APPLICATION NOTE - STABILITY OF LUBRICANTS FOR COLD ROLLING OIL TECHNOLOGY

Fast stability ranking and influence of emulsion preparation

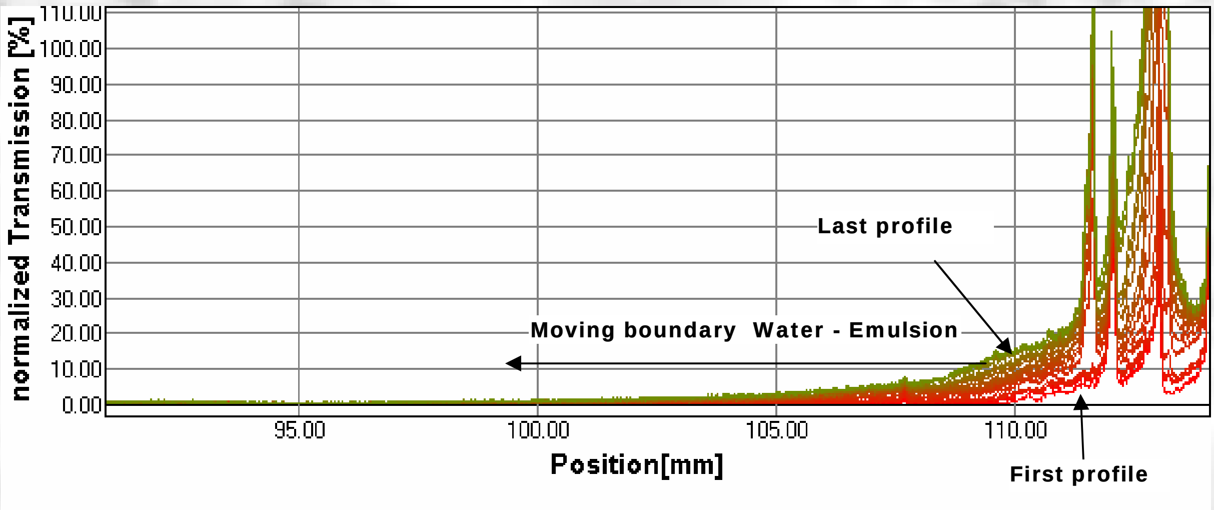
1. Introduction

To meet the constant demands for a productivity increase in sheet and tinplate cold mills, for an improved product quality and lower prodcution costs, several technical solutions are applied. Higher rolling speeds and reductions, reduction of surface carbon and roll wear, and consistent mill performance are ways, where lubricants play an important role.

Strip cleanliness, or amount of extraneous materials (e.g. dirt, iron particles, carbon, etc.) on the steel surface, is a key performance requirement for cold rolling mills. Strip cleanliness is critical for mills supplying coating lines and the automotive industry.
First basic performance concern for cold rolling lubricants, the lubricant usually applied as an emulsion should form an adequate film in the inlet of the roll bite (film forma). Second, intrinsic neat oil properties should display the desired properties (e.g., lower friction and/or reduced roll wear).

Multisample analytical centrifugation, based on STEP®-technology, is suitable for the qualitative and quantitative characterization of the emulsion stability, the results are in agreement with conventional methods, but are obtained much faster, require smaller sample volumes and allow multisample analysis under identical conditions. Three lubricants of different composition were analyzed.

2. Monitoring of destabilization process for lubricants

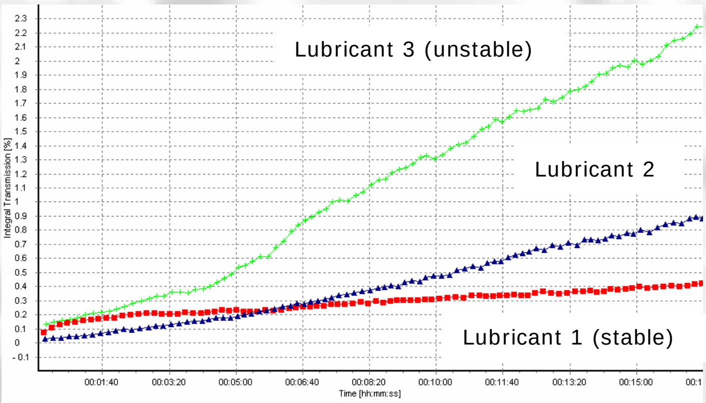


Lubricant 3, prepared with low homogenizer speed, measured 1000 sec at 11 xg, 45°C, every 10th profile displayed.

