Tribotester for evaluating performance of cam/roller systems

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AGENDA

• Introduction
  • Background
  • On the importance of a new rig test
  • Rig specifications

• Rig presentation
  • Overview
  • Applying high loads
  • Oil circuit
  • Friction torque measurement

• First results
• Future
Introduction: background

Application

• Heavy duty diesel engines
• Valve train system
• Cam/Roller/Pin contact
• Performance and environmental reasons
  => higher injection pressures
**Introduction: background**

**PARTNERS:**
- Gnutti Powertrain
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**Camshaft: ”brain” of the engine**

High pressures for performance and environmental considerations => Wear issues to predict
Introduction: background

• Research Goals:
  - **Optimize** conditions to control wear of valve train components with consideration of **economical constraints**.
  - Decision making of **surface combinations** and **conditions**
  - **Software** ready to use by industry
Introduction: background

Experimental

Rolling sliding rig

Metrology

Valve train rig

Comsol Multiphysics 4.1®

Matlab 7.1®

Figure 6.22: Plane displaced on the rough surface

Figure 6.23: Compression of each peak.
Introduction: on the importance of a new rig

• Advantages:
  - No replication of surfaces
  - Topography measurements on site
  - Fast testing of new technical solutions
Introduction: rig specifications

**Function of the rig**

- Rolling contact
- High loads
- Wear measurements
  - Pin/Roller
  - Roller/Cam bearing
- Friction measurement
  - Pin/Roller
  - Roller/Cam bearing
Function of the rig

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Introduction: rig specifications

**Function of the rig**

- Rolling contact
- High loads
- Wear measurements
  - Pin/Roller
  - Roller/Cam bearing
- Friction measurement
  - Pin/Roller (hydrodynamic bearing)
  - Roller/Cam bearing (rolling friction)
- Standard components
Rig presentation: overview
Rig presentation: overview

Rig specification

• Controlled variables
  • Load: max. 15 kN (accuracy 0,25 %)
  • Speed: max. 1500 rpm
  • Oil temperature: max. 110° C
  • Oil pressure: max. 3 bars

• Measured variables:
  • wear
  • Pin Roller friction torque: dual range
  • Rolling friction torque
Rig presentation: overview

Oil temperature

Oil circulation

Rotation speed

Load
Rig presentation: applying high loads
Rig presentation: oil circuit

Precise pressure control

Oil temperature control
+ In line temperature measurement of oil at pin inlet
Rig presentation: friction torque measurement

- Load cell
- Pin/roller torque measurement
- Roller/Pin contact
- Cam bearing
- Oil bath
First results:

- Temperature input
- Oil bath sensor
- Oil at roller outlet
- Cam
- Roller
- Oil at Pin inlet

**Graph:**
- **X-axis:** Time (minutes)
- **Y-axis:** Temperature (°C)
- The graph shows the temperature changes over time for different input sources and locations.
First results: stribeck curves

• Controlled variables
  • Load: 1,5 kN
  • Speed: min: 10 rpm max. 900 rpm
  • Oil: 15W40
  • Oil temperature: 90° C
  • Oil pressure: 1 bar
  • Different configurations of pin/roller
First results: stribeck curves
First results: tribofilm formation

Roller surface

S  Fe  C
O  P  Zn
Conclusion

• **Rig** developed for **cam roller** applications
• **Engine conditions** reached for **Load/Speed/Viscosities/Oil pressure/Oil temperature**
• **Stribeck** behaviours are obtained
• **Discriminating configurations** possible

Future

- Better engine control
- Dynamic testings (accelerations)
- Rolling/Sliding ratio measurements
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Questions