

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

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

25 The Rusal-Alscon plant gets its raw materials from Republic of Guinea in West Africa. The plant
 26 utilizes the Bayer process in its Aluminium production. Two to three tons of bauxite are required
 27 to produce one tone of alumina and two tons of alumina are required to produce one tone of
 28 aluminium metal. Alumina is further reduced into aluminium in aluminium smelter plant using
 29 Hall-Heroult process. There are two primary technologies using the Hall-Heroult process-The
 30 Solderberg cell and the Prebake cell. Modern primary aluminium production facilities use a
 31 variant on Pre;bake technology called Centre Worked Pre-bake(CWPB) technology. A key
 32 feature of this process is the enclosed nature of the process Emissions from the cells are very
 33 low, less than 2% of that generated. The balance of the emission is collected inside the cell itself
 34 and carried away to very efficient scrubbing system which removes particulates and gases [2].
 35 Computer technology controls the process down to the finest detail, which means that occurrence
 36 of the anode –the production of Perfluorocarbons (PFCs) produced can be minimized. The
 37 aluminium industries have standard practices governing its operations. Emissions from
 38 alumimum smelting is generally categorized under class 3 indicators [3].It is highly hazardous,
 39 carcirogenic, tetratogenic, mutagenic and highly toxic. The pollutants are capable of causing
 40 harmful effect to health of the workers, fauna and vegetation and the safety of the community
 41 .The concentration if exceeded may affect the health of the population is called primary pattern.
 42 Any concentration with minimum adverse effects on the well-being of the population is
 43 classified as secondary pattern. The emissions into the atmosphere include sulphur dioxide,
 44 carbon dioxide, ozone, nitrogen dioxide, fluorides, polycyclic aromatic hydrocarbons(PAHs),
 45 perfluorocarbons (PFCs), hydrogen fluoride-gases, sodium and aluminum fluorides and unused
 46 cryolite as particulates unless carefully controlled are very toxic to the vegetation around the
 47 plant [3b] and [4]. These particulates eventually get into air, soil and water. Research work on

the effects of aluminium smelting on soil and water at the plant site and the environment at Rusal-Alscon are available [5]; [6]. 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] .[9] 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 and control samples collected from Ikot Usung village about 60 kilometer 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

Tables 1a and b show the values of air quality samples collected around the plant site .Tables 2a and 2b similarly show the air quality result of the control sample at Ikot Usung Village. Tables 3a and 3b show 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

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

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C	57.3	0.1	0.1	0.4	7.0
D	73.7	0.1	0.1	0.4	7.0
E	61.8	<0.1	<0.1	0.4	7.0

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70 The emitted values of nitrogen dioxide, sulphur dioxide, hydrogen dioxide and carbon monoxide
71 shown in Table 1a are much higher than the recommended values in Tables 3a . At point A the
72 amount of nitrogen dioxide recorded is 0.13 ppm while the recommended standard is 0.021 ppm,
73 the lowest recorded at point E is still significantly higher than the standard. More worrisome is
74 the amount of hydrogen sulphide in the range of 0.4 ppm-0.6ppm around the plant. The
75 recommended emission rate is 0.0797ppm hydrogen sulphide is very injurious to health and can
76 cause instant death over a long time of exposure. Thus for a plant that is expected to run
77 continuously throughout the year with minimal down time the residents around are thus exposed

to danger. The amount of particulate matter is lies between 1.0ppm to 3.0ppm while the maximum stipulated 0.022ppm. The temperature distribution at A 0.5km from the plant is 30° C which is a little higher than the expected ambient temperature is 27° 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 3a. 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 3b. These results shown 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

TABLE 1b: Metrology and Air Quality Result for communities around Alcon

DATA POINT	NH_3 (ppm)	Cl_2 (ppm)	HCN (ppm)	SPM (ppm)	T ° C	RH
A	3.0	0.3	1.0	3.0	30	42
B	2.5	0.2	<0.1	2.0	29	40
C	2.0	0.2	<0.1	2.0	31	43
D	2,0	0.2	<0.1	1,0	30	42
E	1.0	0.1	<0.1	1.0	32	42

Note

Point A-Close to the proposed Akwa Ibom state refinery- 0.5km from smelter plant

Point B-Sir Udoma round about- 4km form smelter plant

Point C- Methodist Church Nigeria - 11 km from smelter plant

Point D Ette town market 10 km from smelter plant

Point E Essene town of Ikpa Nsung Assang- 12 km from smelter 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 engines, diesel engines and human activities , this is also not without diffusion of gases from process plants in the region which Rusal-Alscon is one.

TABLE 2 a: 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)
1	38	0.1	0.15	0.15	4.0	2.0
2	40	0.1	0.1	0.1	4.0	2.5
3	43	0.1	0.16	0.16	4.0	2.3

TABLE 2 b: Air quality of control sample –at Ikot Usung Village , Ikono Clan , Uyo L.G.A

DATA POINT	Cl_2 (ppm)	HCN (ppm)	SPM (ppm)	T °C	RH	Pressure mmHg
1	0.1	<1.0	0.39	31	34.5	727.5
2	<0.1	<0.1	0.41	31.5	36	728
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.

107 **TABLE 3 a Air quality standards by World health Organization**

SPM_{10}	NO_2	SO_2	H_2S	CO	NH_3
ppm (p/a)	(ppm) (p/a)	(ppm(p/a	(ppm) (p/a)	(ppm) (p/hr)	(pp m)
0.022	0.021	0.026	0.0797	20	

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109 **TABLE 3 b Recommended temperature, relative humidity, sound level for homes**

$Temp.^{\circ}C$	RH(mm)	dB
$27^{\circ}C - 29^{\circ}C$	25%-60%	50

110 Sources[10], [11].

111 CONCLUSIONS /RECOMMENDATIONS

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

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