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# Valuation Of Selected Industries In Enugu Urban Area Using The Environmental Factor (E-Factor) Adjusted Cost Approach To Valuation

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***Abstract*—Industries are heavy polluters of the environment in Nigeria. As such their valuation should be carefully done to avoid problems of over-valuation or under-valuation. This paper therefore tries to demonstrate valuation of selected industries in Enugu using the Environmental Factor (E-Factor) Adjusted cost approach to valuation. The paper valued ANAMMCO and NIGERGAS using the conventional cost approach to valuation and arrived at ₦2.639B and ₦111.846M respectively. The industries were re-valued with the E-factor model and an over-valuation of ₦55.337M and ₦16.266M were recorded for the two industries. The paper recommended that the E-factor model should be adopted by the Nigeria Institution of Estate Surveyors and Valuers for the valuation of industries and other facilities generating waste in Nigeria.**

***Keywords—Pollution, Environmental Pollution, Waste, Environment, Environmental Factor, Model***

## 1. Background of the Study

According to Dean, Gray and Steel (1986) valuation is a professionally derived estimate of value, which is based on supportable conclusions arrived at through a thorough and logical analysis of facts and data at a particular time. In Nigeria, the Estate Surveyor and Valuer is the professional that is bestowed with the responsibility of interpreting the values of different categories of properties both fixed and moveable. To carry out his valuation duties, the Estate Surveyor and Valuer depends so much on models developed many decades ago by scholars in Europe and other parts of the world. These models include the Market, Income and Cost approaches, as the primary methods and the Residual, Profit and Statutory methods as the secondary or hybrid methods. Aniagolu (2009) pointed out that these models have implicit environmental considerations in the form of neighbourhood analysis.

In the face of the world's current focus on environment, these models are considered inadequate for valuation of industries and other facilities generating waste in Nigeria. Advocates of Environmental Protection in Nigeria have called for a systems approach, where all professionals should contribute their quota. Hence, Aina (1992) stated that "constant lack of environmental considerations has resulted in a habitual over-valuation of environmentally unsound properties in Nigeria, . but we can change this false valuation syndrome. The Estate Surveyor and Valuer holds the ace and are in a position to call the shots". Ogunba (1999) buttressed this point by concluding that Estate Surveyors should be in the forefront of Environmental Valuation Model development if we are to remain relevant in our valuation duties. Consequently, Aniagolu (2009) came up with the Environmental Factor (E-Factor) Adjusted Cost Approach to Valuation. It is against this background that this paper tries to demonstrate the valuation of ANAMMCO and NIGERGAS Industries in Enugu Using the new model.

## 2. Statement of the Problem

Industries (and other facilities generating wastes) are heavy polluters of the environment. Hence their valuation must be carefully done to avoid the problem of over-valuation of environmentally unsound properties. So far, the cost approach to valuation remains the best method of valuation for industries because industries have no comparables and have no rent passing.

However, the environmental consideration in the Cost Approach is implicit in nature. It is manifested in the value of land and in the ability to calculate depreciation. For valuation of industries (and other facilities generating waste) the model does not consider the effect of these industries on the environment.

Aniagolu (2009) developed the E-factor model as an extension of the Depreciated Replacement Cost Approach. According to Aniagolu, Iloeje and Emoh

(2015) the model simply measures the rate of compliance of industries (and other facilities generating waste) in Nigeria to Environmental Standards as contained in the National Environmental Protection, (Pollution Abatement in Industries and other Facilities generating Waste) Regulation of 1991. As such valuers are expected to inspect pollution abatement facilities in these industries alongside their normal inspection of land building, plant and machinery, equipment, motor vehicles, hand tool, etc and to reflect same in their valuation. Thus, industries polluting the environment should command low values while those that conform with international best environmental practices should command high values.

This paper tries to demonstrate how this could be done using ANAMMCO and NIGERGAS Industries in Enugu.

