

POLLUTION RESULTING FROM OIL EXPLORATION AND PLASTIC DISPOSAL IN NIGER-DELTA NIGERIA: BIODYNAMICS AND ARTIST'S RECYCLING METHODS AS CONTROL MEASURES

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ABSTRACT

Despite the huge efforts of the government and other key players in Nigeria's oil industry to reduce the volume of gas flaring during oil exploration; very little progress can be seen. Billions of standard cubic feet (SCF) of gas are still flared quarterly, which puts the country air quality at a risk. The country's level of particulate matter is still at 10% ratio. This level of particulate matter (PM) is proven to pose high adverse environmental and health implication such as climate change, acid rain, agricultural loss, physiological effects, air pollution caused by burning of petro chemical products causing the destruction of zinc roof, depletion of the ozone layer, decay of concrete walls/ foundations and economic loss. It is therefore the aim of this paper to engage the use of Biodynamic technology and art-oriented approach to see how most of these chemical products could be converted to art forms by way of recycling for aesthetic purposes and also as street furniture instead of resulting to burning them. With these suggestions therefore, the solution to air pollution problems being faced in the Niger Delta Region of Nigeria will be reduced to its barest minimum. Through Biodynamic, smog from the atmosphere could be absorbed/ purified via a catalytic reaction with sunlight and then turned the smog into harmless salt. Being that this technology has already been validated by European Union Studies to 75% active and also owing to the fact that it's basic constituents such as Titanium oxide and Marble mineral is in commercial quantity abundant in Nigeria, is not to rule out the fact that with proper environmental management and control, the Niger Delta Region will be relieved of these menace of pollution. Moreover, the works of art produced from these chemical wastes can also be exported as income generation for the country. Therefore, it is imperative for this technology and creative ventures to be embraced and developed, to allow for not only improvement of air quality but to also see to the emergence of a product that can bring a new face in the diversification of Nigeria's economy through exportation of these products. This will not only grow the country's Gross Domestic Products, but will also be in line with the developmental vision of the Federal Government of Nigeria.

KEYWORDS: Bio, dynamic, Air pollution, Aesthetics, Air quality, Recycling, Niger Delta, Particulate matter, Titanium, Marble, Catalyst, Economy, Artists, Gas flaring.

INTRODUCTION

Today, the world is experiencing global

warming and climate change. The high increase in the earth's atmospheric and oceanic temperature has its located in the Atlantic coast

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of southern Nigeria and is the world's second largest delta with a significant contributor in the oil and gas activities in the Niger Delta region of Nigeria. Niger Delta is coastline of about 450km. (Awosika,1995) The region has an estimated population of nearly 30 million people (UNDP, 2006). It is the largest wetland in Africa and among the largest in the world (Powell, et al., 1985; CLO, 2002; Anifowose, 2008; Chinweze and Abiola-Oloke, 2009). The Niger Delta region is the hub of oil production in Nigeria and is made up of the following states Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Ondo, Imo and Rivers respectively. (See figure 1)

The region has contributed so much to the growing Gross Domestic Products (GDP) of Nigeria, yet experiences devastating landscape, polluted environment in various forms, adverse health implications. From oil and gas related activities. These activities by the oil and gas industry have led to various forms of land degradation and environmental pollution ranging from regular oil spillage, gas flaring down to other minute defects, such as deforestation, burning of fossil fuel, grazing, construction activities, industrialization, residential use of coal and wood for cooking among other uses. Data released by

the Nigerian National Petroleum Cooperation (January, 2018), showed that 76.42billion standard cubic feet of natural gas were flared in the quarter, up from 62.15billion SCF and 66.66 billion SCF in the second and first quarter respectively.

By implication of the data above, it means that air pollution is hitting record high and its negative effects on the Niger Delta Region cannot be downplayed. Gases such as methane, volatile organic compounds, sulfur dioxide, hydrocarbons are emitted. These gases have the ability to cause harmful environmental hazards such as acid rain, heat stroke, depletion of the ozone layer, attracting and killing of migrating songbirds, agricultural loss, physiological effects, pollution, and destruction of zinc roof, the decay of concrete walls / foundations and economic loss as shown in plate 1. With all these problems of oil and gas related activities here analyzed, it is therefore the intent of this research to seek an environmentally sustainable building material approach, through the production/application of active biodynamic cement technology for purification of the atmosphere of smog and to also provide a better air quality for Nigerians.

