FOREWORD

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During the quarter century after No. 1 blast furnace was blown in at Chiba Works in 1953, the ironmaking engineers of Kawasaki Steel accumulated technical capabilities which made it possible for us to export our ironmaking technologies. As one milestone, Kawasaki Steel Technical Report published its first special edition on ironmaking in 1981. Because this was around the time of the second oil crisis, vigorous energy-saving activities were being implemented in the steelworks, and heavy emphasis was placed on maximizing the function of the blast furnace as a gas generating furnace in all-coke operation.

Thereafter, Japan experienced one recession brought on by the sudden appreciation of the yen and then a structural recession. These downturns were followed more recently by an economic recession following the collapse of the financial bubble of the 1980s. Thus, we arrive at the present. In this difficult environment, even greater expectations and requirements than in the past are placed on the ironmaking engineers. Specific technical tasks include the pursuit of economic operation in terms of both operation and equipment, the establishment of stable, long-term operation, and the achievement of extended service life. Research and development and technical development are being carried out to realize these goals, and striking progress in technology can be seen.

In the future, as before, a large number of tasks will face the ironmaking engineers. In addition to the problems of the past, new problems include the global environment, societal problems such as improvement of the working environment, changing trends in natural resources, and resources-related problems, such as the need to make byproducts generated on-site reusable. The needs associated with solving these problems are expected to be linked to further progress in technology. This issue therefore describes some of the noteworthy technologies developed in the ironmaking field since the first special issue was published.

Next, as topics related to the refining processes used in steelmaking in recent years, hot metal pretreatment in advance of primary converter refining can be mentioned, together with the remarkable strengthening of the secondary refining function. This direction was a response to the requirements of a period which demanded products with radically improved purity and cleanliness. As a result, secondary refining is no longer simply an optional part of the refining process, but now occupies a regular position as an indispensable process. The current issue introduces several secondary refining technologies, and can be seen as a follow-up to an earlier issue, published in 1990, which focused on hot metal pretreatment.

Looking more broadly at the future of the steel industry, it is necessary to point not only to efforts to strengthen international cost competitiveness, but also to the group of advanced products sometimes referred to as "fine steel," which will guarantee the superiority of steel over competing materials. In this context, ultra-low carbon steel should be mentioned as a product leading the way to fine steel in the field of non-alloy steels. The development of this steel grade was a response to the auto industry, which demanded IF steel with dramatically improved drawability. However, it also responded to the need for progress in continuous annealing technology, which is the key to a continuous rolling process for sheet gauge products. Turning to stainless steel, which is now the standard-bearer for the fine steels, Kawasaki Steel refines stainless steel by its own unique process, which involves the smelting reduction of chromium ore. This issue introduces a refining method for stainless steel which makes it possible to achieve a remarkable improvement in cleanliness.

Technology related to continuous casting is also discussed. The continuous casting process used to date has had the problem of deteriorated mechanical properties in the center section due to segregation, which results from the concentration of carbon, phosphorous, sulfur, and other impurities in the central area, and porosities, which result from volumetric contraction during solidification. Conventional methods of alleviating centerline segregation include the reduction of the phosphorous and sulfur content in the melt in advance of casting, electromagnetic stirring during the solidification of the continuously cast strand, soft reduction by the CC rolls during solidification to compensate for the amount of volumetric contraction, diffusion annealing by maintaining an elevated temperature over a long period of time in the rolling process, and others, but none of these methods has been fully effective in preventing segregation. Because this problem made it impossible to apply continuous casting to the production of bearing steel and other high-grade products, a fundamental solution was required.

To solve the problem of centerline segregation, we undertook the development of the continuous forging method in 1981. In 1990, we began operation of the world's first continuous forging equipment as a completed technology for control of centerline chemical composition.

Continuous forging is a method which, contrary to the conventional wisdom, produces broad improvement in segregation and porosities in slabs and enables the user to control the chemical composition of the slab center by applying continuous, heavy reduction to the strand while it is still in the unsolidified state. The continuous forging method has made it possible to develop a number of new products, including ball steel for bearing, nut steel, and high-strength spring steel, from continuously cast steel, and to eliminate certain processes, such as diffusion annealing for high carbon steel and heat treatment for PC strand steel. Moreover, the effects of this new technology are useful in a wide range of applications, such as extending the service life of bearing steel and improving the drawability of wire rod steel.

We trust that this special issue, which introduces recent technical advances in the upstream processes of ironmaking and steelmaking, will be of use to our readers. We welcome your comments and criticisms, and thank you for your continuing support.