TCO Endpoint Control System for Converter Steelmaking

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Abstract. In the course of production technology of converter steelmaking, accurate and fast measurement such technical indicators as temperature, content of carbon and content of oxygen of molten steel in the converter, especially the technical indicator of the molten steel of endpoint, it is significant to guarantee the quality of steel products and reducing energy consumption. The structure of equipments, the technological principle of TCO and its application in steelmaking are described and specially the results of TCO application in No. 4 converter in Handan Iron and Steel Co. Ltd are introduced. The converter TCO endpoint control system reaches the equal effect that subsidiary gun measurement controllers, improving two blowing endpoint hit rate, shorting smelt period, and reducing various consumption, improving steel mass effectively. A bright prospect for popularization of this technology in China is pointed out.

Keywords: converter steelmaking, TCO, endpoint control, automatic detection.

1 Introduction

The medium and small-scale converter of our country, has not adopted subsidiary gun to measure automatically because of the limitations of various kinds of factors at present, it is carried on that the majority relies on experience to control blowing endpoint, various kinds of indexes are not very ideal. According to incomplete statistics, among 426 medium and small converters with the capacity of 100t and 58 more than 100t's converters soon, majority still adopt the experience law steelmaking because of technology and fund. No matter producing clean steel or the high-quality steel, or production the stability of steel water quality in continuous casting and continuous rolling, can't meet the follow-up process and demand of the market more and more. Improving the precision of control and hit rate of steelmaking endpoint, have already become urgent technological problem that waits to solve in production at present.

Converter subsidiary gun system has characteristics of high input once, high maintenance cost and huge volume. TCO endpoint control system has solved the difficult problems of most converters haven't or can't install subsidiary gun, and can

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reach equal effect that subsidiary gun measurement controllers, can obtain such information as steel liquid composition and temperature from the converter in case of not stopping blowing or without finial turndown, not only can reduce labor intensity, can also shorten the duration of heating time of each stove, improve two blowing endpoint hit rate, shorten smelt period, reduce various kinds of consumption effectively and improve steel quality.

The equipment has the characteristics of simple structure, compactness, durable use, investment with low costs and little last expenses. Throwing equipment is full-automatically operation, the attendants operate on the man-machine interface, while needing to throw measurement bombing, the attendants click measuring button, throwing equipment will throw it to molten steel from converter unloading mouth or cigarette, measurement time is ten minutes. Data examined are shown on instrument and outdoors screen, the equipment resets automatically right away.

2 TCO Control Technology

The technological principle of the bombing detection technology for steel tapping without final turndown is shown as following. For example, blowing to 85%~90% or to endpoint, under the condition without final turndown and stopping blowing, high temperature measurement bombing is thrown to molten steel in the stove automatically by automatic throwing equipment, then molten steel temperature, content of carbon, content of oxygen measured by the high temperature measurement bombing within ten seconds are shown on the screen to instruct the steelmaking operation, or calculate through the computer, automatically control blowing and tapping.

2.1 TCO Equipment

Bombing detection equipment is shown as Fig.1. Thes TCO system is made up of automatically bombing device and measuring instrument. Bombing device includes bombing mechanism and bombing box, which can store 50~80 high temperature and low temperature bomb. Throwing movement of bombing mechanism and contact of electric signal contact are carried on by two air cylinders, its control system is made up by Siemens S7-400 PLC and picture operation stand, can carry on movements automatically. Measuring instrument is made up of bomb, signal processor and displayer.

The instrument is adopted high integrated design, has few separate packages, and few trouble points, the signal adopts wireless transmission technology, has reduced the trouble incidence of the detection system effectively, the instrument software returns to computing functions, has guaranteed to measure the accuracy of the result, it is extremely convenient to the finding out and download of initial data, the instrument shows and operates the picture machine, operate conveniently.