## 3. Aim and Objectives of the Study

The aim of the study is to value ANAMMCO and NIGERGAS using the Environmental Factor (E-Factor) Adjusted Cost Approach to Valuation. In order to achieve the stated aim, the following line of objectives will be pursued.

a. To value ANAMMCO and NIGERGAS using the Conventional Cost Approach to Valuation.
b. To present the Environmental Factor (E-Factor) Model
c. To re-value ANAMMCO and NIGERGAS using the Environmental Factor (E-Factor) Adjusted Cost Approach to Valuation
d. To show the effect of E-factor on the conventional valuation.

## 4. Materials and Methods

The two industries that are used in this study are ANAMMCO (a motor assembly company that manufactures commercial and service Mercedes Benz Buses and Truck) and NIGERGAS (which produces welding/process Oxygen, Medical Oxygen, Nitrogen and Acetelyne Gases). It must be stated clearly that as today ANAMMCO still offers skeletal services to customers while NIGERGAS is no longer in operation but as at the time of this study the two companies were fully operational.

Also the E-factor model makes extensive use of experimentation and survey research methods. According to Odoziobodo and Aman (2007) experimentation research is the manipulation of experimental variables to ascertain that one is related to or has effect on the other. Also Anyadike (2009) described survey research as one that tends to cover a large population of people by taking and studying samples from the population.

## 5. Valuation of ANAMMCO and NIGERGAS Using the Conventional Cost Approach to Valuation

The conventional Cost approach to valuation is generally adopted for the valuation of industries. Egolum (1993) opined that the method is founded on the principles of substitution and contribution. Kalu (2001) further stated that the method can best be used when the market approach is unsuitable and the investment method is inappropriate. Dean et al (1986) then stated the types of properties where the method can be applied as follows: special purpose industrial properties, service properties such as schools, hospitals, churches, etc. (where comparable sales evidence does not exist) and any other type of property where there is no rent passing and there is no comparable sales evidence.

Aniagolu (2009) summarized the cost approach to valuation as:

$$DRC=V_L + [ ( V_{BI} + V_{PME} + V_{FF} + V_{MV}) - D]$$

Where:

DRC=Depreciated Replacement Cost

$V_L$=Value of Land

$V_{BI}$=Replacement Cost (New) of Building and Improvements

$V_{PME}$=Replacement Cost (New) of Plant, Machinery and Equipment

$V_{FF}$=Replacement Cost (New) of Furniture and Fittings

$V_{MV}$=Replacement Cost (New) of Motor Vehicles

D=Accrued Depreciation

Note that the models could also be represented as:

$$DRC=V_L + [ ( V_{BI} - D) + ( V_{PME} – D) + ( V_{FF} - D) + V_{MV} - D)]$$

### 5.1 Valuation of ANAMMCO Using the Conventional Cost Approach

Aniagolu, Iloeje and Okwudelunzu (2015) quoting Okolo, Okolo and Company (1995) presented a summary of the Valuation of the assets of ANAMMCO as at 11th day of August 1995 as shown in table 1.

**Table 1: Summary of Valuation of Assets of ANAMMCO**

| S/N | Description of Assets | DRC of Assets |
|---|---|---|
| 1 | Land | ₦90,396,000 |
| 2 | Building & Improvements | ₦2,171,571,200 |
| 3 | Motor Vehicles | ₦92,468,000 |
| 4 | Plant Machinery & Equipment | ₦214,962,200 |
| 5 | Furniture & Fittings | ₦70,362,300 |
| | Total | ₦2,639,759,700 |

### 5.2 Valuation of NIGERGAS Using the Conventional Cost Approach

Similarly, Aniagolu, Iyi and Ugwu (2015) quoting Frank Maluze and Associates (2001) equally presented a summary of the valuation of assets of

NIGERGAS as at 12th of September 2001 as shown in table 2.

