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INDUSTRIAL AIR POLLUTION IN ZAMBIA AND AVAILABLE AIR POLLUTION CONTROL TECHNOLOGY

Paper to be presented at the

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by

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1.0 INTRODUCTION

Industrial air pollution in Zambia is a localized problem, and occurs in areas where industrial activities take place (activities such as fertilizer and cement production, and food processing) as well as the quarrying and mining activities, and the metallurgical processes associated with the latter.

Some of the major emitters of air pollutants are Zambia Consolidated Copper Mines (ZCCM), Nitrogen Chemicals of Zambia (NCZ), Chilanga Cement Works, Ndola Lime (a subsidiary of ZCCM), food processing industries and quarries (United Quarries and Crushed Stone Sales).

Major emissions include sulphur dioxide (SO_2), oxides of nitrogen (NOx) and particulate emissions (some of which contain heavy metals). Emissions of carbon dioxide and carbon monoxide occur from lime production and the combustion of fossil fuels such as coal and heavy fuel oil.

The effects of SO_2 on the environment is more pronounced in Kankoyo Township in Mufulira. The vegetation is scant and it is very difficult to grow vegetables in the area. The paint on the walls of houses has peeled off, most probably as a result of acid rain.

Particulate emissions in the Chilanga area have produced a film of dust on the plants and property in the area and there have been some complaints of respiratory diseases such as agravated bronchitus. Experimental results at Mount Makulu Research Station were also affected by the pariculates.

Problems associated with the control of emissions include lack of financial resources to put in place emission control equipment, old worn-out infrastructure which results in fugitive emissions, old and out-dated technologies which were put in place without much consideration for envionmental protection, general negligence or lack of concern for the protection of the environment, as well as ignorance.

However. no study has been carried out as yet on air quality in Zambia.

2.0 SOURCES OF AIR POLLUTION AND AVAILABLE TECHNOLOGY

2.1 ZCCM

Mining of copper bearing ores on the Copperbelt region (about 400 kms along the Great North Road) results in emissions of dust, and the processing of these sulphide-bearing ores results in the generation of SO_2 gas, as well as dust. It is estimated that approximately 200,000 tonnes of SO_2 are emitted from ZCCM and other industries, annually.

Control technology

SO_2 and Particulates

SO_2 is trapped and converted into sulphuric acid (H_2SO_4) at Nkana Division, one of the five divisions of ZCCM. The particulate matter in the flue gas is removed by scrubbing with water and Electrostatic Precipitators (EPs) prior to conversion into sulphur trioxide (SO_3).

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At Mufulira Division no acid plant exists and there is no SO_2 capture. However, the stack height on the smelter has been increased and a venturi system installed so as to increase gas velocity and hence dilution. However, despite the fact that there is no SO_2 capture, particulates are removed from the flue gas, as at Nkana Division, prior to discharge. ZCCM is reluctant to set up an acid plant at Mufulira for fear of having a large excess of acid which has no market. since the acid produced at Nkana is sufficient to cater for the needs of ZCCM. However. sometimes shortfalls occur and acid has to be imported from the Republic of South Africa.

NCSR carried out a study on levels of SO_2 in Kitwe town and the hourly and daily levels were 2 000 and 400 micrograms per cubic metre respectiely as compared to WHO standards of 600 and 200 respectiely.

Particulates containing heavy metals

At Kabwe Division, processing of Zinc (Zn) and Lead-bearing (Pb) ores resulted in particulate emissions containing the heavy metals of Zn Pb and Cadmium (Cd), until March, 1993 when the part of the plant responsible for most of the emissions, the Imperial Smelter Furnace (ISF), was shut down.

A study conducted by National Council for Scientific Research (NCSR) on levels of these metals in soil and vegetables, revealed high levels of Pb and Cd of about of 50 - 320 and 2 - 6 micrograms per cubic metre, respectively.

2.2 NCZ

Located about forty-four kilometers (44 km) south of Lusaka, NCZ is involved in the manufacture of fertilizers and explosive grade ammonium nitrate (NH_4NO_3), and other chemicals. Sulphuric acid (H_2SO_4) and nitric acid (HNO_3), used as raw materials, are also manufactured at the plant, and result in SO_2 (250 mt/yr) and NOx (900 mt/yr) emissions respectively.

Particulate emissions include fertilizer (NH_4NO_3 and NPK) dust (1400 and 100 mt/yr, respectively), coal dust from the coal handling plant (200 mt/yr), and ammonia (NH_3) (80 mt/yr).

Control technology

SO_2

The SO_2 emissions occur mostly when the cyclones that draw the gas for conversion to acid are mal-functioning. No control technology exists for controlling the emissions to the atmosphere, as yet.

NOx

The technology for conversion of NO_2 into di-nitrogen oxide (N_2O) by passage of the NO_2 over a platinum (Pt) or vanadium pentoxide (V_2O_5) catalyst is too costly for the company. Reduction in emissions is achieved by the use of chilled water in the absorption towers, so as to increase NO_2 absorption.

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Ammonia and Ammonium Nitrate dust

No control technology in place.

NPK

Used oil is being sprayed on the fertilizer to reduce dust emissions

Coal Dust

Most of the dust emissions were from the old coal-handling plant which has inefficient dust collecting equipment, and emissions were controlled by scrubbers and EPs in that order. However, there is a new plant on line and emissions are negligible.