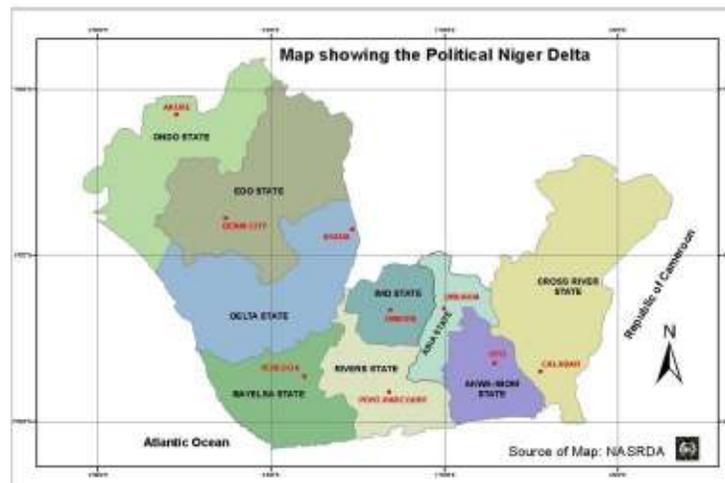


Figure 1: Showing a mapped layout of Niger Delta
Source: NASRDA 2014



Plate 1: Photograph showing gas flaring

Source: www.unep.org October 2009

2.0 NEED FOR THIS PAPER/PROBLEM STATEMENT

Due to oil boom and industrialization in the Niger Delta, the region has experienced rapid population growth, it is also a known fact that the continuous production of oil and gas has led to air pollution of the region. The air pollutants have contributed to the increased greenhouse gases and smog in the atmosphere. Though efforts have been made in cleaning up the environment via enacting of laws and tree planting, there is a need for more efficient and sustainable approach to be developed to synergize and complement other existing measures.

The need for this paper or the research question can be evaluated from three significant points of view namely, Resource Efficiency, Air Quality and Eco Friendly Product Assurance that will benefit the Oil and gas sector and the environment at large. Speaking of *resource efficiency* records have it that Nigeria is abundantly blessed with Titanium ore and marble mineral deposits which are the key constituents for production of biodynamic cements (NMSM, 2016). Advantageously, it will be a cheap way of locally harvesting the mineral resource for production of biodynamic cement and other forms of biodynamic materials for commercial purposes. If biodynamic cement technology is developed and proper sensitization of the public on the benefits of the technology is carried out, there will be huge boost in oil and gas production. This is drawn from the premise that, air pollutants released from gas flaring and other related processes will actively be reduced to a commensurate level equal to the quantity of gas

pollutants released into the environment. The feel that there's an active tool to combat air pollution from the environment, alone is enough to boost oil production capacity. If the government and private individuals can invest the production of affordable and sustainable biodynamic titanium dioxide catalyzed cement, there will be increased construction projects / broader settlement using the product. Its impact(s) shall also be felt in areas of securing clean and pure air for the Niger Delta region. The new technological innovation will also be used in the construction of oil platform components at oil and gas production sites (Off shore). In addition, it will also add more value to the entire landmark of the region and will even go a long way in impacting positively on our country's Gross Domestic Products and export products.

Looking at the need of this research in terms of air quality, report released by Nigerian National Petroleum Cooperation (NNPC) puts Niger Delta at a disadvantage considering the increasing level of PM10/ gases flared on a quarterly basis. It shows that Nigeria flares 26-30percent of her gas annually, with 90percent of it predominantly in the Niger Delta. Environmentally, the percentage of flare is still on the high, hence posses' harmful effects on the ecology of Niger Delta and Nigeria as a whole. For each increased level of PM10 there is a 20 percent higher risk of death. In the light of the above, air purification is very vital to reduce the risk of exposing living beings to the health and environmental effects associated with poor air quality. (World Environment Assessment, 2017). Biodynamic cement (mortar) has the potential to

cut down pollution by 75percent (Italcementi). Owing to that fact, production and application of biodynamic cement technology needs to be encouraged in Nigeria to allow for new and existing building use it to opening channels for cleaner and safer air quality for our cities. Finally, speaking of eco-friendly products biodynamic cement incorporates a wide variety of concepts and strategies during the design and construction process that are driven naturally via photovoltaic effect; which is a vital component of sustainable building. These materials when eventually put to use will enhance greater design flexibility of oil platform related to constructions, better air quality

in the region, health, and efficiency of homes will be properly addressed.

