

THE CONTROL METHODS OF CO₂ EMISSION IN IRON & STEEL INDUSTRY

Wang Meng, Chen Fan, Liu Jie, Cui Qing, Zhao Huixian

(Appraisal Center for Environment & Engineering, Ministry of Environmental
Protection, P.R.China , 100012, wmeng@acee.org.cn)

Abstract The existing problems faced by China's iron and steel industry, such as the irrational structure of energy utilization and the longer production flow, leads to the fact that CO₂ emission in the iron and steel industry stays at a high level and grows steadily each year. Based on the current situations of CO₂ emission and its regulation in China's iron and steel industry, this paper identified such major problems on reducing the discharge of CO₂ as lack of management system and insufficient practice of reduction techniques. To explore the feasible strategy and approach on controlling CO₂ emission in the iron and steel industry, it put forward suggestions in the aspect of management, technique and research.

Keywords Iron and steel industry, CO₂ emission, methods

In terms of CO₂ discharge volume, the iron and steel industry ranks as the top third industry in China. Thus the iron and steel industry is one of the key fields to control CO₂ discharge. In the year 2009, the output of crude steel was more than 567.8 million tons, accounting for 46.5% of the total output of the world. And the CO₂ discharge volume astonishingly amounted to 1.1 billion tons. During the period of Twelfth Five-Year Plan, the output of iron and steel industry will rapidly increase, and the emission reduction of CO₂ faces grim challenges.

1. CO₂ Emission Sources and Status Quo of Iron and Steel Industry in China

1.1 CO₂ Emission Sources of Iron and Steel Industry

(1) Blast Furnace Procedure

Blast furnace procedure consumes most energy and carbon volume in iron and steel industry, accounting for 59.26% and 90%, respectively. Data suggest that through blast furnace during the production of 1 ton products, 1.5 tons of CO₂ would be discharged. Therefore, blast furnace procedure is an important component of controlling CO₂ emission.

(2) Sintering Procedure

Energy consumption of sintering procedure accounts for 12.13% of the total energy consumption of the enterprise, and thus sintering procedure is another important component of controlling CO₂ emission. In 2008, the energy consumption of sintering solid fuel was 54kg/t in key steel enterprises. Some of the enterprises reached advanced level, but a substantial amount of enterprises' energy consumption was above domestic average, even over 90kg/t. There is tremendous potential in the area of energy conservation and emission reduction.

1.2 CO₂ Discharge Status quo of Iron and steel industry

1.2.1 Overview

In recent years, due to the technical innovation and effective implementation of relevant policies in iron and steel industry, CO₂ discharge volume per ton steel has been decreased gradually. But the annual discharge volume still increases year by year^[1]. (Figure 1)

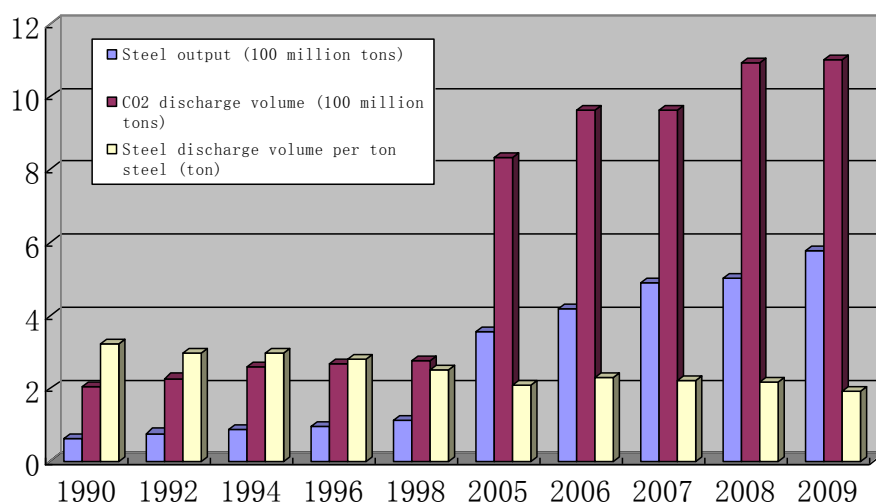


Figure1.CO₂ emission in iron and steel industry from 1990 to 2009

1.2.2 Reason for High Discharge Volume

(1) Coal-dominated dissipative mode

In 2005, the energy consumption of iron and steel industry is dominated by coal, which accounts for 69.90% and makes the data outclass that of other countries^[2]. (Figure 2)

