

INFLUENCE OF ALUMINIUM SMELTING ON AIR QUALITY AT RUSAL ALSCON IKOT ABASI, Akwa Ibom State

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Abstract

This research work addresses the impact of Aluminium smelting on air quality at Ikot Abasi environment arising from the operational activities of Rusal-Alscon plant. The research was conducted by the collection of in situ air quality samples from selected locations close to the plant. Air quality data, 60 ,km at Ikot Usung Ikono , Uyo from the plant location was used as a control sample. Air quality results showed marked differences in the air quality around the plant, compared to the standard and the control sample. This research therefore recommends adequate monitoring of the plant operations by the Nigerian Environmental Standards and Regulations Enforcement Agency (NESREA) to ensure conformity to its emission standards.

Keywords : , Aluminium smelting, emissions, pollutants, air quality,sound, environment

INTRODUCTION

Aluminium is never found in nature as an element owing to its affinity for oxygen [1]. It is the third largest abundant element in the Earth's crust. Aluminium hydroxide and bauxites are the basic raw material for primary aluminium production. The major bauxite deposits are located in the tropics and Mediterranean regions of the World. Due to its high affinity for oxygen, aluminium cannot be reduced to metal by heating. The production process consists of the electrolytic decomposition of alumina in a molten bath composed of cryolite and fluorides in which the carbon anodes collect the oxygen, released from the decomposition process. The liquid

25 Aluminas deposited on the carbon coating of the crucible (pot) which acts as the cathode. The
26 molten Aluminium is subsequently pumped into crucibles of metal which are taken to the ingot
27 casting area.

28 The Rusal-Alscon plant gets its raw materials from Republic of Guinea in West Africa. The plant
29 utilizes the Bayer process in its Aluminium production. Two to three tons of bauxite are required
30 to produce one tone of alumina and two tons of alumina are required to produce one tone of
31 Aluminium metal. Alumina is further reduced into Aluminium in Aluminium smelter plant using
32 Hall-Heroult process. There are two primary technologies using the Hall-Heroult process-The
33 Soderberg cell and the Prebake cell. Modern primary Aluminium production facilities use a
34 variant on Prebake technology called Centre Worked Pre-bake(CWPB) technology. A key
35 feature of this process is the enclosed nature of the process Emissions from the cells are very
36 low, less than 2% of that generated. The balance of the emission is collected inside the cell itself
37 and carried away to a very efficient scrubbing system which removes particulates and gases
38 [2] .Computer technology controls the process down to the finest detail, which means that
39 occurrence of the anode (–) the production of Perfluorocarbons (PFCs) produced can be
40 minimized. The Aluminium industries have standard practices governing its operations.
41 Emissions from Aluminium smelting is generally categorized under class 3 indicators [3] .It is
42 highly hazardous, carcinogenic, teratogenic, mutagenic and highly toxic. The pollutants are
43 capable of causing harmful effect to health of the workers, fauna and vegetation and the safety of
44 the community .The concentration if exceeded may affect the health of the population is called
45 primary pattern. Any concentration with minimum adverse effects on the well-being of the
46 population is classified as secondary pattern. The emissions into the atmosphere include sulphur
47 dioxide, carbon dioxide, ozone, nitrogen dioxide, fluorides, polycyclic aromatic

hydrocarbons(PAHs), perfluorocarbons (PFCs), hydrogen fluoride-gases, sodium and aluminum fluorides and unused cryolite as particulates unless carefully controlled are very toxic to the vegetation around the plant. These particulates eventually get into air, soil and water. Previous research work on the effects of aluminium smelting on the plant site and the environment at Rusal-Alscon are available [4], [5] and were limited to the effect of pollutants on soil and water whereas the present study focuses on the effect of the pollutants on air. Hydrogen fluoride can cause lung cancer, bladder cancer, bone deformity, tooth decay and many untold hazards [7]. This emission is in contradiction to the occupational health practice in industries [8]. [10] has made a review of the operational status of the Rusal-Alscon with a view of meeting best practices in operations and safety standards. The main objective of the research is to establish the effect of aluminium smelting on the air quality at/near the Rusal Alscon plant at Ikot Abasi. The research is also a fact finding mission to determine whether the smelting operations in the plant conform to international best practice.

METHODOLOGY

Direct data were captured in the course of this study. The air quality samples were captured close to plant site at points A, 0.5km north of the factory site. At point B 4km South of the factory site, sample was also collected. Similar sample was also collected at point C, 11km east of factory site and D 12km north of the factory site. Control samples of air quality were collected from Ikot Usung village about 60 kilometers from the plant site. The air quality samples collected were analyzed. Interviews were conducted with experts and plant operators to draw conclusions with the analyzed data.

RESULTS AND DISCUSSION

Table 1 shows the values of air quality samples collected around the plant site. Table 2 similarly

shows the air quality result of the control sample at Ikot Usung Village. Table 3 shows the standard and recommended air quality results.