**Table 2: Summary of Valuation of Assets of NIGERGAS**

| S/N | Description of Assets | DRC of Assets |
|---|---|---|
| 1 | Land | ₦10,608,000 |
| 2 | Building & Improvements | ₦44,106,000 |
| 3 | Motor Vehicles | ₦10,020,000 |
| 4 | Plant Machinery & Equipment | ₦39,595,000 |
| 5 | Furniture & Fittings | ₦7,517,000 |
| | Total | ₦111,846,000 |

Table 1 and 2 clearly show that the assets of ANAMMCO as at 11th day of August 1995 stands at ₦2,639,759,700 (Two Billion, Six Hundred and Thirty-Nine Million, Seven Hundred and Fifty Nine Thousand, Seven Hundred Naira only) while that of NIGERGAS as at 12th September, 2001 stands at₦111, 846,000 (One Hundred and Eleven Million, Eight Hundred and Forty-Six Thousand Naira only).

## 6. Shortcomings of the Valuation of ANAMMCO and NIGERGAS Using the Conventional Methods

Aniagolu (2009) discussed the shortcomings of the two valuations done with the conventional valuation method as follows:

### 6.1 Air Pollution

According to World Bank (1978), "air pollution is the presence in the outdoor atmosphere of one or more contaminants such as dust, fumes, gas, mist, odour, smoke or vapour in quantities, characteristics and duration as to make them actually or potentially injurious to human, plant or animal life or property or which unreasonably interfere with the comfortable enjoyment of life and property". Hence, the model did not consider the ability of the industry to produce air pollution agents.

### 6.2 Water Pollution

Again the model did not take into consideration the water pollution tendencies of these industries. Since effluent discharge from the industrial processes if not properly treated would definitely pollute nearby water bodies. Hence the model did not also consider such water pollution parameters as colour, odour, pH conductivity, total solids, dissolved solids, suspended solids, acidity, alkalinity, calcium, magnesium, total hardness sodium, potassium, copper, zinc, iron, manganese, lead, chloride, sulphate, nitrate, dissolved oxygen, BOD, COD, E-Coli, Coliform, oil/grease, total plate count, etc.

### 6.3 Soil Pollution / Solid Waste Management

Also the model made no provision for assessment of level of solid waste management in the industries. Solid waste management involves solid waste generation, collection, disposal and resource recovery. Hence, the model did not consider the possibility of soil contamination from solid waste from industrial processes. The soil analysis should have been in the form of Soil Element analysis to determine the level of calcium (Ca), Magnesium (Mg), Sodium ($Na_2$), Iron (Fe), Aluminum (Al), Lead (Pb), Zinc (Zn), Copper (Cu), Manganese (Mn), Silica (Si), Loss on Ignition (LOI), Titanium (Ti) and Cadmium (Cd).

### 6.4 Noise Pollution

Noise has been defined by Aution (1979) as 'an unwelcome sound". Noise pollution can come from automobiles, human activities, industrial and commercial activities, railways, tramp-ways, building/construction activities, etc. The existing valuation model does not take into consideration the noise pollution tendencies of industrial processes.

### 6.5 Industrial Health and Safety

Furthermore, industrial Health and Safety is of utmost importance to modern day industries. Industrial accidents are usually fatal and attract serious criticism especially where safety measure were not taken seriously. The existing model does not consider the issue of industrial safety and the ability of the industry to provide Health and Safety facilities/gadgets by way of clinics, helmets, boots, overalls, hand gloves, respirators, ear plugs, nose masks, fire alarm systems, fire fighting system, etc.

## 7. The E- Factor Model:

### 7.1 Name of Model

The proposed model is the Environmental factor Adjusted Cost Approach to Valuation or in short form the E-factor model.

### 7.2 Basic Assumptions of the Model

Since the E-Factor model is an extension of the Cost Approach to Valuation the following basic assumptions are put forward:

a. That the cost approach to valuation is widely used by valuers in Nigeria and is adapted the way it is practiced in Nigeria.

b. That land, building and improvement, furniture and fittings on their own do not RELATIVIELY pollute the Environment.

c. That the major sources of industrial pollution are from the operation of Plants, Machinery, Equipment and Motor Vehicles.