Country	Coal	Petroleum	Natural Gas	Electric Power
Japan	56.40	19.90	0	23.70
Germany	55.80	20.70	8.20	15.30
America	60.00	7.00	17.00	16.00
China	69.90	3.20	0.50	26.40

Figure2. The energy consumption in China, Japan and other countries in 2005

(2) High steel-iron ratio

In 2009, the steel-iron ratio in China reached 0.957, which was sharply higher than the world average (0.736). Without China, the world average steel-iron ratio would decrease to 0.543. Research shows that if the steel-iron ratio increases by 0.1, the comprehensive energy consumption to produce per ton steel would increase by 50kgce/t. It follows that the China comprehensive energy consumption for production of per ton steel is 110kgce/t higher than the world average and 207kgce/t higher than the world advanced level respectively, and the CO₂ discharge volume is 20%-40% higher than that of the world average^[3].

(3) Restricted development of short process

The CO₂ discharge volume of conventional BF-BOF process is up to 1.7 ton for per ton steel, while that of EAF process is only 0.4 ton. Recently in China, the steel is mainly used for infrastructure construction. As a result, the long reuse cycle of scrap steel and insufficient resources of scrap steel as well as high domestic electricity price, to a certain extent, restrict the development of short process for steel production^[4].

(4) Disparity among enterprises

It is certain that the development levels of technology and equipment in different domestic steel enterprises are unbalanced. In China, the technology and the equipment of about one third of steel enterprises reach world average level; on the contrary, about one fourth of steel enterprises lag behind in this area^[5].

2. Predicaments of CO₂ Control for Iron and steel industry

In the aspects of system, technology and theory, the CO₂ control of China iron and steel industry faces certain problems.

2.1 Deficient Management System

The state and local authorities have worked out policies on energy saving, emission reduction and elimination of backward productivity; but in the area of CO₂ discharge reduction of iron and steel industry, there are few laws and regulations. Meanwhile, current system of environmental impact assessment could not effectively control CO₂ discharge.

2.2 Insufficient Technology Promotion

Advanced technology is promoted in China's iron and steel industry. But overall, the advanced technology for energy conservation and emission reduction has not been popularized as expected, and the coefficients of TRT, coke dry quenching, and dry dedusting converter are 30%, 52% and 20% respectively, which results in the fact that comprehensive energy consumption in China's iron and steel industry was 15% higher than the world advanced level. In China, advanced technology of energy conservation and emission reduction has not been widely applied, and therefore, the

function to control CO₂ discharge has not been fully exerted.

2.3 Rare Basic Theory Research

There is no clear control index and scientific assessment standard of CO₂ discharge in iron and steel industry. For example, restrictive standards for emission volume and emission contents, supervision measures, as well as contamination source calculating method are deficient. The lack of basic research is restricting the efficiency of CO₂ discharge control of iron and steel industry.

3. Suggestions on CO₂ Discharge Control in Iron and Steel Industry

3.1 Establishment of Management Mechanism and System

Environmental control policies on CO₂ emission reduction of iron and steel industry shall be worked out, and the CO₂ emission reduction target for every industry and region shall be clearly defined. Also the development orientation and basic requirements of emission reduction skills shall be clearly stipulated.

CO₂ management shall be involved in environment impact assessment system. Assessment index system, assessment standard, technology and supervision skills shall be improved. International CO₂ calculating method shall be imported in order to ensure the legitimacy of CO₂ discharge volume calculation.

3.2 Promotion and Application of Technology and Project

The CO₂ discharge control method of iron and steel industry shall depend on the process of energy conservation and emission reduction, the focus of which is energy conservation.

