EFFECT OF TRIBOTESTING SCALE ON THE UNDERSTANDING OF HIGH TEMPERATURE TRIBOLOGY OF TOOL MATERIALS

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KEYWORDS

Experiments in tribology; Wear; Friction; Hot forming tribology

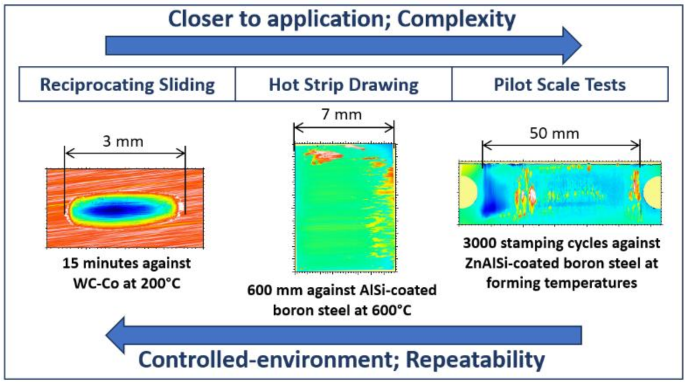

Fig.1 The different scales in tribotesting discussed in this work, along with optical interferometry image of tool material worn surface: fundamental tests (reciprocating sliding); simulative tests (hot strip drawing); and pilot scale tests.

ABSTRACT

Tribology research of hot metal forming processes is essential for the development of tool materials and tool design. Regardless of metal forming technique, tools are exposed to harsh and complex conditions where several factors – such as temperature, contact pressure, sliding speed, oxidation, metallurgical affinity, among others – affect the tribological behavior [1]. Consequently, it is paramount to design tribological studies that are able to isolate, and/or replicate particular phenomena and obtain reliable results. Lab scale experiments are ideal in terms of controlled conditions, repeatability, and cost. However, reducing a tribosystem complexity can make it less representative of the real-life application. On the other hand, more simulative experiments can pose difficulties in terms of controlled operating conditions and cost [2]. Thus, considering a multi-scale approach in experimental design can aid to optimize the knowledge created and make efficient use of resources.

In this work, different tribological campaigns involving the same tool materials are scrutinized and compared with the aim of learning the advantages and drawbacks of the different scales in tribotesting. **Figure 1** shows the three scales of experimental campaigns discussed in this work: fundamental tests using a reciprocating sliding tribometer; simulative tests using a hot strip drawing tribometer [3,4]; and pilot scale tests using a full scale press and furnace set-up.

The fundamental tribotests allowed for a systematic and quick screening of different tool materials, where it was possible to quantify and compare the wear resistance at different temperatures, without necessarily reproducing the wear mechanisms in a forming process. The simulative hot strip drawing tests allowed for more representative operating conditions and reproducing wear and friction mechanisms closer to the application. The main limitation is that quantitative wear analysis is difficult. The pilot scale tests are closest to the real application. It was seen that the wear mechanisms obtained in the simulative hot strip drawing tests correlate with those in pilot scale tests. Limitations due to the lack of a controlled lab environment were observed and discussed.

ACKNOWLEDGMENTS

The authors would like to thank Uddeholms AB and Gestamp AB for providing experimental materials. This project is funded by the program Metallic Materials under grant number 2019-02941 and is part of the Swedish Innovation Agency's (Vinnova), the Swedish Energy Agency's and Forma's investment in strategic innovation programs.

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