### 7.3 Data Requirements for the Model

The data required for the E-factor model are summarized into the following:

a. Data on air pollution
b. Data on water pollution
c. Data on soil pollution / solid waste management
d. Data on noise pollution and
e. Data on industrial health and safety.

Details of data requirement are as presented below

***(a) Data On Air Pollution***

- Dust Particulates
- Carbonmonoxide (CO – Carbon II Oxide)
- Sulphur Dioxide ($SO_2$ – Sulphur IV Oxide)
- Carbondioxide ($CO_2$ – Carbon IV Oxide)
- Nitrogen Dioxide ($NO_2$ – Nitrogen IV Oxide)
- Ammonia ($NH_3$)
- Hydrocarbons

***(b) Data On Water Pollution:***

i. Physical Analysis

- Odour- Colour- pH- Conductivity

ii. Chemical Analysis

- Acidity - Alkalinity - Total Solids - Dissolved Solid - Suspended Solid
- Calcium - Magnesium - Total Hardness - Sodium - Potassium
- Copper - Zinc - Iron - Manganese – Lead - Chloride - Sulphate
- Nitrate - Chemical Oxygen Demand (COD)
- Biological Oxygen Demand (BOD) - Dissolved Oxygen

iii. Microbiological Analysis

- E-coli - Coliform - Total Plate Count

***(c) Data On Soil Pollution / Solid Waste***

**i. Oxide Analysis**

- Calcium (Ca) - Magnesium (Mg) - Sodium (Na) - Iron (Fe) - Lead (Pb)
- Aluminum (Al) - Zinc (Zn) - Copper (Cu) - Manganese (Mn) - Silica (Si)
- Loss on Ignition (LOI) - Titanium (Ti) - Cadmium (Cd)

**ii. Solid Waste Management**

- Generation Areas - Collection Method - Composition - Recycling
- Disposal

***(d) Data On Noise Pollution***

- Administration Block (Area) - Production Area (Workshop)
- Generator Area - Distribution Area (Marketing Warehouse)
- Security Area

***(e) Data On Industrial Health and Safety***

- Availability of clinics / First Aid Kits (Box)
- Availability of Fire Fighting equipment e.g Fire Alarm, Fire Service, Fire Extinguishers
- Availability and use of safety devices e.g helmets, hand gloves, eye goggles, ear muffs, boots, overall, nose masks etc.
- Availability of Environmental Auditing / Reporting Procedure
- Facilities for collection, treatment, transportation and disposal of waste generated by the industry
- Establishment of a pollution monitoring unit within the industry
- Availability of list of chemical used in the industrial process, including details of stored chemical and storage condition.
- Possession of pollution response machinery and equipment which are readily available to combat pollution hazards
- Availability of NESREA discharge permit
- Installation of pollution prevention equipments that reduce the level of pollution in the industry.

### 7.4 Computation of the E-Factor

E-factor model assigns 20 marks to each of the parameters to be measured as shown in table 3.

**Table 3: Parameters and the Assigned Marks**

| S/N | Parameters | Assigned Marks |
|---|---|---|
| 1. | Air pollution | 20 marks |
| 2. | Water pollution | 20 marks |
| 3. | Soil pollution (10 mks)<br>Solid waste management (10 mks) | 20 marks |
| 4. | Noise pollution | 20 marks |
| 5. | Industrial Health and Safety | 20 marks |

#### 7.4.1 Computation for Air Quality

Gas detectors are used to test the presence of air pollutants and gases that are dangerous to the environment as shown in section 7.3. The gas readings are taken from different locations in the industry and the average reading determined. The average reading is then compared with WHO / Federal Ministry of Environments Standard. The deviation will help us determine the rate of compliance and rate of non-compliance by simple proportion taking into consideration that the maximum mark is 20 marks. The result from ANAMMCO and NIGERGAS is presented in table 4 and 5.