3.0 BIODYNAMIC CEMENT TECHNOLOGY AND ITS APPLICATIONS

Biodynamic cement is a new type of cement developed by Italcementi Company. The cement cleans pollutants from the air automatically by using sunlight (photovoltaic effect) to generate a catalytic reaction that modifies them to useful salts. The salts then wash off the walls when it rains. This technology has been used to build a distinctive building in Milan (The Palazzo Italia). (See plate 2 below)



Plate 2: Photograph showing one of the first buildings in the world to use cement that can clean the air (Palazzo Italia). Designed by: Nemesi & Partners, Source: Don Willmott, XPRIZE contributor, March 27, 2015.

Biodynamic cement is made from Titanium dioxide, scraps of marble and left over aggregates. It uses a titanium catalyst that is activated by ultraviolet light to drive the chemical reaction by turning nitrogen oxide and sulfur dioxide from traffic into inert salts. Manufacturers say it has the potential to cut air pollution by 75 per cent. This by estimation is validated by

European Union studies. Similarly, air purifying building can also be seen in famously smoggy Mexico City, where a hospital building called Torre de Especialidades is shielded by an eye-catching 100-yard-long façade made with unique tiles that have air- scrubbing abilities as seen in plate 3 below.



Plate 3: The façade of the Torre de Especialidades sucks up pollution in Mexico City. (Created by Berlin-based architecture firm Elegant Embellishments)

4.0 Production Mechanism for I. Active Biodynamic (Mortar)

a. Preparation:

Inactive Biodynamic mortar is prepared according to the specified formulation by using a planetary mortar mixer equipped with a steel bowl as follows:

1. Place the dry premix into the mixer.
2. Add the exact amount of water.
3. Mix for 2 minutes.
4. Stop the mixer, check the homogeneity of the mix (absence of apparent solid parts) and scrap the bowl walls.
5. Mix again for 2 minutes.

Source: Technical Data Sheet–Italcementi, Italcementi Group 2014.

b. Pouring:

1. Pour the mix into the mould immediately or keep it in a container ensuring continuous mixing for maximum 30 minutes.
2. For the purpose of obtaining elements with high-quality surface finish, we recommend pouring the mix into vertical moulds made of a rigid material - to avoid deformation in the final elements - with a controlled surface roughness below 50nm.
3. The vertical moulds with demountable walls that are used at CTG / Italcementi Group labs are fitted with a side sealing system which ensures the compression of the material in the mould during the casting and curing steps.
4. Moulds must be fitted with an integrated vibration system to remove any air bubbles possibly entrained during the pouring process and especially in case of thick sections.
5. Its formulation based on fine materials allows achieving perfectly smooth and uniform surfaces as well as an excellent reproduction of mould textures.

Source: Technical Data Sheet–Italcementi, Italcementi Group 2014.

4.1 Composition of I. Active Biodynamic

- a) It is made of a dry premix.
- b) It possesses white photo-catalytic cement containing the TX Active® principle.

- c) Selected aggregate i.e. Carara Marble, Titanium etc and admixtures in the proper proportions.
- d) Water is added to obtain a high flow able white mortar.

4.1.2 Features and Properties of I. Active Biodynamic

- a) It has a beautiful white Colour with great versatility with regard to its excellent physical and mechanical properties.
- b) It has a remarkable strength performance combined to enhanced flow ability which allow for the creation of elements of extremely complex geometry as well as cladding panels for discontinuous façades with hollow sections.
- c) It possesses high aesthetic value via the additional water to meet various architectural challenges through an efficient and reliable process.
- d) It serves as air purifier and achieves an effective reduction of organic and inorganic polluting substances generated by human activities such as oil exploration, burning of fossil fuel, green house gases and other activities associated with air pollution.
- e) It self enhances and preserves over time its aesthetic appeal and reduces the frequency of cleaning and aesthetic maintenance services.

4.1.3 Applications

Biodynamic can be applied in a wide number of ways, ranging from building construction, infrastructural constructions to work of arts, these include:

- a) Cladding Panels for facades.
- b) Decoration complements.
- c) Works of art
- d) Production of kerb stones
- e) Tio-Cem
- f) Indoor and outdoor furniture piece.
- g) Road construction

However, Biodynamic material forms have been seen to work effectively and functional in Europe and Asia. None seems to have been recorded for use in Africa, nonetheless Nigeria. Niger Delta is known to possess high humidity in air, with a relative humidity of 70-100percent in ratio. The region usually experiences a record high annual rainfall with a climatic temperature of

between 27 – 36 degree Celsius. From the above analysis, it is necessary therefore for the material produced for use in Niger Delta to be modified in area of strength, coloration, heat resistant ability, weather resistance etc due to the mentioned limitations. The modification of its physical, mechanical and chemical properties will be carried out through the help of experimental processes, thus shall not be discussed in the course of this presentation.

