China-Japan International Academic Symposium
Environmental Problem in Chinese Iron-Steelmaking Industries
and Effective Technology Transfer
Sendai, Japan, 6, March 2000

PRESENT STATES AND MEASURE FOR ENVIRONMENTAL POLLUTION FROM IRONMAKING INDUSTRIES IN SHANXI PROVINCE IN CHINA

Reijiro Takahashi[*1], Xinghe Zhang[*1]
Izumi Omura[*2], Nozomu Kawabata[*2]
Hisashi Sinohara[*3] and Toyoaki Ito[*3]

*1 Institute for advanced Materials Processing, Tohoku University
2-1-1 Katahira, Aoba-ku, Sendai, 980-8577, JAPAN
Tel: +81-22-217-5173, Fax: +81-22-217-5211
E-mail: reijiro@iamp.tohoku.ac.jp

*2 Faculty of Economics, Tohoku University
Kawauchi, Aoba-ku, Sendai, 980-8576 JAPAN
Tel: +81-22-217-6297, Fax: +81-22-217-6297
E-mail: omura@econ.tohoku.ac.jp

*3 Faculty of Agriculture, Tohoku University
1-1 Tsutsumidori-Amamiyamachi, Aoba-ku, Sendai, 981-8555 JAPAN
Tel: +81-22-717-8695, Fax: +81-22-717-8697
E-mail: sinohara@bios.tohoku.ac.jp

ABSTRACT

International scientific research group between China and Japan was organized and carried out the field research, since 1997 to 1999 in Shanxi province which is the largest locality with coal production and use in China.

In this paper, the present state of the air pollution based on the iron and steel industry (coal and coke industries are contained) and the preventive measure for environmental protection in Shanxi province are reported here.

Finally, co-generation system of clean energy and pig iron are proposed as a new process.

Keywords: Ironmaking, Coking, Energy, Air pollution, TSP, SO_2, Smelting reduction, Shanxi province, China

1. INTRODUCTION

The China is continuing higher economical growth since 1978. The iron and steel industry is also similar tendency as shown in Figure 1. Crude steel production in China was the slight 30 million tons at 1978, but it has been increased up to 60 million tons at 1989. Further more, over 100 million tons crude steel production were attained in 1996. In the present time, China is the largest country of the world for the crude steel production while economic growth advances. However, China where depends the coal on 75% of the energy source, is generating a serious problems for the environmental pollution by sulfur oxide and soot derived from coke and ironmaking industries. For clarifying present state of environmental problem in China, authors organized the international scientific research group between Chine and Japan, and carried out the field research since 1997 to 1999 in Shanxi Province, which is the biggest locality with coal production and use in China. In this paper, the present state of the air environmental pollution based on the iron and steel industries (coal, coke industry are contained) and the preventive measure for environmental protection in Shanxi Province are reported.

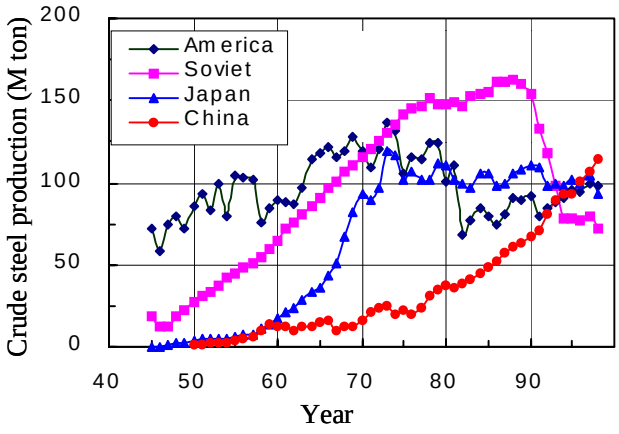

Fig.1 Change of crude steel production in the main steel making countries.