**Table 4: Comparison Between ANAMMCO Air Quality and WHO/FMENV Standard**

| Parameters | Methodology | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| Dust Particles | Gasometer | NS | NC | - | 16.67 | 3.33% | NC |
| Carbon II Oxide (CO) | Gasometer | 1 – 5 | 1 – 3 | - | | | WSL |
| Sulphur IV Oxide ($SO_2$) | Gasometer | 0.5 | 0.04 | - | | | WSL |
| Carbon IV Oxide ($CO_2$) | Gasometer | 1 – 5 | NC | - | | | NC |
| Nitrogen IV Oxide ($NO_2$) | Gasometer | 0.085 | 0.01 | - | | | WSL |
| Ammonia ($NH_3$) | Gasometer | 0.2 | 0.40 | 0.2 | | | ASL |
| Hydrocarbons | Gasometer | 6.0 | 1.20 | - | | | WSL |
| Chlorine | Gasometer | 1.0 | 0.21 | - | | | WSL |
| Hydrogen Cyanide | Gasometer | NS | NC | - | | | NC |

Legend: NC - Not Compared, NS - Not Stated, WSL - Within Stipulated Limit, ASL - Above Stipulated Limit

**Table 5: Comparison Between NIGERGAS Air Quality and WHO/FMENV Standard**

| Parameters | Methodology | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| Dust Particles | Gasometer | NS | - | - | | | NC |
| Carbon II Oxide (CO) | Gasometer | 1 – 5 | 14 | 9 | | | ASL |
| Sulphur IV Oxide ($SO_2$) | Gasometer | 0.5 | 0.1 | - | | | WSL |
| Carbon IV Oxide ($CO_2$) | Gasometer | 1 – 5 | NC | NC | | | NC |
| Nitrogen IV Oxide ($NO_2$) | Gasometer | 0.085 | 0.0 | - | 16.67 | 3.33% | WSL |
| Ammonia ($NH_3$) | Gasometer | 0.2 | 0.14 | - | | | WSL |
| Hydrocarbons | Gasometer | 6.0 | 2.0 | - | | | WSL |
| Chlorine | Gasometer | 1.0 | 0.14 | - | | | WSL |
| Hydrogen Cyanide | Gasometer | NS | 0.0 | NC | | | NC |

### 7.4.2 Computation for Water Quality

Water samples from effluent discharge points in the industry should also be collected and sent to the laboratory. Laboratories belonging to government establishments are preferred for authenticity of the results. Again the results from the laboratory analysis are compared with the WHO/FMENV Standard for water quality. The deviation is equally used to determine the rate of compliance and non-compliance respectively still taking into cognizance the 20 marks assigned to water quality. The result from ANAMMCO and NIGERGAS is presented in table 6 and 7.