4.2 Availability of Raw Materials for Biodynamic Cement in Nigeria

This research is limited to the production/ application of Titanium dioxide catalyzed materials not used only for buildings but also for use in paving (tiocem), roof tiles, road construction, and highway sound buffering wall. The two major constituent of Biodynamic cement are Marble and Titanium which have their mineral deposits abundant in Nigeria as shown in Table 2.

Table 2: Showing few Nigeria states with Mineral resources relevant to the research.

S/N	STATE	POTENTIAL RAW MINERALS IN RELATIVE COMMERCIAL QUANTITIES PER STATE
1.	Abia	Glass sand, limestone, salt, shale, ball clay, granite, Galena, marble , laterite, bentonite, phosphate, kaolin, pyrite, feldspar, petroleum, lignite, gypsum, sphalerite, clay
2.	Benue	Gemstone, barites, feldspar, marble , mica, silica sand, quartz, Galena, lead, zinc ore, silica sand, clay, crushed and dimension stone, fluorspar, wolframite, bauxite, shale, magnesite, limonite.
3.	Cross Rivers	Salt limestone, coal, manganese, mica, limonite, gold, quartz, glass sand, tourmaline, petroleum, natural gas, kaolin, tin ore, sharp sand, spring water, salt deposit, talc , granite, Galena, lead, zinc, tin ore, muscovite, uranium, barite Barytes, Ceramic Raw Materials, Hard Stone, titanium
4.	Ekiti	Clay, charnokite, quartz, lignite, limestone, granite, gemstone, bauxite, cassiterite, columbite, tantalite, feldspar, kaolin, titanium
5.	Imo	Crude oil, shale, natural gas, kaolin, laterite sand, limestone, salt, marble

Source: (Nigeria Ministry of solid minerals, 2016; Finelib.com, 2017; The Nation online, 2014)

In Africa, the major countries where titanium occurs in commercially quantities include South

Africa, Sierra Leone, Kenya and even Mozambique.

4.3. Petroleum Industry: It’s Impact on the Environment



Plate 4: A Beach after an Oil Spill. Result from Oil Exploration

Source: www.wikipedia.org

Petroleum is one of the unavoidable links to source of energy supply the world over. This product is used to produce other products being used as fuel for other forms of business enterprise. Wikipedia mentions some of these areas as transportation, industry, domestic and electricity. Studies in Taiwan according to Lin Meng Chao (2001) link proximity to oil refineries to premature birth. Other areas of production using petroleum are the plastic manufacturing and recycling companies. Why is every action taken on the petroleum chains of activities

creating a diverse effect on the environment? Simply, productions are carried out using the heat method thereby polluting the environment. Petroleum Solvents Overview says that crude oil and petroleum distillates cause birth defects. It is worthy of note at this point that the rationale for bio dynamism which professionally means the biological presence which deals with the energy production and activities of organisms. This is an indication that production cannot be carried out in the absence of pollution.



Plate 5: Petroleum Diesel Exhaust from a Truck
Source: Achieves of Environmental Contamination and Toxicology.

4.4. Ways of Controlling and Reducing Air Pollution

It is the responsibility of individual under the planet earth to be sensitive to whatever takes place in the environment. It is therefore necessary to be aware of the degree of growth in air pollution. Every step should be taken to address the threat being envisaged as a result of pollution, especially the one caused by oil exploration. Montagloni (2015) says that many methods can be used to measure the toxicity of the crude oil and other petroleum related products, he emphasized further by saying that certain levels of toxicity can meet the target lipid model through biodegradability. On health ground, air pollution has created serious health hazards due to direct or indirect contact with the emission or respiratory contact not to count on the massive degree of allergies. The impact of oil pollution has in no small measure, created ecological imbalance coupled with psychological impotence.

As explained by Nicodem (1997) other factors influencing the rate of long- term contamination is the continuous input of residues and the rate at which the environment can clean itself.

