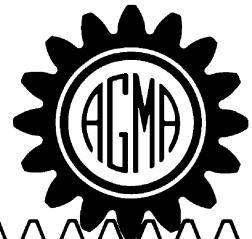


Gear Lubrication as a Reliability Partner

by: M. Holloway, NCH Corporation

American Gear Manufacturers Association



TECHNICAL PAPER

Gear Lubrication as a Reliability Partner

Michael Holloway, NCH Corporation

[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

Performance lubrication is quickly becoming a component of preventive, predictive, proactive and reliability based maintenance programs. Using the best gear lubricant coupled with system condition, monitoring and analysis actually reduces overall operating expenses dramatically. Various techniques such as system conditioning, oil and equipment analysis along with product selection and management are valuable tools, which convert many maintenance departments into reliability centers. These concepts and others are discussed in this informative, hands on discussion which will review best maintenance practices from various companies and review how to implement similar programs.

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Michael Holloway, NCH Corporation

Introduction

Gearboxes are applied in many mechanical systems. They may only be a few in cooling towers or dozens on conveyor lines or hundreds in mixing facilities. For many companies, it can be difficult to accurately identify the factors and conditions that contribute to gearbox failures. The majority of the direct and indirect costs associated with equipment reliability are especially difficult to understand. Some engineering and maintenance teams use software to help track equipment repair costs with the goal of implementing root cause analysis and corrective action plans, while many others engage in reactive maintenance practices and do not track these costs because it would be too difficult.

In order to increase overall reliability, many companies follow a four-step approach to improve plant reliability in general and gearboxes reliability specifically:

- 1) Identify the Failure Sources
- 2) Measure the Financial Impacts
- 3) Analyze Options to Increased Reliability
- 4) Control the Failure Sources

1. Identify Failure Sources

AGMA identifies the following gear failure modes:

- **Wear:** uniform wear associated to metal-to-metal or metal-to-contaminant contact.
- **Surface fatigue:** identified by high wear metal concentration and the formation of cavities.
- **Plastic flow:** surface deformation due to high-contact stresses combine with the rolling and sliding action.
- **Breakage:** partial or whole gear tooth fracture caused by sporadic or continuous overloading.

These failures are typically associated with overtaxing the component or system, improper maintenance practices or incorrect application.

In the book *Root Cause Failure Analysis* by Keith Mobly, several problems associated with gearbox failures and the causes for each problem are discussed (table 1). The lack of lubrication and excessive torsional loading are identified as the most common causes of failure. Excessive torsional loading is typically the result of poor maintenance practices, misuse or improper application. Lack of proper lubrication is directly related to gear oil performance and proper oil change intervals.

Performance gear oil can improve gearbox reliability dramatically and in some case actually reduce the energy demands of the motor. Various failure sources as they relate to gear oil performance have been identified, they are:

Leaking Seals – Seals leak because they become brittle and crack with age, acids from oxidized oil attack them, metal shavings and rust particles cause abrasive wear and foam build-up increases pressure and causes them to rupture. Some plastisizers used in seal material will actually dissolve in synthetic gear oils. Synthetic gear oils are known by many maintenance technicians as the weeping oils because they would leak or “weep” from the gearboxes.

Gear oil leaks result in poor or no lubrication, entry of abrasives and contaminants, the potential for safety and environmental problems and oil loss.

Dry Start Wear – 80 to 85% of gear wear occurs during start-up. Most gear oils drain off during shut down and leave gears unprotected. Dry starts lead to mechanical wear and cold welding, flash rusting and corrosion. Dry starts increase heat and friction on unprotected gears. Increased heat and friction lead to wear and oil breakdown. Metal particles are excellent nucleation sites for internal contaminants such as sludge.