



Short Communication

Study of Tail Gas Treatment in Dariba Lead Smelter

Rekha Tripathi

Maharaja Surajmal Institute of Technology, C-4, Janakpuri, New Delhi, India
rekhatripathi@msit.in

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Abstract

The off gas treatment plant treats the off-gas from the blast furnace, fuming furnace, dross reverberatory, and primary furnace. The total handling capacity is 126168.07m³/h, SO₂ density: 0.054%. The off-gas volume of blast furnace is 54920m³/h and fuming furnace is 39735m³/h while the dross reveberatory furnace is 7168 m³/h. The off-gas produced from primary furnace for acid-making is 24345.07m³/h. Zinc oxide scrubbing technology is adopted to treat the off gas. The discharged ZnSO₄ solution is 1.5m³/h and the content of ZnSO₄ is 112.5g/l. The removed SO₂ is 57.41m³/h and the efficiency is 85%. The SO₂ in the discharged air is ≤100ppm and this is in accordance with the Indian national emission standards.

Keywords: Blast furnace, Fuming furnace, Dross reverberatory, SO₂ and Zinc oxide scrubbing.

Introduction

Primary and secondary lead both worked with lead processing and smelting plants. Primary lead is mined, separated from ore, and refined into various products, whereas secondary lead is recovered from used objects – such as used lead-acid batteries¹⁻², for reuse in other products. Smelting is a main process in lead product production, which involves heating lead ore or recovered lead with chemical reducing agents. Both secondary and primary smelting processes can be responsible for contamination of the surrounding environment due to release of large amounts of lead, SO₂ and hot waste gas.

The SO₂ rich off gas with lead dust generated in the smelting process is continuously removed under the negative pressure created by an Induced Draft Fan in the Off-Gas System. Along with the Smelting off Gas, air sucked from throat and feed inlets also enters the Off gas stream. Around 15 % PbS to PbO Conversion takes place in the off gas. The off gas stream passes

through the Waste Heat Recovery Boiler (WHRB) and Electro-Static Precipitator (ESP) before entering the Acid Plant Battery Limit (Gas Cleaning Plant). Almost 97.67% of sulphur fed into the furnace enters the off gas and rest being carried in the SKS Slag.

Materials and methods

Study area selected for the project is HZL (Hindustan Zinc Ltd) Dariba Lead Smelter having 1LTPA (lakh tonne per annum) capacity, village- Dariba, Tehsil-Relmarga, District- Rajsamand and state- Rajasthan.

Off gas from blast furnace, fuming furnace, dross reverberatory, and primary furnaces having temperature: 120°C, pressure: 200 Pa and dust content: <0.1g/m³ sent to off gas treatment system. Volume and component of off-gas from different parts is given in Table 1-5.

Table-1: Volume and component of blast furnace off-gas after dust collection.

Off-gas component	SO ₂	CO	CO ₂	N ₂	O ₂	H ₂ O	Total
Off-gas volume Nm ³ /h	17.03	1131.35	2827.83	40937.37	8585.09	1421.33	54920
%	0.031	2.060	5.149	74.540	15.632	2.588	100

Table-2: Volume and component of fuming furnace off-gas after dust collection.

Off-gas component	SO ₂	CO	CO ₂	N ₂	O ₂	H ₂ O	Total
Off-gas volume Nm ³ /h	34.97	418.41	3764.89	30018.20	3301.98	2196.55	39735
%	0.088	1.053	9.475	75.546	8.310	5.528	100

Table-3: Volume and component of reverberatory furnace off-gas after dust collection.

Off-gas component	SO ₂	CO ₂	N ₂	O ₂	H ₂ O	Total
Off-gas volume Nm ³ /h	9.45	461.48	5412.92	804.97	479.18	7168
%	0.132	6.438	75.515	11.230	6.685	100

Table-4: SKS furnace off gas component and volume (for acid making).

