Effect of Aluminium Smelting Emissions on Water at Rusal Alscon Ikot Abasi

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Abstract

This paper is the study of the impact of Aluminium smelting on Ikot Abasi environment arising from the operational activities of Rusal-Alscon plant. The research was conducted by the collection and analysis of water samples at the plant site and host community. A control sample 100km from the plant sit a was also analyzed. These were compared with the Nigerian standard for drilling water quality .The analyzed sample results from the plant/host community contained pollutants in water that markedly exceeded the benchmarks standards. It is recommended that the Nigerian government should conduct a detailed assessment of the Aluminium smelting operations at Ikot Abasi to prevent serious environmental problems.

Keywords : ,Aluminium smelting, emissions, pollutants, water, environment

Introduction

Aluminium is never found in nature as an element owing to its affinity for oxygen (Calister, 1996). It is the third largest abundant element in the earth crust. Aluminium hydroxide and bauxite is the basic raw material for primary Aluminium production. The major bauxite deposits of the world are located in the tropics and Mediterranean. 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.

The Rusal-Alscon plant gets its raw materials from the west African country of Guinea. The plant utilizes the Bayer process in its Aluminium production. Two to three tons of bauxite are required to produce one tone of alumina and two tons of alumina are required to produce one tone of Aluminium metal. Alumina is further reduced into Aluminium in Aluminium smelter plant using Hall-Herouth process. There are two primary technologies using the Hall-Herouth process-The solderberg cell and the prebake cell. Modern primary Aluminium production facilities use a variant on pre;bake technology called centre worked pre-bake(CWPB) technology. A key feature of this process is the enclosed nature of the process Emissions from the cells are very low, less than 2% of that generaed. The balance of the emission is collected inside the cell itself and carried away to very efficient scrubbing system which removes particulates and gases (Environmental effects of airborne fluorides from aluminuim smelting, 2003). Computer technology controls the process down to the finest detail, which means that occurrence of the anode –the production of perfluorocarbons (PFCs) produced can be minimized. The Aluminium industries have standard practices governing its operations. Emissions from Alumimum smelting is generally categorized under class 3 indicators (Measuring the environmental impact of Aluminium production, 2011) .It is highly hazardous, carcirogenic, tetratogenic, mutagenic and highly toxic. The pollutants are capable of causing harmful effect to health of the workers, fauna and vegetation and the safety of the community .The concentration if exceeded may affect the health of the population is called primary pattern.

Any concentration with minimum adverse effects on the well-being of the population is classified as secondary pattern. The emissions into the atmosphere include sulphur dioxide, carbon dioxide, zone, 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 (Environmental literacy council 2008) and Anthony(2008). These particulates eventually get into water. Hydrogen fluoride can cause long cancer, bladder cancer, bone deformity, teeth decay and many untold hazards (Aluminium smelter in the Eastern cape , 2007).This is in contradiction to the occupational health practice in industries (Igbokwe, e tal 2008) .Uko (2000) 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 water condition 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 standards.

Methodology

Direct data were captured in the course of this study. The soil samples were obtained from Uta Ewa/Plant site and control water samples collected from Ntak Inyang about 100 kilometer from the plant site The water samples was employed in the analysis. . Interviews were carried out with experts and plant operators to draw conclusions with the analyzed data.

Results and Discussion

Table 1 shows the analyses of water samples obtained from / the host community. These results are compared with the Nigerian standard for drilling water quality (NSDWQ).The presence of cadmium is markedly above the stipulated limit and not acceptable. The presence of cynanide , aluminium and ammoonia above the regulatory limit are also of concern. The BOD result is not acceptable. Table 2 presents the control sample results at Ntak Inyang - about 100 kilometer from the plant site .By comparing these sample results from plant/Uta Ewa along side with NSDWQ framework the negative impact of Aluminium smelting on the water at Ikot Abasi is evident. The results present a clear lack of best practices by the plant operators to safety and environmental standards and also the failure of the regulatory authorities- The Federal ministry of mines and power and the ministry of Environment to perform their duties.