4.5. Suggestions

The way forward to reducing air pollution in this regard, are suggested thus:

- a) Since petroleum and petro chemicals form the basic raw materials in most industries in Nigeria, such should not be cited in the residential area.
- b) Many years back, Nigeria government banned all the second hand vehicles; this accordingly was carried out because it was believed that second hand vehicles used to cause smoke which used to come out from the exhaust. The vehicle maintenance culture should be encouraged

- c) Local ways of controlling air pollution should be worked out. Tucella (2017) backs this up by saying that emission of not only carbon dioxide but other pollutants like nitrous oxide and aerosols can cause serious health hazards.
- d) The tiers of government should form a team of interested parties to monitor and checkmate the excesses of the manufacturing industries.
- e) All the non- governmental organizations should organize awareness programmes on the need to reduce air pollution in the society.
- f) The idea of bombing the seized boats of illegal oil dealers on our waters should be discouraged as the consequence is very hazardous to human existence.

4.6. The Recycling Method in Preventing Air Pollution.

In business circle; super markets, market places, shopping malls and eateries; plastics, water proofs and plastic bottles are used for packaging of goods and services. All these are not properly disposed simply because there is no proper orientation and facilities to dispose of these petro chemical products. Rather, these plastics end up being thrown to the streets and they later find their way to the gutters, streams or worst still, they are gathered and burnt. This causes serious threat to the environment resulting to serious air pollution. As artist, these petro chemicals can be recycled into beautiful works of art which can find their way back into homes and offices and can even be exported to generate revenue for government.

4.7. Causes of Air Pollution

Rapid industrialization: Owing to fast development of industries, the rate of production has so grown that the environment is shocked with the industrial consequences.

Fast Urbanization: Urban development carries with it the societal expectancy of growth in a geometrical progression. This is why every product finds its way to all urban centres thereby causing rapid growth also in the consumption of goods and services.

Rapid Growth in Population: Essentially, the population of a place depends on the degree of goods and services consumed. Therefore, more vehicles, industries, structures and other things which constitute population growth will naturally come into existence.

Natural Causes: Bush burning, burning of refuse bins, emission of auto mobiles smokes and cooking with fire wood, all are attributes to the existence of air pollution.

4.8. OBJECTIVES AND RELEVANCE

- I. Since Niger Delta includes both urban and rural settlements the material technology proffered shall be geared towards simple application techniques to enable both rural and urban developers make use of the technology.
- II. To develop biodynamic materials for use in construction of oil platforms that will also serve as purifiers to harmful gases within oil exploration sites.
- III. To combat climate change and global warming via the use of energy-efficient materials that contributes zero emission to the environment.
- IV. To develop affordable building/ construction materials to curb green house and smog effects generated into the environment during oil and gas production.
- V. To encourage mining investors in Nigeria to invest more in the search/exploration of more minerals i.e. Titanium ore, Marble etc that shall be useful to the growth and development of biodynamic cement technology in Nigeria.
- VI. To in the nearest future reduce by 75percent air pollutants present in the Niger Delta region.
- VII. To encourage and improve the use of Biodynamic technology in new and existing structural and infrastructural developments, so as to promote the product and ensure cheap and affordable settlements in the region; that are eco-friendly and air quality driven.
- VIII. To ensure durability and quality of the different forms of the product.
- IX. To encourage the creation of large and medium scale biodynamic cement factories; targeted towards wealth creation, job employment, and improved export produce to grow the economy.
- X. To develop a frame work that can be adopted throughout the country, after successful test running its model in the Niger Delta.

5.0. METHODOLOGY

- I. Research and coalition of data from existing literature on Biodynamic cement

and its application in the Oil and gas industry.

- II. Field survey through sampling and analysis of air pollutants in case studies area, measurement and analysis of metrological parameters. SO₂& NO₂ sampling train, Suspended Particulate Matter (SPM) Sampling Train, Respirable Dust Sampler, Photometric Oxidant, Electro Optical Spectrophotometer, Gas Chromatograph and observation will be used to support the analysis and analysis.
- III. Social survey will be done through questionnaires and interview of building users, road users and in general, Niger Deltans using Post Occupancy Evaluation (POE) Checklist.
- IV. Strategic synergy with Nigeria mining investors in areas of data collection for existing, new and yet to be discovered mineral resources plus field exposure to Oil exploration and mining sites.

CONCLUSION/ EXPECTED RESULT

The results predicted for this paper work is expected to improve on the air quality of Urban and Rural settlements of Niger Delta through the application of affordable eco-friendly building/construction materials (air purifiers) that cleans off the environment of air pollutants. Furthermore, the results of this research is also expected to clearly highlight more benefits of using Biodynamic cement technology so as to promote production and application of the various forms in the oil and gas sector and building construction industries. In addition, it is expected that the results of this research will bring about employment opportunities to teaming youths, lead to creation of industries and above all, increased export produce for the growth of our economy.

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