**Table 6: Result of Comparison Between ANAMMCO Effluent and WHO/FMENV Standard**

| Parameters | Methodology | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| **(a) Physical Analysis** | | | | | | | |
| Odour | - | NS | NC | - | | | NC |
| Colour (Haven Unit) | Lovibond | 25 | 187.5 | 162.5 | | | ASL |
| Ph ($31^{oC}$) | Meter | 6.5 – 9 | 7 | - | | | WSL |
| Conductivity (chm/km) | Meter | 1000 | 19,000 | 18,000 | | | ASL |
| **(b) Chemical Analysis** | | | | | | | |
| Acidity Ng/lCa/$Co_3$ | Microbiological | 400 | 100 | - | | | WSL |
| Alkalinity Mg/LCa/$Co_3$ | Microbiological | 30 – 500 | 350 | - | | | WSL |
| Total Solids Mg/L | A.P.H.A | 2000 | 400 | - | | | WSL |
| Dissolved Solids | A.P.H.A | 500 | 400 | - | | | WSL |
| Suspended Solids Mg/L | A.P.H.A | 30 | Nil | - | | | NC |
| Calcium Mg/L | E.D.T.A | 75 | 20.4 | - | | | WSL |
| Magnesium Mg/L | E.D.T.A | Not 230 | 0 | - | | | WSL |
| Total Hardness Mg/L | E.D.T.A | 50 – 200 | 50 | | | | WSL |
| Sodium Mg/L | Flame Photometer | NS | NC | - | | | NC |
| Potassium Mg/L | Flame Photometer | NS | NC | - | | | NC |
| Copper Mg/L | Flame Photometer | NS | NC | | **12.65%** | **7.35%** | NC |
| Zinc Mg/L Ca/$Co_3$ | ASS | 200 | 32,493.5 | 32,293.5 | | | ASL |
| Iron Mg/L | Spectrophoto meter | 0.3 | 2.167 | 1.867 | | | ASL |
| Manganese Mg/L | | 0.1 – 0.5 | 0 | - | | | WSL |
| Lead PPM | | 0.01 | 5.25 | 5.24 | | | ASL |
| Cloride Mg/L | | 250 | 35.46 | - | | | WSL |
| Sulphate Mg/L | | 250 | NC | NC | | | NC |
| Nitrate Mg/L | | 50 | 0.10 | - | | | WSL |
| COD Mg/L | A.P.H.A | 80 | 49.77 | - | | | WSL |
| BOD Mg/L | A.P.H.A | 30 | 54.80 | 24.8 | | | ASL |
| Dissolved Oxygen Mg/L | | NS | NC | NC | | | NC |
| **(c) Microbiological Analysis** | | | | | | | |
| E-Coli 100ml | Microbiological | -ve | -ve | - | | | WSL |
| Coliform 100ml | Microbiological | 100 | NC | NC | | | NC |
| Total Plate Count | Plate Count | 100 | NC | NC | | | NC |

**Table 7: Result of Comparison Between NIGERGAS Effluent and WHO/FMENV Standard**

| Parameters | Methodology | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| **(a) Physical Analysis** | | | | | | | |
| Odour | - | NC | NC | - | | | NC |
| Colour (Haven Unit) | Lovibond | 25 | 10 | - | | | NC |
| Ph ($31^{oC}$) | Meter | 6.5 – 9 | 10 | - | | | WSL |
| Conductivity (chm/km) | Meter | 1000 | 130,000 | 129,000 | | | ASL |
| **(b) Chemical Analysis** | | | | | | | |
| Acidity Ng/l$Ca/Co_3$ | Microbiological | 400 | 100 | - | | | ASL |
| Alkalinity Mg/L$Ca/Co_3$ | Microbiological | 30 – 500 | 2,650 | 2,150 | | | WSL |
| Total Solids Mg/L | A.P.H.A | 2000 | 1520 | - | | | ASL |
| Dissolved Solids | A.P.H.A | 500 | 1380 | 880 | | | WSL |
| Suspended Solids Mg/L | A.P.H.A | 30 | NC | - | | | ASL |
| Calcium Mg/L | E.D.T.A | 75 | 76.152 | 1.152 | | | NC |
| Magnesium Mg/L | E.D.T.A | 30 | 389.12 | 359.12 | | | ASL |
| Total Hardness Mg/L | E.D.T.A | 50 – 200 | 1790 | 1590 | | | ASL |
| Sodium Mg/L | Flame Photometer | NC | NC | NC | | | ASL |
| Potassium Mg/L | Flame Photometer | NS | NC | - | **12.65%** | **7.35%** | NC |
| Copper Mg/L | Flame Photometer | NS | NC | | | | NC |
| Zinc Mg/L $Ca/Co_3$ | ASS | 200 | 32,493.5 | 32,293.5 | | | NC |
| Iron Mg/L | Spectrophoto meter | 0.3 | 2.167 | 1.867 | | | ASL |
| Manganese Mg/L | | 0.1 – 0.5 | 0 | - | | | ASL |
| Lead PPM | | 0.01 | 5.25 | 5.24 | | | WSL |
| Cloride Mg/L | | 250 | 35.46 | - | | | ASL |
| Sulphate Mg/L | | 250 | NC | NC | | | WSL |
| Nitrate Mg/L | | 50 | 0.10 | - | | | NC |
| COD Mg/L | A.P.H.A | 80 | 49.77 | - | | | WSL |
| BOD Mg/L | A.P.H.A | 30 | 54.80 | 24.8 | | | WSL |
| Dissolved Oxygen Mg/L | | NS | NC | NC | | | ASL |
| **(c) Microbiological Analysis** | | | | | | | |
| E-Coli 100ml | Microbiological | -ve | -ve | - | | | |
| Coliform 100ml | Microbiological | 100 | NC | NC | | | WSL |
| Total Plate Count | Plate Count | 100 | NC | NC | | | NC |