As typical for oil-in-water emulsions the separation of the contineous phase is the primary process of lubricant destabilization. The boundary water-emulsion is moving from the cell bottom (position here 114 mm) upwards, the separation process is characterized by the creaming of oil droplets inside the contineous acqueous phase.

3. Fast stability ranking and influence of emulsion preparation

The higher the slope within the initial range of the Integral transmission curves (see next page), the higher the clarification speed of the lubricant, the more unstable is the lubricant. The value for the speed as characteristic analytical parameter is output by SEPView® software (see 4.).



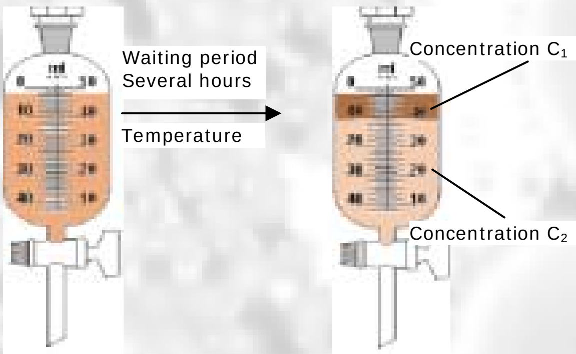
Fast evaluation of lubricant stability within 1000 sec at 11 xg, 45°C, determined with Integral transmission mode in the range 101-111 mm. Lubricants prepared with high homogenizer speed.

The order of stability is Lubricant 1 (stable) > Lubricant 2 > Lubricant 3 (unstable).

The influence of the emulsion preparation (homogenizer speed) was evaluated by comparing low and high homogenizer speeds. The same order of stability was found, hence the clarification speed values are higher for Lubricant 3 (14.8%T/h) and Lubricant 2 (7.8 %T/h), when prepared with low homogenizer speed. The stable Lubricant 1 has the same value (1 %T/h) for both homogenizer speeds.

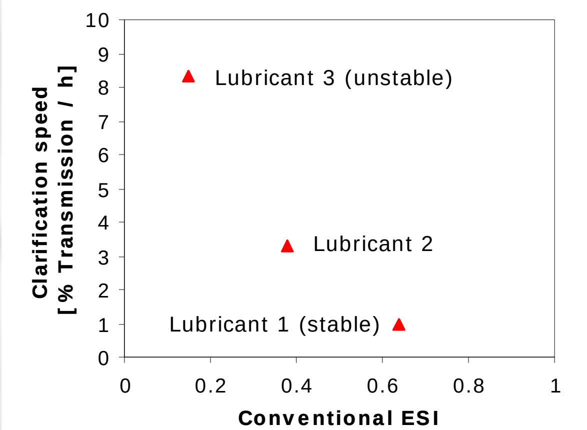
4. Comparison with conventional emulsion stability index

Conventional stability ranking – several hours



ESI = C_2(Oil in bottom phase) / C_1 (Oil in top phase)
ESI = 1 for ideal stable emulsion
ESI < 1 for *unstable* lubricant (technical product).

Fast stability ranking within minutes



Clarification speed by LUMiSizer/LUMiFuge within 1000 sec, 11 xg, 45°C, high homogenizer speed.
ESI values provided by customer.

The order of stability obtained by multisample analytical centrifugation, is the same as from the conventionally determined emulsion stability index ESI.

5. Summary

The analytical photocentrifuges LUMiSizer® and LUMiFuge®, based on STEP®-technology, determine the lubricant stability in a very short time, require only a small amount of sample volume and allow the measurement of up to 12 samples under identical conditions. The temperature range between 4 – 60 °C provides high flexibility for analysis.

6. References

- Stability Analyser LUMiFuge® 116 for Rapid Evaluation of Emulsion Stability and Demulsifier Selection, D. Lerche, T. Sobisch, S. Küchler, CME 2002, available as P114-24
- STEP-Technology see www.lum-gmbh.com/pages/technology.htm
- Dispersion Stability and Particle Characterization by Sedimentation Kinetics in a Centrifugal Field, D. Lerche, J. Dispersion Sci. Technol. 23 (5), 699-709, 2002
- Impact of Novel Cold Rolling Oil Technologies and Materials on Strip Cleanliness, N. L. J. M. Broekhof, C. E. Mueller, http://www.ethoseastafrica.com/Lubricity_ColdRollingOil.aspx