AIR POLLUTION EMISSIONS FROM A STEEL MILL PLANT USING ELECTRIC ARC FURNACE

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INTRODUCTION

Air pollution from steel mill industries is a serious problem. Steel smelting process emits a large quantity of dust which is detrimental to health. Steel mill industries have to control the emission to comply with the existing regulations in order to obtain a licence to operate. This study measures particles and gaseous emissions from a new steel mill plant using electric arc furnace system.

The smelting process is carried in a "dog house" system where the furnace is enclosed in a house with air extraction system. Fugitive dust and fume generated during the smelting process is extracted and passed through a baghouse system before being released into the atmosphere.

METHODOLOGY

Sampling of particle in the stack gas after the filter bag-house system was achieved by utilising Andersen Universal Stack Sampler. Glass fiber thimble was used as a filter medium to collect the extracted particle. The mass of particle collected was obtained by gravimetric analysis of the thimbles. These thimbles were dried and desiccated prior to the initial weighing and subsequent re-weighing after sampling. The concentration of particle in the flue gas was calculated by dividing the mass of collected particles with the total volume of gas sampled. The thimbles were subsequently digested in a concentrated acid solution in a teflon outoclave. The solution was then analyzed using Atomic Absorption Spectrometer (AAS) for cadmium, lead, zinc, iron, and copper contents.

The compositions of the stack gas (NO, NO_2 and SO_2) were measured using a Greenline Combustion Gas Analyzer manufactured by Eurotron. The analysis of the gas was based on a group of electrochemical cells equipped with a selective diffusion membrane. Readings of the parameters were recorded every minute over approximately 30 minutes and then averaged to obtain average concentrations of each gaseous component.

RESULTS AND DISCUSSION

Particle concentrations in the gas leaving the baghouse system measured between 1993 and 1995 are shown in Table 1. The concentrations ranged from 0.18 to 0.070 g/Nm3. These levels were well below the allowable limit set by the Department

of Environment for such a process (0.30g/Nm3). The baghouse system was designed to comply with the German T.A. Luft regulation of 0.05 g/Nm3. Usually a well designed and operated baghouse fabric filter system is capable of removing particulate matter from gaseous stream at efficiency greater than 99%.

Table 1: Air Pollution Leaving the Baghouse System from Steel Smelting Plant Using Electric Arc Furnace.

Date	Particulate (g/Nm^3)	SO2 (mg/Nm^3)	NOx (mg/Nm^3)
10/6/93	0.030	ND	26
23/8/93	0.050	ND	14
14/1/94	0.018	ND	9.6
14/7/94	0.070	ND	4.2
25/1/95	0.046	ND	4.0
18/4/95	0.039	ND	4.4

Table 1 also shows that SO2 and NOx emission from the electric arc furnace steel smelting process were very low. Fabic filter did not remove gaseous pollutants. SO2 and NOx were usually produced from combustion of fossil fuel. Since the process used electric arc furnace system, there was no source of sulphur to produce SO2. Nitrogen oxides, in particular NO, was produced from combustion process where nitrogen and oxygen in combustion air fixed at temperature exceeding 1600 C. The results indicate that electric arc furnace system produced very low level of NOx.

Although the baghouse system removed particulate from gaseuos effectively, dust pollution from the steel mill plant was high. Concentration of total suspended particle (TSP) in the ambient air measured at the plant perimeter was high. For example, TSP level measured using high volume sampler (HVS) on 18/4/95 was 0.214 mg/m3. Malaysian recommended guideline for TSP is 0.260 mg/Nm3. Analysis of elemental content of dust collected on the HVS filter there was similarity with content of dust sampled from the baghouse (Table 2).

Table 2: Contents of Heavy Metals in Particle Sampled from Ambient Air and from Gas Leaving the Baghouse (ppm)

	Cd	Zn	Pb	Fe	Cu
Particle from baghouse	220	25,000	9,400	5,900	500
Particle from ambient	370	28,000	8,400	52,000	500

It was observed that some of the dust generated from the smelting process escaped through the roof. The smelting process was supposed to be conducted in a doghouse system where all of the dust generated will be extracted to the baghouse. The dust that escape the extraction system would escape to the atmosphere resulting in dust pollution problem. Improper handling of dust collected from the baghouse also contributed to dust pollution.

Disposal of the dust collected from the baghouse is a problem. The dust is classified as a schedule waste under the Schedule Waste Regulations 1989. Since there is no approved disposal site available, the dust have to be stored in the plant premises. The quantity of dust generated is huge. It was estimated that for every 1000 metric ton of steel produced, 7 metric ton of dust was generated. For a steel mill with annual capacity of 50,000 metric ton, there would be 350 metric ton of steel dust generated annually.

CONCLUSION

1. Fabric filter system was effective to control particle emission from steel mill
2. Electric arc furnace system eliminated the problem of SO_2 and NOx emission from steel smelting process
3. Management of dust collected from the baghouse system was a problem to steel mills
4. Zinc is a suitable "finger print" for dust pollution from steel mills