Abstracts

Group B: Fluid Power Components – Pumps

B1 Estimating the Reliability of Hydraulic Pumps and Motors under Consideration of Different Loads

A. Romer, B. Bertsche, S. Rohde

The goal of this paper is to present a method to provide quantitative predictions for the reliability of products and parts using given information about failure behavior and about respective loads. The required previous knowledge is accessible either due to previous generations of the product, or it can be generated via analysis experience of the product in the field. The focus of this work is on the concept of a new method in general as well as on the detailed description of the method in the special case of fatigue calculation.

B2 A Model-Based Approach to Optimize the Noise Harmonics of Internal Gear Pumps by Reducing the Pressure Pulsation

K. Hartmann, H.-H. Harms, T. Lang

Regarding hydraulics, the reduction of noise emissions is one of the main topics researchers and manufacturers are working on. Even after many years of experience, this field represents a big challenge, because, on the one hand, the transmission of oscillations from fluid to air is influenced by many components and numerous parameters. Finally, it is the operator's perception that decides which kind of sound has to be regarded as noise. On the other hand, manufacturers are forced to generate quick solutions that focus directly on the customer's benefit. Concerning noise reduction, this is hard to achieve, not just by test rig experiments but even more on a full theoretical basis.
This paper presents a semi-theoretical approach to model the generation, transmission and judgement of sound of an internal gear pump in one special application. A basic principle of this work is the analysis of pump harmonics in the frequency spectra of pressure and sound signals. The aim is to set up the pre-conditions for an optimization process, which allows reducing the machine noise by modifications of the pump affecting the pressure pulsation.

B3 Modeling the Axial Balancing Mechanism of Orbit Annular Hydraulic Machines

F. Grasselli, M. Milani, F. Paltrinieri, A. Sassi

A customized combined methodology, based on both 2D CFD and lumped parameter numerical modeling, useful for simulating the hydraulic behavior of orbit annular machines, has been developed and here presented. More in details, the predictive capabilities of this CAE tool can be applied for the study of both roller and gerotor architectures and considering both pumping and motoring operating mode.
First of all, a in-house developed 2D CFD methodology, based on the integration of the stationary form of the Reynolds equation for the determination of the pressure distribution inside the lateral clearances bounded by the sides of the stator-rotor group and the valve plate, as well as the internal manifold surface, is firstly presented and applied. The same computational procedure has been also involved for the investigation of the leakages through the clearance between the valve plate and the balancing ring.
After that, a lumped and distributed parameter numerical model has been involved for the simulation of a typical orbit roller motor operation. In this case, particular care has been devoted to the modeling of the axial leakage clearances, adopting analytical interpolation functions deducted from the numerical results calculated applying the previously described 2D CFD methodology.
Finally, the whole CAE approach has been validated by means of a comprehensive numerical vs. experimental comparison, obtaining a general good accordance for the overall operating field of this particular type of hydraulic unit.

B4 Research on the Distribution Characteristic of the Double Acting Axial Piston Pump

L. Quan, J. Huang, B. Li, J. Wang

In order to use only one hydraulic pump as two independent power source, to control the differential cylinder with only one pump, the scheme of double acting axial piston pump is put forward. There are two types of valve plate of the new double acting axial piston pump. One is asymmetrical structure with three flowing distributing windows and the other one is symmetrical structure with four flowing distributing windows. In paper, the structure and parameters are deteremined for prototype by digital simulation. And then two prototypes are tested. Although the results of the theoretical analysis are similar, the testing results show that the pressure fluctuation and the noise level of the symmetrical double acting axial piston pump with four flow distributing windows are much lower than the asymmetrical one. The research has laid a theoretical foundation for further promoting the using of the new double acting axial piston pump.

B5 Unsteady Flow through a Valve Plate Restrictor in a Hydraulic Pump/Motor Unit

L. Ericson, J-O. Palmberg

Noise is a well known challenge in hydraulic systems. Hydrostatic machines are among the largest noise contributors in a hydraulic system. The noise from the machine originates from flow pulsations at the discharge and suction ports, as well as pulsations in piston forces and bending moments. This article investigates the dynamic behaviour of unsteady flow through a valve plate in an axial piston pump. The proposed extension of the steady state restrictor equation includes a dynamic internal mass term and a resistance. The results from 1D model are validated with a 3D CFD model. Different valve plates' configurations and pump sizes are easily simulated with the two simulation models. The simulation results show very good comparison with experimental tests. The proposed method is verified with a hydraulic pump application but it can probably also apply for original restrictors too.