2. GENERAL CONDITION OF SHANXI PROVINCE

Shanxi province is located in around 1000m highlands above sea level, where is in about 560km southwest area from Beijing. The industrial-economical conditions are shown in Fig.2. The land area is 15.6 $\times 10^4$ km^2, and the population is

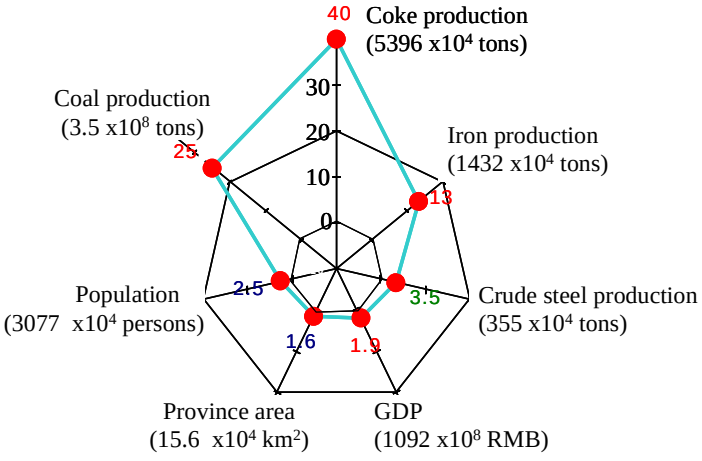

Fig.2 Occupancy ratio of Shanxi province in China at 1996.

the 30 million person remainder. Both of the GDP per capita and crude steel production are greatly lower than national average. However a lot of coal resources are reserved in underground, and occupancy ratio of coal production (3.5×10^8 tons) and annual coke production (5396×10^4 tons) are 25% and 40% in China respectively.

3. PRESENT STATE OF THE AIR POLLUTION

The field research was carried out in the metropolis of Shanxi province such as Taiyuan, Xiaoyi, Jiaokou, Jiexiu and Linfen in July 1998. These industrial areas for coke and pig iron production were covered by the pollution gas. Figure 3 shows the feature in which a small blast furnace is emitting dirty smoke.

Fig.3 Air pollution from small blast furnace in Shanxi province.

Table 1 shows air pollution data of the metropolis in Shanxi province. TSP (total suspended particulate matter) and SO_2 became several times larger than the reference value. The annual discharge of soot and SO_2 in Shanxi province were 8.3×10^5 tons and 10×10^5 tons respectively in 1995.

Table 1 Measured values of air pollution at 1995 for main cities in Shanxi province.

Cities	TSP		SO_2	
	Measured (mg/m^3)	Measured / 2nd Class*	Measured (mg/m^3)	Measured / 2nd Class*
Datong	0.426	2.1	0.185	3.1
Gujiao	0.466	2.3	0.210	3.5
Taiyuan	0.563	2.8	0.247	4.1
Yangquan	0.454	2.3	0.229	3.8
Xiaoyi	0.746	3.7	0.261	4.4
Linfen	0.705	3.5	0.330	5.5
1st Class*	0.08		0.02	
2nd Class*	0.20		0.06	
3rd Class*	0.30		0.10	

*1st, 2nd and 3rd Class of National Air Quality Standard of China (NAQS)
(Data from the Committee on Environmental protection in Shanxi province)

These pollutants come from small blast furnace and beehive coke oven. Figure 4 shows

the distribution and change of inner volume of blast furnace in Shanxi province. The figure shows that number of blast furnace drastically changed since 1993 to 1995. The small blast furnaces which inner volume is smaller than 100 m^3 are very much being concentrated in Shanxi province, they are over 1500 furnace which are half number of blast furnace in China at 1995.

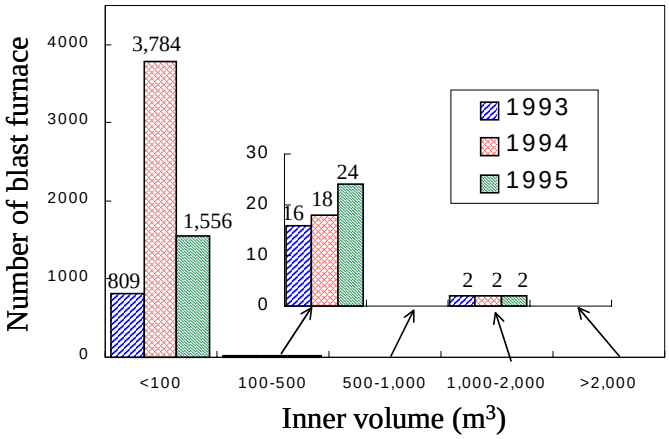

Fig.4 Distribution and change of inner volume of blast furnace in Shanxi province .

The coal resources are widely distributed for about 40% (57 $\times 10^3$ km^2) of the total area of the province, and the place where there is only 10 m distance from earth surface to the coal seam is also distributed. Therefore, the coal mining exists in about 5000 points, which have small investment and small-scale production facilities. In addition to above, a lot of beehive coke oven which the construction period is short and there are a lot of small investments are widely constructed in Shanxi province.

