

Preface

In Japan, the steel making industries have developed rapidly in the 1960s and 1970s. The production of steel has exceeded over 100 million tons, and the rolling speed in cold sheet rolling has exceeded over 2000 m/min. Then, the flow stress and the coefficient of friction in cold steel sheet rolling with higher rolling speed were unknown parameters, so that the parameters had intensely investigated in Japanese steel making industries. In 1970s, the joint researches on the flow stress and the coefficient of friction in cold sheet rolling with higher rolling speed were carried out in ISIJ. From these joint researches, the stress-strain curve involving the strain rate and the temperature for higher speed rolling was developed, and the experimental relationship between coefficient of friction and rolling speed over 2000 m/min was derived. In 1980s, the friction pick up in cold sheet rolling had intensely investigated in Japanese steel making industries. The evaluation testing of the friction pick up using tribo-simulators was carried out, so that it could be understood that an interface temperature among the tribological parameters was most important to evaluate the antiseizure property. Then, the microscopic analysis of the interface phenomena between roll and workpiece has been carried out from the viewpoint of the control of surface properties in ISIJ.

In hot sheet rolling, the rolling oil has been used around 1970 in Japan, and many researches on tribological behavior in hot sheet rolling were carried out in steel making industries. In these researches, the effects of rolling oil on rolling load reduction and roll wear reduction were examined and the lubrication mechanism in hot sheet rolling was investigated. In 1990s, researches on hot sheet rolling with higher reduction were carried out, and in the Japanese national project on PRO-TEUS from 2002 to 2006, the hot rolling technology with higher rolling reduction was developed in order to manufacture the ultra-fine-grain steel.

On the other hand, from 1985 to 1987, a joint research on estimation system of surface brightness in cold sheet rolling of stainless steel was carried out in ISIJ, and from 1989 to 2003, a joint research on mechanism of friction pick up in cold sheet rolling was carried out in ISIJ.

Under such an environment, the author began the study of flow stress of steels for high speed cold rolling in Master's course of Graduate School of the University of Tokyo, and in the Doctor's course, the experimental study of the tribological behavior in cold steel sheet rolling with higher rolling speed and the analytical study of the inlet oil film thickness between roll and workpiece have been continued. Then, the sliding-rolling-type tribo-simulator was newly developed in order to evaluate the tribological behavior in cold sheet rolling. In Yokohama National University, the author has studied on the tribology in cold sheet rolling and hot sheet rolling using the sliding-rolling-type tribo-simulator for 30 years. The author became leaders of the joint researches in ISIJ and the tribology division of the national project.

This book has been written based on research results published by the authors on the tribology in cold sheet rolling and hot sheet rolling. In this book, before the main chapters, the fundamental of tribology and the characteristics of tribology in metal forming have been written. The chapters of this book are as follows: Chapter 1 is Fundamental of Tribology, Chap. 2 is Characteristics of Tribology in Metal forming, Chap. 3 is Fundamental of Rolling, Chap. 4 is Tribology in Cold Sheet Rolling, and Chap. 5 is Tribology in Hot Sheet Rolling.

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