(1) Updating and Upgrading Equipments and Technology

The elimination of backward technology and equipment shall be expedited. Seventy million tons-100 million tons of steel backward productivity shall be eliminated. Also the advanced technology shall be widely applied throughout iron and steel industry.

(2) Optimization of Technological Structure

The management of energy conservation and emission reduction should be enhanced in its whole production process in order to achieve the overall control.

Sintering: Through optimizing dissolvent and ingredient structure of sintering ore, the internal quality of sintering ore can be improved; thick sinter bed sintering technology shall be adopted to increase utilization coefficient of sintering machine.

Carbonization: Through optimizing coke oven structure and improving quality of coking coal, coke composition can be decreased, which would guarantee the coke quality^[6].

Blast furnace: Focusing on clinker and beneficiated materials, the operation would get

steady and utilization coefficient of blast furnace would get improved.

Steel production: In order to achieve molten steel for continuous casting throughout the process, the high-efficiency reformation of continuous casting machine shall be the breakthrough of steel production for technology optimization and energy conversation of steel production system.

The preprocessing of liquid iron can help to decrease the consumption of minor ingredient such as converter lime, to reduce injection time and material consumption, and to increase service life and production coefficient of converter.

(3) Recycling of Resource

The recycling rate of excess heat of iron and steel industry is only 30%-40%, which is lower than world advanced standard (80%-90%). Thus the excess heat recycling ratio and reusing ratio shall be improved. Iron and steel industry shall use more scraps steel to decrease the consumption of natural ironstone and reduce environmental pollution^[7].

3.3 Relevant Research

- (1) China should primarily establish a suitable calculating method, and rationally define the CO₂ discharge volume for recent iron and steel industry.
- (2) Carbon emission assessment system, discharge information disclosure system and discharge supervision files system should be established. National Development and Reform Commission has chosen 5 provinces and 8 cities as low-carbon pilot provinces and cities in China in August 2010, which would help to establish statistics management system for greenhouse gas discharge in pilot provinces and cities. Domestic metallurgic clean production center also has developed software to calculate CO₂ discharge volume for iron and steel industry.

In summary, during the period of Twelfth Five-Year Plan, government should stress on establishing management mechanism and system, promoting technology and relevant research, to control CO₂ emissions in iron and steel industry.

Reference

- [1]JIANG Qi, "CO₂ EMISSION INVENTORY AND EMISSION-REDUCING POTENTIAL ANALYSIS IN REPRESENTATIVE IRON&STEEL ENTERPRISES", *METALLURGICAL INFORMATION REVIEW*, Vol.3:38-40,2009
- [2]WU Keng, "CO₂ EMISSION IN ROIN AND STEEL INDUSTRY AND THE MEASUES OF EDUCE", *IRON AND STEEL*, Vol.36:24-26,No.11,2001
- [3]HU Xiulian, "GHG EMISSION REDUCTION TECHNOLOGY OPTIONS AND EVALUATION IN CHINA", BEIJING, CHINA ENVIRONMENT SCIENCE PRESS, 2011,P84

[4] HU Xiulian, “GHG EMISSION REDUCTION TECHNOLOGY OPTIONS AND EVALUATION IN CHINA”, BEIJING, CHINA ENVIRONMENT SCIENCE PRESS, 2011,P86

[5] HU Xiulian, “GHG EMISSION REDUCTION TECHNOLOGY OPTIONS AND EVALUATION IN CHINA”, BEIJING, CHINA ENVIRONMENT SCIENCE PRESS, 2011,P87

[6]CAI Jiu-ju, “MATERIA FLOWS AND ENERGY FLOWS IN ION AND STEEL FACTORY AND THEIR INFLUENCE ON CO₂ EMISSIONS”, **RESEARCH OF ENVIRONMENTAL SCIENCES**, Vol.21:44-45,No.1, 2008

[7]RAN Rui, “CURRENT SITUATION OF CO₂ EMISSION IN IRON AND STEEL PRODUCING AND ITS CONTROLLING METHODS”, **SCIENCE&TECHNOLOGY REVIEW**, Vol.24:78-79, No.10, 2006