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SULPHUR DIOXIDE EMISSION FROM LIGNITE-FIRED INDUSTRIAL BOILERS

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ABSTRACT

Consumption of domestic lignite in power and industrial sectors of Thailand has increased rapidly and the growth will remain at about 17 % per annum until the year 2000 when the consumption of domestic lignite is expected to reach 38.3 M tons.

In industry, lignite-fired boilers are used mainly in pulp and paper, food and textile factories. In a base - case, the lignite consumption in industrial boilers is estimated to increase from 0.20 M tons in 1987 to 0.82 M tons in the year 2000. However, recent studies indicate that lignite as a substitute for fuel oil in industrial boilers can amount to 0.77 M tons per annum. In addition, potential for lignite consumption in industrial cogeneration systems could reach 7.2 M tons by the year 2000.

As most of the lignite - fired industrial boilers are in urban or sub urban areas and domestic lignite contains high sulphur content, sulphur dioxide emission from the boilers poses direct threat to public health. Studies on sulphur dioxide emission from lignite - fired boilers revealed that the sulphur dioxide content in the flue gas greatly exceeds the limit set by the recommended emission standard. Emission abatement measures have to be seriously enforced.

KEYWORDS

Boilers, emission, industry, lignite, sulphur dioxide.

INTRODUCTION

Lignite is one of the major domestic source of energy in Thailand. In 1989, the production of lignite was about 8.90 M tons which represented an increase of 26.5% over the previous year [1]. The growth of lignite utilization in the country is expected to remain very high at an average rate of about 17% per annum until the year 2000 when the lignite production is projected at 38.3 M tons [2]. The past and projected lignite consumption in power production and industry are shown in the table below [1, 2]

Table 1. Lignite Consumption, 1985-2000.

	1985	1987	1989	1995	2000
Power	3.85	5.97	6.78	20.75	33.97
Industry	0.48	1.02	2.12	3.36	4.39
Total	**4.33**	**6.99**	**8.90**	**24.11**	**38.36**

Industry in the above table includes cement pulp and paper, food, tobacco curing and others.

LIGNITE DEMAND IN INDUSTRIAL BOILERS

In industry lignite-fired boilers are mainly used in pulp and paper, food and textile factories. Table 2 shows the past and projected demand for lignite in various industrial sectors [1, 2].

Table 2. Industrial Demand for Lignite, 1985-2000.

	1985	1987	1989	1995	2000
Cement	0.39	0.74	1.49	2.73	3.47
Tobacco	0.09	0.08	0.14	0.11	0.11
Industrial Boilers	-	0.02	0.48	0.52	0.81
Total	**0.48**	**1.02**	**2.12**	**3.36**	**4.39**

From recent studies [3,4], the above projected demands for lignite may appear to be under estimated. With relatively cheap supply of domestic lignite, it would be economically feasible to replace heavy fuel oil by lignite in about one thousand existing industrial boilers throughout the country and the consumption of lignite for these boilers is estimated at 2.53 Mb.o.e [3] or about 0.77 M tons of lignite per annum. In addition, potential for steam cogeneration exists in several industrial sectors such

as chemical, food, pulp and paper, textiles, etc., and the power generating capacity is estimated to be over 1800 MWe [4] within a decade. The potential of power generation by the private sector in Thailand will be further enchanced when private cogenerators are allowed to export electricity in the near future. If only 50% of the estimated potential for cogeneration use lignite-fired boilers, the demand for lignite could reach 7.2 M tons per annum while the base-case demand for industry in Table 2 is only 4.39 M tons in the year 2000.

SULPHUR DIOXIDE EMISSION

Lignite from domestic reserves contain very high sulphur contents ranging from 1-9%. The average sulphur content from several samples of lignite appears to be about 2%. Based on this value and on the assumption of complete combustion for sulphur, amounts of sulphur dioxide emission form industrial boilers are estimated and shown in Table 3 for the base-case lignite demand, the case of lignite substitution in existing boilers and the case of cogeneration using lignite-fired boilers.

Table 3. Sulphur Dioxide Emission from Industrial Boilers

	1987	1989	1995	2000
Base-case	0.008	0.019	0.021	0.033
Lignite substitution	-	-	0.031	0.031
Sub Total	0.008	0.019	0.052	0.064
Cogeneration	-	-	0.144	0.288
Total	0.008	0.019	0.196	0.352

EMISSION ABATEMENT MEASURES

The amount of sulphur dioxide emission from industrial boilers is quite small in comparison to the emission from the power sector (5). However, as most industrial boilers are in urban or suburban areas of Bangkok and surrounding provinces, sulphur dioxide emission from all lignite-fired boilers exceeds the 400 ppm limit recommended in the Standard for Emission at Sources in populated areas [6]. Direct threat to public health is therefore a serious issue. In the long run, the problem of acid rain may also arise. Fortunately, in the near future, the emission standard will be made compulsory by the government and emission abatement measures will then be necessary.

From a study on a lignite-fired fluidized-bed boiler in a textile factory in a sub-urban area of Bangkok, the ash absorbed 41% of the sulphur content and 17% were separated by the cyclone while the remaining 42% went out with the flue gas into atmosphere [7]. The average sulphur dioxide content in the flue gas was 570 ppm. A recent study revealed that

a paper factory attempted to reduce sulphur dioxide emission from the boilers by mixing domestic lignite with imported low-sulphur coal. The sulphur dioxide content in the flue gas still remained very high at about 1100 ppm [8].

CONCLUSIONS AND RECOMMENDATIONS

A rapid increase in the use of lignite-fired boilers can be expected in Thai industry. As domestic lignite contains very high sulphur content, sulphur dioxide emission from industrial boilers definitely exceeds the limits set by the recommended emission standard. Direct threats to public health and acid rain in the long run have to be seriously dealt with.

The existing emission standard for sulphur dioxide should be immediately made compulsory as the first step to reduce the sulphur dioxide emission. Suitable clean coal technologies such as fluidised-bed combustion should then be assessed and adapted for domestic lignite and recommended for implementation in industrial boilers. Later on, the existing emission standard should be reexamined, refined and enforced.

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