Estimation of lubricity by numerical method on surface of NbC-reinforced tool for hot steel rolling

Masayoshi Akiyama *, Yoshifumi Higashigawa†

* Department of Mechanical and System Engineering, Kyoto Institute of Technology,
Gosho-Kaido-cho, Matsugasaki, Sakyo-ku, Kyoto, 606-8585, Japan
e-mail: makiyama@kit.ac.jp, web page: http://www.mesh.kit.ac.jp

†Department of Mechanical and System Engineering, Kyoto Institute of Technology,
Gosho-Kaido-cho, Matsugasaki, Sakyo-ku, Kyoto, 606-8585, Japan
e-mail: m3623041@edu.kit.ac.jp, web page: http://www.mesh.kit.ac.jp

ABSTRACT

It is known that the tool life for hot steel rolling extends ten times as long as that of conventional tool when the surface is reinforced by NbC powder using a Plasma-Transferred-Arc (PTA) welding technique[1]. The reinforced tool is also applicable to stainless steel or Titanium [2] but the mechanism operating on the surface for elongating the tool life has not been clarified yet. The authors have made clear the influences of size and fraction of NbC particle in the parent powder mix for PTA on the wear resistant characteristics of the reinforced tool. In the course of the past investigation it has been estimated that NbC grains on the tool surface may reveal lubricity when the tool is used at high temperature. In the present work attention is focused on the characterization of the surface of NbC grain on tools surface when it is exposed to high temperature. NbC changes to Nb_2O_5 at high temperature and Nb_2O_5 shows high lubricity. On the second stage of investigation attention is focused on the estimation of friction coefficient of Nb_2O_5 at high temperature. Elastic-plastic FEA is carried out on hot sheet rolling using Nb_2O_5 as lubricant. When no lubricant is applied on both surfaces of sheet the geometry of rolled sheet is flat, but when a lubricant is applied on one side of the sheet the rolled sheet curls exposing the lubricated side toward the outside depending upon the intensity of the coefficient of friction. The result of laboratory experiment showed that the value of friction coefficient of Nb_2O_5 is almost the same as that of graphite. The experimental result is compared to the result of FEA in order to estimate the value of the coefficient of friction. The estimated value is 0.15 when the coefficient of friction of ordinary hot rolling is 0.3.

REFERENCES

[1] K. Tsubouchi, M. Akiyama and T. Okuyama, “Development and Optimization of Carbide-Reinforced Tools and Application to Hot Rolling of Stainless Steel”, Journal of Tribology, Vol. 119, 10, 687-693 (1997)

[2] M. Akiyama, K. Tsubouchi, T. Okuyama and N. Sakaguchi, “Applications for plasma transferrse arc welded tools during hot steel tube making”, Ironmaking and Steelmaking, Vol. 27, No.3, 183-188 (2000)