Course: **Energy aspects of tribology**

Points: 4 hp

Time: February 26–28 2013. Ångström Laboratory, Uppsala

Scope: It is well known that by reducing the coefficient of friction in vehicles and various types of machinery, substantial amounts of energy can be saved. We may call this – reducing the production of wasted heat through friction losses – the primary tribological energy gains. These savings are well established, relatively large in many cases, and comparatively easy to measure or estimate. However, the role of tribology in energy saving is so much larger than this. By improving lubricants, lubricating systems, materials, surface topographies and coatings we can also reach secondary tribological energy gains. These include

- Keeping the efficiency of machinery (verkningsgraden) from deteriorating
- Improved wear life and reduced downtime (both in energy production, such as in wind mills and in all sorts of energy consuming machinery)
- New energy efficient designs of machines and components, made possible by better tribological surfaces, better lubricants, etc.
- More energy efficient manufacturing processes,
- and much more.

These roles of tribology in reducing the energy costs, in all phases of the life cycle of materials, from material creation, product manufacturing, transportation, use, to disposal and recycling, are often totally neglected. The energy potentials here are very high in many cases!

The course will present an organised overview over the area, and present selected examples form transportation, industrial processes and power generation.

Objectives: - to understand the concepts of primary and secondary tribological gains.
- to understand the roles of tribology in life cycle considerations
- to understand the roles of tribology in the embodied energy concept
- to be able to discuss and estimate the importance of different energy aspects of tribology in all applications of energy consuming or energy generating machinery
- to be able to propose and motivate suitable tribology based improvements in such applications
- to understand the concepts of primary and secondary tribological gains.
- to understand the roles of tribology in life cycle considerations
- to understand the roles of tribology in the embodied energy concept
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Contents: Introduction: How does it all connect to energy?
Life cycle considerations and embodied energy, in tribology
Primary and secondary energy savings with tribological design
Overview and selected examples from important areas including manufacturing, cars, wind mill power plants, and more.
Nationella forskarskolan i tribologi

Teaching: Lectures and case study workshops in groups. Short presentations of preliminary results from the groups and open discussion during the last day.

Prerequisites: Introduction to tribology or corresponding

Examination: Follow up case studies reports sent in not later than 3 weeks after the week the course was given. The case studies will be collected and distributed to all participants.

Grading: Pass or Fail

Examiner: Prof. Staffan Jacobson, Uppsala University

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Literature: Lecture notes including excerpts from textbooks and selected papers

Location: Ångström Laboratory, Uppsala. Enter through the main entrance and follow the signs.
Energy aspects of tribology

February 26, Lecture Hall: Polhelmssalen

8.15 Welcome and introduction to concepts of tribology and energy. Overview of energy production and use on the national scale. How much is due to tribology? SJ
9.15 Primary tribological energy gains. Basic concepts of reduced friction losses. SJ
10.00 Energy losses and improvement potentials in cars, Peter Andersson, VTT Finland
10.45 Secondary tribological energy gains. Introduction and basic concepts, SJ
11.30 Lunch
12.30 Energy losses in paper mill machines, Peter Andersson, VTT Finland
13.30 Tribological energy aspects in materials production. The concept of embodied energy. How much can we save? UW
14.15 Recent examples of tribological energy gains from Agro oil, Dr Mikael Åstrand
15-17 Case study work shops in groups, first round.
18 Dinner
19-21 Evening activity

February 27, Lecture hall: Polhelmssalen

8.15 Selected examples of secondary tribological energy gains, SJ
9.15 The many roles of tribology in life cycle considerations, ÅK
10.15 Primary energy gains in lubricated contacts – trends and potential, RL
11.30 Lunch
12.30 Case study work shops in groups, second round
15.30 Practical examples; energy losses and possible gains in pumps, and more. PH
16.15 Tribological energy aspects in the metal industry. Examples from steel production, and from cutting and forming of components. MO
18 Dinner

February 28, Lecture hall: Polhelmssalen

8.15 Tribological aspects of energy production; wind mills, water power plants, turbines, etc. SH
9.15 Rolling bearings – can the low loss solution be improved?
10.15 Case studies, final preparation
11.30 Lunch
12.30 Seminar, case study presentations and discussions
15.00 Tribological energy losses – history and outlook
16.00 End of course

Lecturers
SJ: Prof Staffan Jacobson, MO: Prof Mikael Olsson, UW: Prof Urban Wiklund,
PH: Dr Patrik Hollman, ÅK: Doc Åsa Kassman, SH: Sture Hogmark, All representing the Tribomaterials group, Uppsala universitet,
RL: Prof Roland Larsson, LTU
PA: Dr Peter Andersson, VTT Finland