Off-gas component	SO ₂	SO ₃	CO ₂	N ₂	O ₂	H ₂ O	Total
Off-gas volume Nm ³ /h	6.09	0.24	1429.06	20147.74	2758.54	3.40	24345.07
%	0.025	0.001	5.870	82.759	11.331	0.014	100

Table-5: Mixed off-gas volume and component.

Off-gas component	SO ₂	SO ₃	CO	CO ₂	N ₂	O ₂	H ₂ O	Total
Off-gas volume Nm ³ /h	67.54	0.24	1549.76	8483.26	96516.23	15450.58	4100.46	126168.07
%	0.054	0	1.242	6.544	76.039	12.822	3.308	100

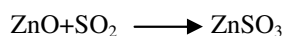
Off-gas temperature: 112°C, Off-gas pressure: 200Pa, Dust content in off-gas: <0.1g/m³.

Mixed off-gas: The ZnO reacts with the SO₂ present in the off-gas and zinc sulfite is produced. Then the zinc sulfite is oxidized into zinc sulfate and sent to the zinc smelting process. This process will not consume the acid but can reduce the emission of SO₂, which is good for the environment protection. The four off-gases mix and treated by one off gas treatment system. The plant includes calcine pulp preparation system, SO₂ absorption and oxidizing system, ZnSO₄ solution discharge system and process water system³⁻⁴.

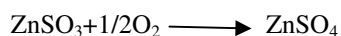
Volume of treated off-gas and product plan

The capacity of the off gas treatment plant: 126168.07m³/h, SO₂ 535.3ppm, product ZnSO₄ solution:1.5m³/h, ZnSO₄ content:112.5g/l.

Process principle: The SO₂ containing off-gas fully contact with calcine pulp that contains ZnO. In this process, SO₂ dissolves and absorbs. The reaction is:



Under the influence of agitator, the pulps that have absorbed SO₂ will fully contact with the blast in air. The zinc sulfite will be oxidized into zinc sulfate. The reaction is:



ZnO pulp preparation system: ZnO transported by the bucket elevator to the ZnO calcine storage bin. The ZnO mixes with

water to make 20% ZnO pulp and store it in the pulp storage tank. Then it is pumped to the scrubbing tower.

SO₂ absorption and oxidizing system: The off-gas from the blast furnace, fuming furnace, dross reverberatory furnace mix with the off-gas from the SKS furnace, then it pressurized by the transfer blower and enter the upper part of the scrubbing tower. It reversely contact with the ZnO containing circulating pulp from above. After intensive collision, fluid film froth zone formed. In the froth zone, with the refreshing of liquid film, most of the SO₂ is absorbed, dissolved. Most of the dust intercepted by the liquid film and enter the circulating pulp.

The circulating pulp that has absorbed SO₂ enters in circulating tank with agitator under the gravity force and fully contact with the in-blast air and the ZnSO₃ oxidized to ZnSO₄. After the circulating pulp reaches certain amount, it is drained. At the same time add moderate fresh ZnO calcine pulp according to the density of Zn²⁺ in the circulating pulp.

Pulp drainage system: The discharged ZnSO₄ will go to the storage tank and be pumped to leaching process in the zinc system.

Results and discussion

There is no direct emission of SO₂ gas. SO₂ gas is being utilized to form sulphuric acid. The tail gases which generates from various sections being treated then emitted from high stack. The maximum allowable limit is 100ppm as per norm⁵⁻⁶.

Conclusion

From this project, we learnt that air pollution contribute to many weathering processes, namely acid rain. In conclusion, the two primary sources of acid rain is sulfur dioxide and nitrogen oxide. Automobiles are the main source of nitrogen oxide emissions, and utility factories are the main source for sulfur dioxide emissions. These gases evaporate into the atmosphere and then oxidized in clouds to form nitric acid and sulfuric acid, to form acid rain. Sulfur dioxide emission can be reduced by adding scrubbers to utility plants.

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