Effect of different base oils on tribological performance of different metal sheets for stamping

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Several types of metal sheets were tested in model tribological device, simulating stamping process, by using different types of base lubricants. In addition the tests without lubricant were also performed. The results show that some lubricants can even deteriorate tribological performance of stamping contact, by increasing the coefficient of friction between metal sheet and tool. What is more, the chemical composition of base metal working fluid and well as its viscosity play an important role in tribological performance that is critically defined by amount of transfer film from metal sheet to tool.

Keywords (from 3 to 5 max): tribology, stamping, metal-working fluids, metal sheet

1. Introduction

Industries in packaging sector, automobile sectors etc. are using increasingly stamping process as sheet-metal working to get high quality product with less cost. The tribological conditions during this process effect on quality of product and durability of process and tools and usage of different metal working fluids is commonly inevitable. However, residuals of lubricant after the process is un-desired for post-cleaning of the metal sheet [1]. Therefore, the selection of proper lubricant for specific metal sheet is of the great importance.

2. Methods

2.1. Tribological tests
Tribological tests were performed on conventional tribological device that are commonly used for stamping [2], simulating contact between fresh metal sheet and tool (initial 10000 passes) as well as contact between fresh metal sheet and worn tool (additional +10000 passes). Three different types of metal sheets were tested against WC-Co ball (tool material) at normal load of 185 N and stroke length of 10 mm under ambient conditions. For lubrication five types of base lubricants were used, namely paraffinic and naphthenic (both with two different viscosities) and demineralized water.

2.2. Surface analyses
Metal sheets and balls (tool) were analyzed after the test under the SEM and with FT-IR. In addition the surface roughness changes on tool were determined by using white-light interferometry technique.

2.3. Results
Results of tribological tests for metal sheet without coating are presented in Figure 1. Results show that paraffinic oil with low viscosity (vanishing) even increase coefficient of friction compared to unlubricated contacts. In general both paraffinic oil provide higher friction to naphthenic ones.

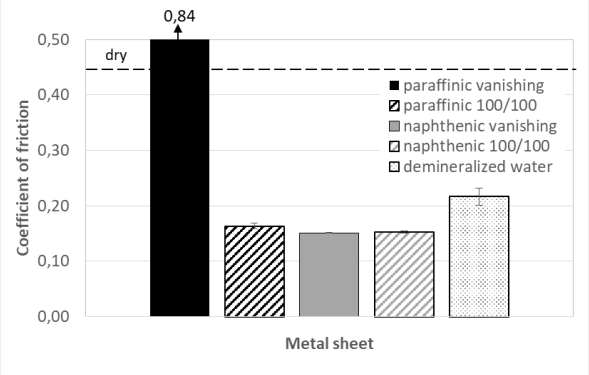

Figure 1: Coefficient of friction results.

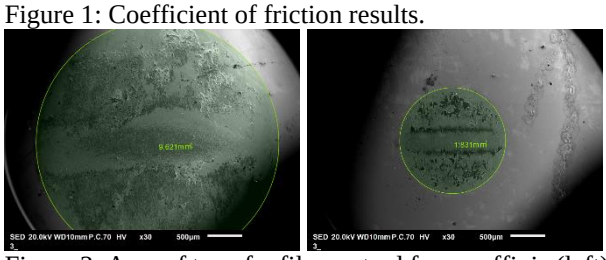

Figure 2: Area of transfer film on tool for paraffinic (left) and naphthenic (right) oil.

3. Discussion

The SEM analysis shown in Figure 2 indicates that high coefficient of friction for paraffinic vanishing oil compared to naphatenic ones originates from larger area on transfer film from metal sheet. On the other hand the area of transfer film for other lubricants is similar and coefficient of friction results in this case is governed mostly by physical properties of base lubricant.

4. References

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