Wear phenomena and simulation of hot shearing process

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1. Abstract

Shearing is a necessary procedure for dimensional controlling of metal sheets after hot rolling process. This is conducted by shearing red-hot steel with cutting blades which, due to extreme operating conditions, suffer from severe wear. After comprehensive damage and tribosystem analyses, the hot shearing process was simulated by means of FEM with DEFORM™ software in order to investigate stress distributions and thermal loading in the cutting blades. Furthermore tribotests on a high temperature forming- tribometer were conducted to gain information about friction conditions in the tribocontact, and these data were implemented in the simulation. On the basis of this simulation further improvement of shearing process and cutting geometry can be done in order to decrease tribological loading regime for lifetime increase of cutting blades.

2. Results

Damage analysis [cf. 1] shows fatigue cracking with corrosion due to the cooling water present in the system. Also blade rake and flank faces show massive wear which may be attributed to contact stresses experienced during cutting; their effect being enhanced by corrosion phenomena, see Fig. 1.

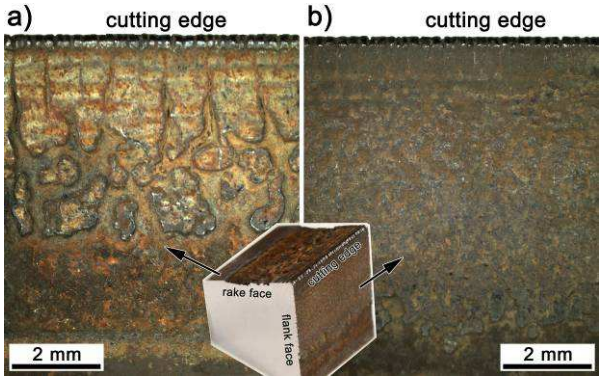

Fig.1 Macro investigation of a typical worn cutting blade: a) rake face, b) flank face [1]

High temperature forming tribotests were performed at piece temperature of up to 900°C and selected lower tool temperatures. Results show a coefficient of friction of ~0.3 during the simulated cutting process in the tribometer.

By means of FEM simulation, distribution of local high stresses (e.g. Fig. 2) and temperature influence of the red-hot sheet metal on the cooled cutting blade was calculated. The highly loaded zones predicted by FEM are in good correlation with wear loss found at damage analyses.

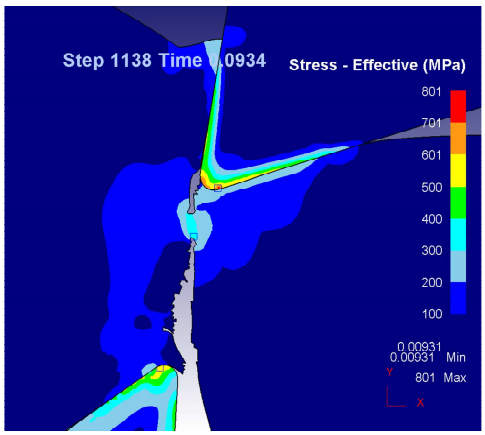

Fig.2 von Mises stress distribution in blades during shearing calculated by FE simulation

3. References

[1] Torres, H., Varga, M., Adam, K., Badisch, E., "Wear phenomena in high temperature sheet shearing blades," Materials and Corrosion, submitted, 2013.