Journal of Biological Sciences and Bioconservation
Volume 6, Number 1, 2014
ISSN: 2277-0143

SUSTAINABLE CHEMISTRY AS A TOOL FOR RE-SHAPING THE NIGERIA CHEMICAL INDUSTRY IN THE AREA OF ENVIRONMENTAL PROTECTION

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ABSTRACT
Sustainable Chemistry seeks to reduce the impact of Chemistry on the environment by preventing pollution and its source and using fewer natural resources. The focus of this paper, therefore, is to explain the role the chemist can play in assisting chemical industries in meeting the needs of society at the same time not harming the surrounding and invariably the people.

Keywords: Sustainable Chemistry, Environment, Re-Shaping, Protection.

INTRODUCTION
Chemistry, according to Okiemen (2007), is the branch of science that studies the properties, composition and structure of matter together with the associated changes (physical and chemical) and how such changes impact on the welfare of society. And according to Agho (2005), the concept of waste has no basis in chemistry. Nature produces no waste, and chemistry is a natural science. What society calls waste can be converted by the chemist. But our environment as it is today is littered with all manners of bye-products from our industries serving as wastes or pollutants. And these industries are springing up on daily basis, thus giving rise to continual supply of waste to the environment without the corresponding capacity to deal with it. A walk through our cities and even villages will show you the level of waste/pollutants ranging from solid, aqueous and gaseous. To say this is telling on the image of the country is an understatement. The country is branded as a dirty country. And remember, cleanliness, they say is next to Godliness.

The focus of this paper, therefore, is to explain the role the chemist can play in assisting industries in meeting the needs of society at the same time not harming the surrounding and invariably the people. This will inevitably give the country a new name (good name).

LIFE FORMS AND THEIR INTERDEPENDENCE

One thing interesting about nature is its cyclical processing of both organic and inorganic components of the planet earth. The systems that support life on the planet are the part of biosphere. The plants sustain animal world directly or indirectly. In the end, the microbes help to process all dead matter back into the biosphere for fresh recirculation.

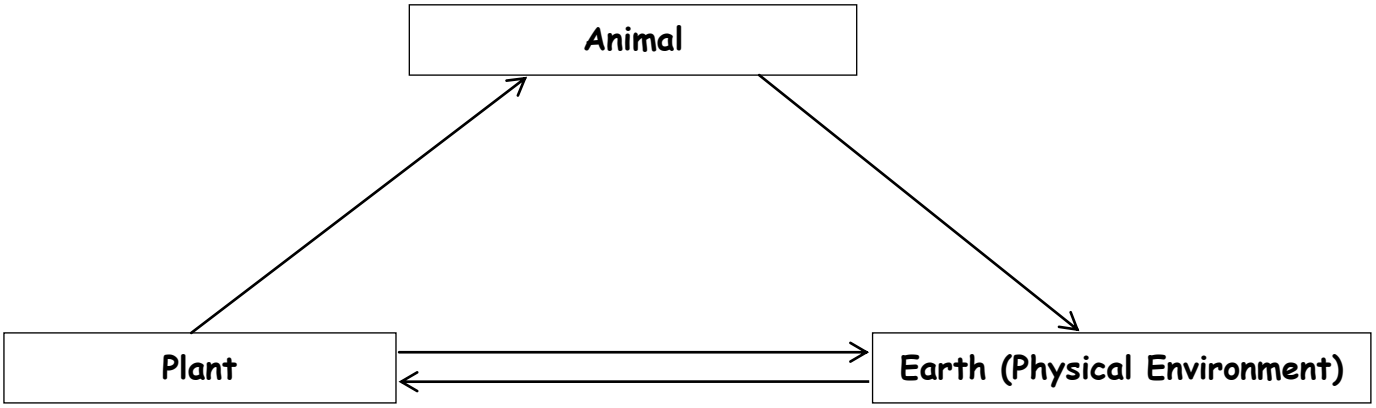

Fig. 1: Interdependence of Life Forms and the Environment

To give more light to the above model, let's look at nitrogen cycle, which is a circulation of nitrogen between air and plants. It is a series of processes by which nitrogen is converted from a gas in the atmosphere to nitrogen-containing substances in soil and living organisms, and then reconverted to a gas. The main chemical transformations are performed by micro organisms and include nitrogen fixation, nitrification and denitrification.