TABLE 1: Metrology and Air Quality Result for communities around Rusal Alscon

DATA POINT	Noise (dB)	NO_2 (ppm)	SO_2 (ppm)	H_2S (ppm)	CO (ppm)	NH_3 (ppm)	Cl_2 (ppm)	HCN (ppm)	SPM (ppm)	T °C	RH
A	54.4	0.13	0.2	0.6	8.8	3.0	0.3	1.0	3.0	30	42
B	69.1	0.12	0.15	0.5	8.0	2.5	0.2	<0.1	2.0	29	40
C	57.3	0.1	0.1	0.4	7.0	2.0	0.2	<0.1	2.0	31	43
D	73.7	0.1	0.1	0.4	7.0	2.0	0.2	<0.1	1.0	30	42
E	61.8	<0.1	<0.1	0.4	7.0	1.0	0.1	<0.1	1.0	32	42

Note

Point A-Close to the proposed Akwa Ibom State Refinery- 0.5km North of Smelter Plant factory

Point B-Sir Udoma round about- 4km South of Smelter Plant factory

Point C- Methodist Church Nigeria - 11 km East of Smelter Plant factory

Point D Ette town market 10 km West of Smelter Plant factory

Point E Essene town of Ikpa Nsung Assang- 12 kmNorth of Smelter Plant factory.

The emitted values of nitrogen dioxide, sulphur dioxide, hydrogen dioxide and carbon monoxide shown in Table 1 are much higher than the recommended values in Tables 3 . At point A the amount of nitrogen dioxide recorded is 0.13 ppm while the recommended standard is 0.021 ppm,

the lowest recorded at point E is still significantly higher than the standard. More worrisome is the amount of hydrogen sulphide in the range of 0.4 ppm-0.6ppm around the plant. The recommended emission rate is 0.0797ppm hydrogen sulphide is very injurious to health and can cause instant death over a long time of exposure. Thus for a plant that is expected to run continuously throughout the year with minimal down time the residents around are thus exposed to danger. The amount of particulate matter (SPM) varies between 1.0ppm and 3.0ppm while the standard is 0.022ppm. The temperature distribution at A 0.5km from the plant is $30^{\circ}C$ which is a little higher than the expected ambient temperature is $27^{\circ}C$ at the time conducting this research. Higher temperature can cause discomfort to humans and may affect some economic trees in the nearest communities. The humidity of 42% is within the recommended standard has shown in Table 3. The sound pressure to the surroundings lies between 54.4 and 73.7 dB. These are much higher than 50 dB recommended for residential areas in Table 3. These results show the severe impact of Aluminium operation with poor or sub-standard emission control on the air around the environment. It is worrisome if these are allowed to continue over the economic life time of the plant

The air quality results at Ikot Usung village are better than those at the plant site but fall short of the recommended standards. More worrisome is the quantity of hydrogen sulphide which at 0.1ppm is still much higher than the maximum of 0.0797ppm recommended. The high rates of nitrogen dioxide, sulphur dioxide, and carbon dioxide could be attributed to vehicular, petrol and diesel engine operations and human activities , this is also not without diffusion of gases from process plants in the region which Rusal-Alscon is operating. The average value of chlorine 0.2ppm at both the factory site and neighboring villages is so high quite above the acceptable limit of 0.01ppm which can be injurious to inhabitants of that environment. Also cyanide has an

average value of less than one ($< 1.0\text{ppm}$) as against a standard value of 1.0ppm which is within the tolerable limit thus not likely to pose a serious problem to the inhabitants of that environment.

TABLE 2 : Air quality results around Ikot Usung Village , Ikono Clan , Uyo L.G.A

DATA POINT	Noise (dB)	NO_2 (ppm)	SO_2 (ppm)	H_2S (ppm)	CO (ppm)	NH_3 (ppm)	Cl_2 (ppm)	HCN (ppm)	SPM (ppm)	T $^{\circ}C$	RH	Pressure mmHg
3 km East of Ikot Usung	38	0.1	0.15	0.15	4.0	2.0	0.1	<1.0	0.39	31	34.5	727.5
3km West of Ikot Usung	40	0.1	0.1	0.1	4.0	2.5	<0.1	<0.1	0.41	31.5	36	728
3 km South of Ikot Usung	43	0.1	0.16	0.16	4.0	2.3	0.1	<0.1	0.37	32	37	729.5

These results show the need of more researches in this direction in order to determine sources of these gases and ways of reducing their emission to the environment. Table 3 presents air quality standard by WHO and USEPA as adopted for discussion in this work

121 **TABLE 3 Air quality standards by World health Organization(WHO) and USEPA**

SPM_{10} ppm (p/a)	NO_2 (ppm) (p/a)	SO_2 (ppm(p/a	H_2S (ppm) (p/a)	CO (ppm) (p/hr)	NH_3 (pp m)	$Temp.^{\circ}C$	RH(mm)	Cl_2 ppm	HCN ppm	Noise (dB)
0.022	0.021	0.026	0.0797	20	NIL	27-29 ⁰ C	25%- 60%	0.01	1.0	50

122 Source : [11], [12]

123 CONCLUSIONS /RECOMMENDATIONS

124 From this research it is clear that the Rusal-Alscon is not operating within the standards of best
 125 practice in the industry as shown on Table 2. The carbon dioxide, carbon monoxide, hydrogen
 126 sulphide, nitrogen (iv) oxide, and ammonia emission levels at the plants and its environments
 127 are all above the recommended levels for safety. Operational and maintenance audit of the plant
 128 is recommended to save human and the environment from its effect. Regular public awareness
 129 on the effect of these plant emissions is also necessary.

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