HYDRAULIC FAILURE ANALYSIS

Fluids, Components, and System Effects

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George E. Totten, David K. Wills, and Dierk G. Feldmann, editors

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Foreword

This publication, *Hydraulic Failure Analysis: Fluids, Components, and System Effects*, contains papers presented at the symposium of the same name held in Reno, Nevada, on 5–6 December 1999. The symposium was sponsored by Committee D-2 on Petroleum Products and Lubricants. The symposium co-chairmen were George E. Totten, Union Carbide Corporation, David K. Wills, Sauer-Danfoss, and Dierk G. Feldmann, Technical University Hamburg-Harburg.

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Overview

Problems in hydraulic systems associated with hydraulic fluids have been an important area of investigation for many years. Of equal importance is the mutually dependent interaction of hydraulic fluids with component design, component metallurgy, and the design of the hydraulic system itself. Investigation related to these important areas include the following:

- The effect of fluid chemistry on component failure as the result of oxidation, wear debris, viscosity loss, generation of corrosion by-products, and yellow metal wear.
- Metallurgy of the material, including material pair effects and physical properties.
- The effect of surface finish.
- Modeling wear mechanisms as a function of material pair contact loading, speed, and other factors.
- Dynamic versus static wear.
- Wear mechanisms including rolling contact fatigue, cavitation, lubrication failure, abrasive wear, and others, in addition to combinations of these mechanisms.
- Methods of failure analysis focusing on strategies to identify root causes of failure.
- Hydraulic component design and metallurgy of bearings, gears, slippers, and end-plates.

Since there are relatively few, if any, books published that provide a comprehensive overview of these issues, an International Symposium on Hydraulic Failure Analysis, Fluids, Components and System Effects was held in Reno, Nevada on December 5–6, 1999. The objective of this conference was to address these issues and to provide an insight into new technologies that are being developed to address hydraulic wear and failure problems.

The first paper in the first section of this book: Theory, Mechanism, and Simulation provides a thorough overview of the importance of tribological design. Many hydraulic wear and failure problems could be eliminated if appropriate design principles were employed. The remaining papers in this section, taken together, provide the reader with a thorough overview of fundamental principles involved in hydraulic lubrication and wear and set the stage for the wide range of topics discussed in the remainder of the book.

The second section of the book, Failure Analysis, provides a wide range of discussion on numerous topics related to hydraulic failure analysis. These include: methodologies for root cause analysis to identify hydraulic wear, importance and different applications of wear particle analysis to identify the sources of hydraulic component failure, and a failure catalog of hydraulic pump and rolling element bearing wear provided by the examples given in the papers comprising this section.

The third section of this book, Materials, provides an overview of significant research underway to identify superior materials for hydraulic pump and component design. The areas of research include: effect of material selection on cavitation erosion, surface engineering to improve material properties, and surface texturing.

Hydraulic wear and failure is not limited to hydraulic pumps and motors. The fourth section, Components—Seals, Valves and Rolling Element Bearings, addresses the effects of various wear, selected failure mechanisms of hydraulic seals, and yellow metal wear.

The last section of the book is Fluids. The papers provided in this section discuss the effects of fluid shear stability, additives, and bio-oils on hydraulic pump wear.

The information provided in this book make it an excellent resource for the hydraulic design engineer and maintenance engineer to properly design, maintain, and troubleshoot a hydraulic system. Additionally, the tests and recommendations made by the speakers at this conference will be carefully analyzed within the ASTM D.02N subcommittee to determine their applicability for the development of new ASTM standards and guides.

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