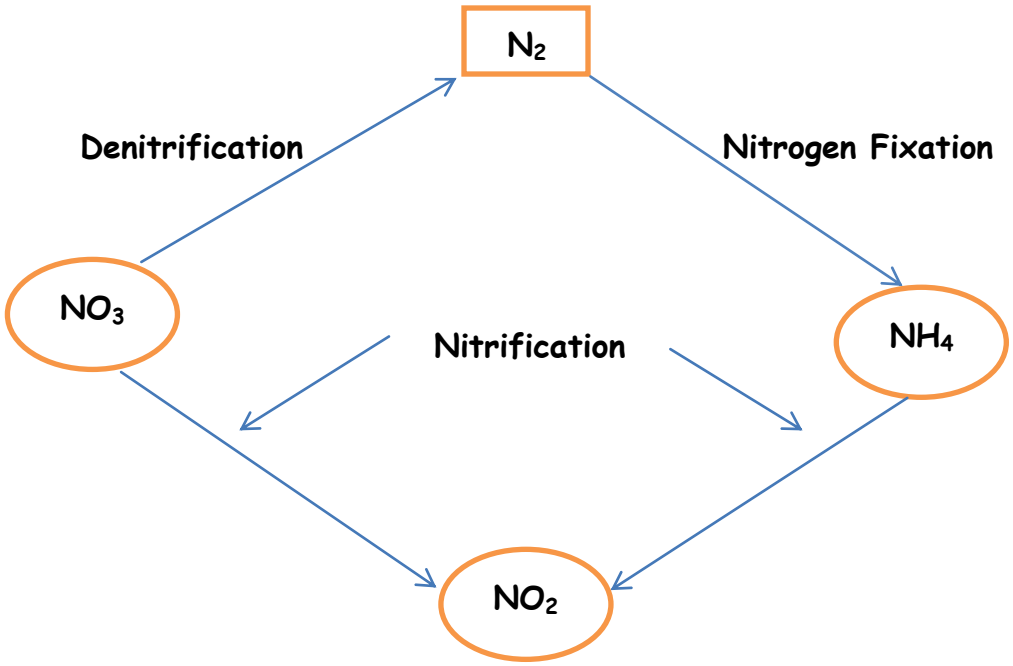

Fig. 2: Nitrogen Cycle

A careful study of this cycle shows convincingly that there are no wastes in nature in the sense that; all products and bye-products are useable for the other processes. Plants derive their nutrients from soil for subsistence and growth. Animals live on plant and both kingdoms replenish the earth when they decay. The environment does not see or feel anything new. In nature, there are no wastes. All natural processes of conversion are looped and converted to one another Mukhlyonov (1979).

Nature's model of production may be described by the model in Fig. 3 below. Three production houses labeled A, B, C are part of an industrial cluster where the output from one industry is an input for the next. With such a cluster, there is no waste. This is then the ultimate challenge for the chemist; to organize all production processes into cluster where the bye-products of a factory are raw materials for another. This will eliminate wastes/pollution.

It is interesting to note that our industries as we know them today have linear mode of production. Here, raw materials are converted into products and the bye-products may be wastes or pollutants to the environment. In a nutshell, industrialization is generating wastes faster than we are able to get rid of, and in some cases, beyond our means to dispose of. The linear mode of production is not sustainable, and the chemist must practice his art in line with nature's model

of production. Let's look at two out of many industries in this country to give practical examples.

Building Industry

The building industry rests much on cement products. Cement is a mixture of calcium materials, including tri-calcium silicate ($3CaO.SiO_2$), tricalcium aluminate ($3CaO.AlO_2$) and calcium oxide (CaO).

The major process of cement production is the decomposition of limestone to give CaO, and CO_2. For every one mole of CaO produced one mole of CO_2 is expelled. By implication in a cement industry, for every ton of clinker produced, about that much of CO_2 is expelled.

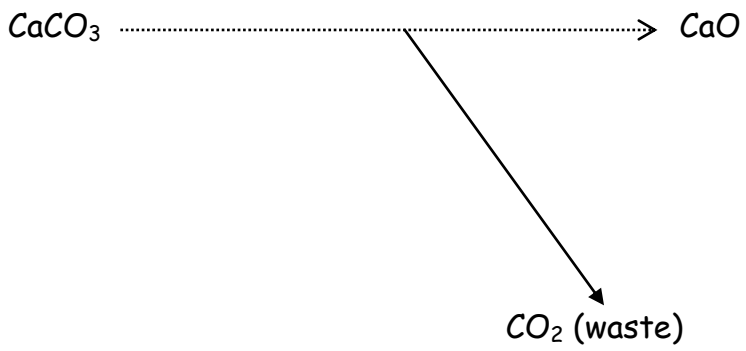

Fig. 4: Calcining

Now let us think of the industries producing cement in Nigeria. How much amount of CO_2 these industries pump into the atmosphere? Your guess is as good as mine. The effect of CO_2 on the environment cannot be over-emphasized. Yet CO_2 even without conversion, except cleaning, has a number of uses that can lead to clustering in cement industry which include; its use in fire extinguisher, carbonating drinks and as dry ice. It can be converted to urea through its reaction with ammonia providing a useful link to the fertilizer industry.

Therefore, a cement factory can lead to the clustering of the following industries: fire-extinguisher industry, carbonating drinks industry, dry ice industry and fertilizer industry.

Polythene Bag Industry

Polythene bags are a wonder to life. They are quite hardy and a truth, they are serving their purpose. But what do we do with them after use? The environment is littered with heaps and heaps of these discarded polythene bags. Our major cities and towns and even villages are an eyesore now because of them. Polythene is synthetic and not produced by nature. We produce them to satisfy our desire; nature therefore rejects it; since it is human creation. And we all know that polythene is non-biodegradable. The chemist can work out conditions that harmlessly convert polythene to other useful products.

CONCLUSION

Conclusively, for man kind to enjoy a clean environment, the chemist must use the power of recreation given to him by God to fashion out ways and means of converting wastes or bye-products of our industries to useful materials copying nature's model. This will lead to an increase in our income base, employment opportunities and a cleaner environment. In effect, this will give our nation a new brand name and we would have been among the most advanced nations in the world by the year 2020. Nigeria then would be embracing the philosophy of Green chemistry, being a chemical research and engineering that encourages the design of products and processes that minimize the use and generating of hazardous substances.

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Reference to this paper should be made as follows: Azuaga, I. Chia *et al.* (2014), Sustainable Chemistry as a Tool for Re-Shaping the Nigeria Chemical Industry in the Area of Environmental Protection. *J. of Biological Science and Bioconservation,* Vol. 6, No. 1, Pp. 85 – 90.