Abstracts

Group 2: Fundamentals

2-0 Advanced Technologies for a Challenging Future

S. Stoll

Minus 15 degrees Celsius, wind speed of 8, and four meter high ocean waves: the external conditions of offshore installations make extreme demands that cannot be reproduced in any lab. The Norwegian research project NODE ART, where offshore outfitters, scientists and hydraulics manufacturers are working together on hydraulics systems and, in particular, on next generation hydraulic cylinders, calls into question all materials, technologies and engineering principles applied so far. This research project, which has already resulted in three phD research projects and numerous other studies, is searching for new ways to considerably increase the service life of large cylinders. The objective is to achieve an, at least, five-year operation period or to cover 20,000 km operation distance for offshore applications, such as production platforms, heave compensation systems on ships or service vessels used in the construction of wind power plants /1/. NODE ART shows that further basic research is essential for the industry to develop new products and solutions based on the results obtained.

2-1 Friction and Wear of Some Selected Polymetric Materials for Conformal Tribopairs Under Boundary Lubrication Conditions

D. Nilsson, B. Prakash

This work is aimed at investigating the friction and wear performance of different polymeric materials having potential for hydraulic system components under lubricated sliding conditions against a steel counter face. A pin-on-disc test configuration was used for the experimental study. The different polymeric materials selected for these studies were commercial polyimides (PI), polyether ether ketone (PEEK) and flouropolymers, some of them were bulk materials whereas others were coatings applied on cast iron substrate. The tribological characteristics of the polymers were compared with a reference grey cast iron. The frictional characteristics were evaluated in both static and dynamic conditions. The results have shown that by using polymeric materials it is possible to reduce breakaway friction by an order of magnitude compared to grey cast iron. However, the breakaway friction increased significantly after the wear tests. The polymeric materials having lowest breakaway friction have shown the highest wear with the exception of the PEEK-PTFE coating which showed low wear. PI with graphite fillers also showed low wear but it resulted in relatively high friction. The carbon fibre reinforced materials resulted in unstable friction as well as higher wear compared to the PI materials with graphite fillers.

2-2 High Speed Friction and Wear Measurements on Guide Rings for Reciprocating Compressors

L. Mazza, A. Trivella, R. Grassi

This paper shows the recent state of development of a Condition-Monitoring-System for hydraulic and transmission fluids. Besides physical parameters the particle contamination is measured to evaluate the fluid and system condition. With an intelligent and automated combination and interpretation of the data, condition definitions and predictions are made available. An intuitive Man-Machine-Interface illustrates results in different levels of complexity.

2-3 The Importance of Viscosity for Hydraulic Fluid Efficiency – What Can We Learn from a Decade of Fluid Development?

M. Alibert, T. Schimmel

Nowadays, fuel economy and improving efficiency of equipment are key parameters and drivers in the development and design of modern equipment. This trend now also becomes important for hydraulic equipment: more efficient pumps and motors, hydraulic hybrids, and high performance hydraulic fluids all contribute to improved efficiency.

In this paper, we will focus on the hydraulic fluid which is often overlooked. However in the last years, the industry has started to recognize the importance of a careful selection of hydraulic fluid. Indeed in the past decade, extensive work based on field tests, pump tests and laboratory studies has been conducted to improve equipment efficiency by using multigrade shear stable oils (HV) in comparison to conventional, monograde (HM) oils.
The purpose of this paper is to provide a review of the results and conclusions published during the last ten years. It will show the enormous influence of hydraulic fluid properties on the efficiency of hydraulic systems.

2-4 Automatic and Detailed Analysis of Customer's Requirements for Rapid Decision Making in Actuation Design

J.-C. Maré

The analysis of customer's requirements is addressed in the case of actuation design. Once introduced the need for early decisioin making in the today's very challenging times, the focus is put on mission profiles that can provide efficient indicators for performance assessment and design comparisons. It is proposed to firstly condition the mission profile and then to extract quantities that are representative of the energy and power needs, the thermal and mechanical fatigue and the control performance in the frequency domain. A particular attention is paid to the consistency of power and control performance requirements then preliminary calculations are proposed to facilitate the early sizing evaluation of control demand for electrohydraulic or power by wire actuators.

2-5 Development of Lightweight Hydraulic Components in Innovative Fibre Composite Design

W. Hufenbach, A. Ulbricht, O. Helms, S. Münter, F. Cichy

The increasing competition in the field of aerospace industry requires the development of innovative lightweight-hydraulic actuators made of fibre reinforced plastics (FRP) to reduce the direct operating costs. The usage of carbon fibre reinforced plastics (CFRP) with its outstanding specific strength and stiffness provide the opportunity to achieve significant weight reductions. Because of their well defined loads the shell-shaped cylinder tube and the piston rod of hydraulic actuators are especially predestined for the application of CFRP. Metallic materials are very well suited for the glands due to the possible space-saving integration of hydraulic connections and sealing grooves as well as the resistance to the hydraulic fluid. The realisation of such an advantageous multi-material-design requires the development of innovative load introduction systems to connect metallic flanges to the CFRP-cylinder tube and the piston rod respectively. Furthermore the different coefficients of thermal expansion (CTE) have to be considered for multi-materials design in order to avoid strength-decreasing residual stresses. A further challenge arises from the integration of a diffusion-resistant coating or liner on the inner side of the CFRP-cylinder tube to provide a diffusion barrier against the hydraulic fluid and a sliding surface for the piston seal.

2-6 Structure-Borne Noise Transmission Behaviour of Hydraulic Hoses

U. Heisel, T. Stehle, V. Slavov

Within a project at the Institute for Machine Tools of the University of Stuttgart numerous investigations were carried out in order to identify the basic mechanisms of the structure-borne noise transmission through high pressure hydraulic hoses. The influence of the different constructive and operational parameters on the noise transmission was shown for longitudinal, bending and torsional excitations. This paper describes also the development of a finite element model of the hydraulic hose. The experimentally gained knowledge about the dynamic behaviour of the hose was used in the development phase of the FE model. To validate this model, the results of the conducted modal analysis can be applied. The basic guidelines of the model verification will be introduced.

2-7 The Hydraulic Buck Converter Exploiting the Load Capacitance

H. Kogler, R. Scheidel

The hydraulic buck converter requires a pressure attenuation device at its output to smoothen the pressure ripples excited by the switching process. For this purpose often gas filled accumulators are used. Such accumulators' installation with low hydraulic impedance is challenging and maintenance causes and extra effort. Furthermore, the nonlinear behavior of the gas spring is often unwanted. A number of applications, especially high force hydraulics, use huge cylinders with a correspondingly high fluid volume which may have sufficient capacitance for pressure attenuation. Additionally, a phase shifted operation of several parallel hydraulic buck converters reduces the pressure pulsations by increasing the effective switching frequency at the load. This paper investigates such a multi hydraulic buck converter arrangement with a phase shifted operation and with just the cylinder capacitance for pressure attenuation.