2.3 Chilanga Cement Works

This cement producing company is situated a few kilometers south of Lusaka and has a plant in Ndola on the Copperbelt. The main emission is particulate matter (cement dust) which passes out of the kiln stack with the combustion gases.

Most of the emissions occur from one of the kilns in Ndola which emits five times the emissions from the other kilns (500 mg/m^3).

Control technology

Limestone dust produced from the primary crusher is abated by the use of water sprinklers, and from the secondary crusher by suction. Cement dust from the kiln stacks is the major source of emissions and is abated by EPs. However, the EPs are only in operation 80 % of the time, and when removed for cleaning, the emissions go on unabated. However a project to reduce emissions is currently being considered by DANNIDA.

.4 Ndola Lime

Ndola Lime produces both anhydrous and hydrated lime , CaO and $Ca(OH)_2$ respectively from limestone.

Emissions include dust (33,150 tonnes/yr) and carbon dioxide (CO_2) (121,050 tonnes/y).

Control technology

The flue gas that is emitted to the atmosphere contains the CO_2 and dust. The dust is controlled by the use of pneumatic filters and electro filters. The electrical filters are only 80 % efficient as they are in need of rehabilitation, which will be done in the next five years. Residual dust (dust emitted) is about 1.5% of total dust produced in the rotary kiln.

2.5 Indeni Petroleum Refinery

Hyrocarbons are the main emissions. They are controlled by combustion at the point of discharge to the atmosphere.

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2.6 Food Processing Industries

Some food-processing industries such as Zambia Cold Storage Corporation (ZCSC), a meat-processing industry. produces offensive odours from its operations.

Control technology

The vapours containing these offensive odours are condensed and released into the drain where there effect is minimal. However. the machinery for the control of these offensive odours is old and frequent breakdowns result in the gases being released into the atmosphere unabated. This is a nuisance to people in the surrounding area. However plans are in place to rehabilitate the equipment.

2.7 Quarries

The main emission from the quarries is dust. This occurs during blasting and crushing. No control exists for the former but dust emissions from the crushing stage are controlled by wetting the rock.

2.8 Vehicular emissions

Emissions from motor vehicles are mainly CO_2, NOx, CO, particulates, smoke, Pb and some SO_2. It is estimated that about 60 000 tonnes of vehicular emissions are released into the atmosphere annually. of which 40 000 tonnes are CO emissions. while NOx and HCs constitute about 6000 tonnes each. Others are SO_2 (1,000), particulates (2,000) and Pb (500).

There are a lot of smoking vehicles on the roads. Maintenance of vehicles is difficult as it is a costly measure in Zambia and most vehicle owners cannot afford to. These poorly maintained vehicles emit a lot of black smoke, CO and particulates. as fuel combustion is inefficient.

Another aspect that is still not controlled in Zambia is the level of Pb in petrol.

3.0 CONCLUSION

Very little work has been done on air pollution in Zambia. The extent of air pollution and the ambient air quality country-wide in Zambia is still unknown and is yet to be determined. Emissions from the various mining and industrial activities need to be controlled and levels of pollutants in the ambient air monitored. This responsibility lies with the Air and Noise Pollution Control Unit of the newly established Environmental Council of Zambia, which is in the process of acquiring air pollution monitoring equipment and drafting regulations for air pollution control.

The common problem faced by industry seems to be the lack of financial resources. In most cases funds are being sourced from various donor

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organizations for the control of emissions into the atmosphere. For example Chilanga Cement is being assisted by the Dannish International Development Agency (DANNIDA) and NCZ by the Japanese International Co-operation Agency (JICA), and ZCCM is sourcing assistance from the World Bank. At least an effort is being made to abate emissions.

The installation of emission abatement machinery, the introduction of modern environmentally friendly technologies, and the rehabilitation of existing infrastructure so as to cut down on fugitive emissions is vital for the control of emissions into the atmosphere. Captured gases can also be converted into useful products, provided a market exists. Alternatvely, the trapped gases can be converted into less toxic substances and disposed of, provided this measure is more environmentally friendly than releasing the gases into the atmosphere. For example there is an argument that it would be better to emit SO2 into the atmosphere than to form excess acid, neutralize it and dispose of it by releasing it into a water body or landfilling it.

Apart from enforcement of the regulations, creation of environmental awareness amongst the polluting companies and the public is necessary. Environment is a new field in Zambia and, therefore, most people are either ignorant of the dangers of air pollution to human health and the environment or they are simply negligent.

The control technology for dust emissions in most cases is by the use of EPs, scrubbers or both. And for quarries. wetting-down.

SO_2 can be controlled by conversion into H_2SO_4, elemental S (though this is expensive) or gypsum (calcium sulphate - $CaSO_4$). In Zambia, ZCCM say that it is expensive to set up an acid plant and even if the funds were available they are reluctant to set up another acid plant at Mufulira Division for fear of producing a large excess of H_2SO_4 which has no market. And there is also no market for gypsum which can be produced from the acid.

They would prefer to increase the stack height, though this would also be expensive. However. increasing stack height does not solve the problem and eventually .the effects will be felt.

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