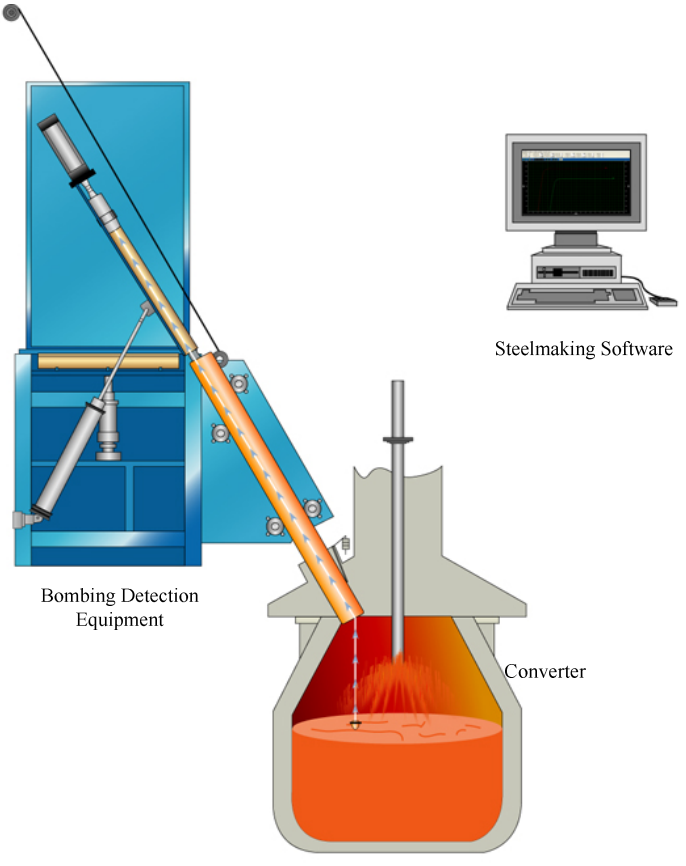

Fig. 1. TCO Equipment Structure

2.2 TCO Steelmaking Operation

In order to improve converter steelmaking endpoint control level, reduce after-blowing, lower consumption, improve production capacity and steel quality, Handan Iron and Steel Co. ltd has developed TCO steelmaking operation technology software, has realized the goal of using bombing detection technique to control steelmaking endpoint.

The main function of TCO steelmaking operation software has calculation of amount of oxygen blown and calculation of the time of dropping a bomb of TCO, through the first TCO examining result, instruct steelmaking endpoint control. Before the converter begins to blow, only the kind of smelt steel planned, amount of main raw materials and relevant packs of raw materials and endpoint goal value are imported into computer artificially, amount of oxygen blown and bombing moment are calculated by computer, the number value points out appearing on the main picture, after dropping a bomb and measuring automatically, measure result is shown on screen, steel worker is instructed to blowing endpoint control operation in order to reduce after-blowing and improve endpoint carbon and temperature hit.

3 Application

Application of TCO technology realizes the goal of steel tapping directly without finial turndown under converter steelmaking endpoint, thus smelt period of converter is shortened. It made the production membership credentials of the steelmaking plant in order, enable producing more orderly. Every stove steel smelts period is shorten by 2.4 minutes calculated according to 60 stoves steel per day under normal working condition, so more steel 6 stove every day can be produced in no. 4 converter of Handan iron and steel Co.ltd, can produce benefit of increasing production. Meanwhile, the hit rate of blowing endpoint is improved and have improved the smelting operation state of the converter to a great extent. On this basis, the supplies consumption and oxygen content of endpoint molten steel are reduced, the artificial experience steelmaking has been avoided, it is automatically control to implement, oxygen consumption is reduced, metal afford charge ratio is improved, the inclusion is reduced, steel quality is improved, has obtained better metallurgical result.

4 Conclusion

The TCO automatic bombing detection technique is an advanced detection technique developed and adopted by Handan Iron and Steel Co. ltd, its function is closed to automatic detection using subsidiary gun in large-scale converter. Fast taking a sample devices designed in converter are all driven pneumatically, is automatically controlled throwing bomb, integrated assemble, reliable compactness, less space, little investment once, low maintenance cost and convenient overhauling, is suitable for the medium and small-scale converter without subsidiary gun. Its technical equipment is simple, it is rational to fix up, fault rate is low, durable in use, suitable for medium and small converter use. Medium and small-scale converters are in large quantity at present in our country, and steelmaking is mostly under the artificial experience operation conditions, the TCO technique has very wide prospects to popularize.

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