Figure 5 shows the change of the coke production of Shanxi province, and the difference of production method. From this figure, though coke production in 1995 was 3 times larger than in 1990, this increasing was caused by the increase of non-chamber oven. In the most of these ovens, the fuel consumption was very much amount. And then, as the by-products recovery and environmental protection have not been conducted, much amount of soot, SO_2, and etc. are discharged to the atmosphere. As mentioned above, small blast furnace and non-chamber type coke oven are the most important factor for the environmental pollution in Shanxi province.

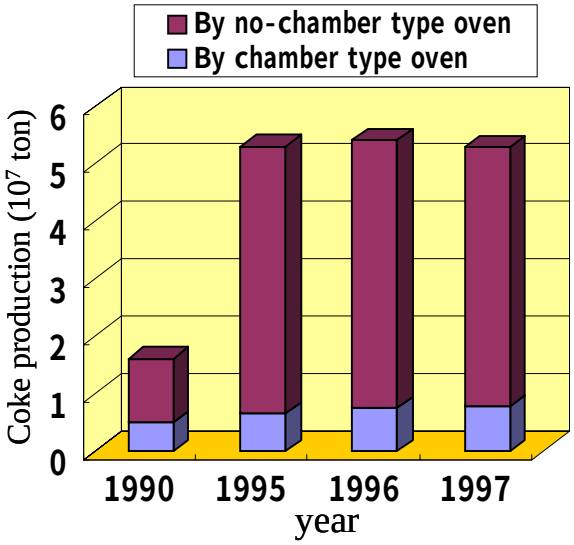

Fig.5 Change of coke production by two production methods in Shanxi province.

4. TECHNOLOGICAL SUBJECT FOR AIR ENVIRONMENTAL PROTECTION

We would like to show the following three proposals in order to improve the environmental pollution in Shanxi Province. (1) Intensiveness of some companies: Combination of the very small companies, extension of the blast furnace scale, coke production by chamber type oven, recovery of the by-product and reduction of the fuel consumption are must done at first. (2) Effective technology transfer and process development for dust collection and desulphurization: Since sulphur content of the coal produced in China is higher (average 1.35%), the development of the low-cost and high-efficiency desulphurization technology are necessary. (3) Introduction of the new process: For example, it is expected that the co-generation system for the productions of pig iron by smelting reduction furnace and clean gas as shown in Figure 6. This system produce the pig iron by use too much coal at the same time as the clean energy such as city gas and electricity by using the gas generated from smelting reduction furnace.

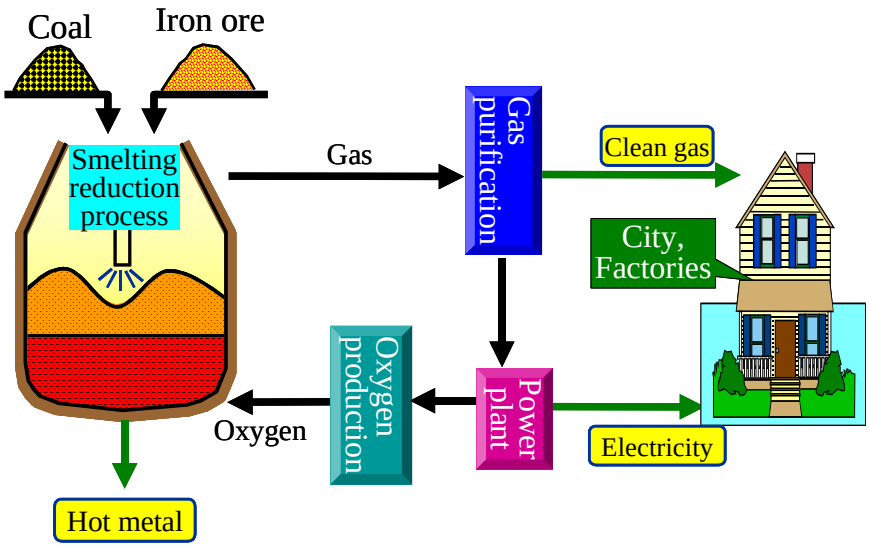

Fig.6 Conceptual scheme of research project for co-generation system of clean energy and pig iron.

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