid or solid film, is extremely important in preventing wear. The various types of liquid lubrication are: hydrodynamic, hydrostatic, elastohydrodynamic, and boundary (thin-film). Several compounds and polymers make excellent solid-film lubricants.

7. Laboratory examination of worn parts is difficult because one is often limited by lack of knowledge of the lubricants, abrasive materials, temperatures, and service conditions in general. Also, the exact characteristics of the worn metal cannot be determined because the metal is no longer available.

8. Laboratory wear tests usually have limited practical value because the test conditions typically are completely different from the conditions encountered in actual service.