Table 1: Plant site and Uta Ewa water sample analyses results compared to NSDWQ

S/N	Parameter	Plant site drain water	Uta Ewa . Imo River water	NSDWQ	Remarks
1	appearance	Brownish		clear	
2	Colour (H.U)	5	5	15	Acceptable
3	Acidity	4	-	4.5-8.2	Acceptable
4	Temperature $^{\circ}C$	28.2	28.9	Ambient	Tolerable
5	pH	6.77	7.21	6.5-8.5	Acceptable
6	Copper(Cu) mg/l	0.35	0.24	1	Acceptable
7	Iron(Fe)mg/l	0.19	0.16	0.3	Acceptable
8	Salinity	0.1	0.6	0.50	unacceptable
9	Electrical conductivity $\mu s/cm$	142.7	16.45	1000	Acceptable
10	Total dissolved solids(mg/l)	62.5	8.33	500	Acceptable
11	Manganese mg/l	0.047	0.039	-	Inconclusive
12	Turbidity(NTU)	8.37	26.5	5	unacceptable
13	Nitrite (No_2)	0.025	0.015	0.2	Acceptable
14	Ammonia (NH_3) mg/l	10.2	0.09	0	Unacceptable
15	Phosphate (PO_4) mg/l	1,280	0.149	3.50	Acceptable
16	Suspended solids mg/l	54	24	10	Unacceptable
17	Total silica (S_io_2)	0.144	0.073	17	Acceptable
18	Sulphate	11	1	1000	Acceptable
19	Chloride	1.4	0.4	250	Acceptable
20	Aluminium	0.6	0.02	0.2	Unacceptable
21	Selenium(Se) mg/l	0.05	0.06	-	Heavy meta
22	Chromium(Cr) mg/l	0.05	0.02	0.05	Acceptable
23	Cadmium(Cd) mg/l	0.09	0.001	0.003	unacceptable
24	Total hardness mg/l	50	-	500	Unacceptable
25	Calcium hardness mg/l	44	148	75	Acceptable
26	Magnesium hardness mg/l	6	-	0.2	Unacceptable
27	Total alkalinity mg/l	7.2	22.8	100-200	Acceptable
28	Methyl alkalinity	7.2	22.8	100-200	Acceptable
29	Cynanide (Cn) mg/l	0.02	0.04	0.01	Unacceptable
30	BOD(mg/l)	0.2	0.2	0.1	Unacceptable
31	Nitrates (No_3)	0.00	0.015		Acceptable

Table 2: Control water sample results from Ntak Inyang in Itu L.G.A Compared to NSDWQ

S/N	Parameter	Ntak Inyang	NSDWQ	Remarks
1	Apppearance	Brownish	Clear	
2	Colour (H.U)	10	15	Acceptable
3	Odour	odourless	Unobjectionable	Acceptable
4	Temperature $^{\circ}C$	27.4	Ambient	Tolerable
5	pH	6.62	6.5-8.5	Acceptable
6	Copper(Cu) mg/l	0.01	1	Acceptable
7	Iron(Fe)mg/l	0.25	0.3	Acceptable
8	Salinity	0.00	0.5	Acceptable
9	Electrical conductivity $\mu s/cm$	12.29	1000	Acceptable
10	Total dissolved solids(mg/l)	4.8	500	Acceptable
11	Manganese mg/l	0.046	-	Acceptable
12	Nitrates (No_3)	0.06	50	Acceptable
13	Nitrite (No_2)	0.015	2.0	Acceptable
14	Ammonia (NH_3) mg/l	0.11	0	Unacceptable
15	Phosphate (PO_4) mg/l	0.172	3.5	Acceptable
16	Suspended solids mg/l	4.2	10	Acceptable
17	Total silica (S_io_2)	0.029	17	Acceptable
18	Sulphate	6	1000	Acceptable
19	Chloride	0.5	250	Acceptable
20	Aluminium	0.02	0.2	Acceptable
21	Selenium(Se) mg/l	0.12	-	Heavy metal
22	Chromium(Cd) mg/l	0.00	0.05	Acceptable
23	Cadmium(Cd) mg/l	0.002	0.003	Acceptable
24	Lead(Pb) mg/l	0.009	0.01	Acceptable
25	Zince(Zn) mg/l	0.04	3	Acceptable
26	Barium(Ba) mg/l	5	0.7	Acceptable
27	Fluoride(F) mg/l	BD	1.5	Unacceptable
28	Dissolved Oxygen (O_2)	0.7	0.001	Acceptable
29	Cynanide (Cn) mg/l	0.002	0.01	Acceptable
30	BOD	0.00	0.015	Acceptable

Conclusions /Recommendations

The result indicates the presence of cadmium in unacceptable level. The level of ammonia and cyanaide are not tolerable. The health and safety of the workers could be affected and the community not exempted. Since most of the local inhabitants are peasant farmers, their yield and thus means of livelihood will reduce. It is recommended that The Nigerian Ministry of Power and Steel, Ministry of Environment and the Akwa Ibom State Ministry of Environment should liaise with relevant authorities to perform a detailed assessment of the operations of Rusal-Alscon to established the extent of compliance to the International practice in the Aluminuim industry.

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