### 7.4.3 Computation for Soil Pollution

Computation for Soil Pollution is subdivided into two (2) namely (a) Soil Element Analysis and (b) Solid waste management.

#### 7.4.3.1 Soil Element Analysis

Soil samples from various areas in the industries were collected and sent to the laboratory for analysis. Sample must also be collected from the dumpsites in the industry to ensure that any trace of soil pollution is captured. The result of the soil sample analysis should then be compared with WHO/FMENV – Standard to determine the deviation. The deviation would then be used to determine the rate of compliance and non-compliance taking into cognizance the 10 marks assigned to soil element analysis. The results from ANAMMCO and NIGERGAS are presented in tables 8 and 9 respectively.

**Table 8: Result of the Comparison Between ANAMMCO Soil Sample and WHO/FMENV Standard**

| Parameters | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|
| (b) Element Analysis | | | | | | |
| Calcium (Ca) | NS | NC | | | | |
| Magnesium (Mg) | 2 – 10 | 8.70 | - | | | WSL |
| Sodium (Na) | NS | NC | - | | | NC |
| Iron (Fe) | 0,5 – 1.0 | 50.20 | 49.20 | | | ASL |
| Aluminium (Al) | 10 – 100 | 15.30 | - | | | WSL |
| Lead (Pb) | 1 – 20 | 1.40 | - | | | WSL |
| Zinc (Zn) | 0.10 – 300 | 0.18 | - | 8.75% | 1.25% | WSL |
| Copper (Cu) | 20 | 0.80 | - | | | WSL |
| Manganese (Mn) | 0.20 – 300 | 0.33 | - | | | WSL |
| Silica (Si) | NS | NC | - | | | NC |
| Titanium (Ti) | NS | NC | - | | | NC |
| Cadmium (Cd) | 0.03 – 0.3 | 0.08 | - | | | WSL |
| Loss on Ignation (Lol) | NS | | | | | |

**Table 9: Result of the Comparison Between NIGERGAS Soil Sample and WHO/FMENV Standard**

| Parameters | FMENV/WHO Standard | Result from Industrial Sample | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|
| (b) Element Analysis | | | | | | |
| Calcium (Ca) | NS | NC | | | | NC |
| Magnesium (Mg) | 2 – 10 | 4.80 | - | | | WSL |
| Sodium (Na) | NS | NC | - | | | NC |
| Iron (Fe) | 0.5 – 1.0 | 0 | - | | | WSL |
| Aluminium (Al) | 10 – 100 | 60.0 | - | | | WSL |
| Lead (Pb) | 1 – 20 | 3.40 | - | | | WSL |
| Zinc (Zn) | 0.10 – 300 | 0.03 | - | 10% | 0% | WSL |
| Copper (Cu) | 20 | 0 | - | | | WSL |
| Manganese (Mn) | 0.20 – 300 | 0.3 | - | | | WSL |
| Silica (Si) | NS | NC | - | | | NC |
| Titanium (Ti) | NS | NC | - | | | NC |
| Cadmium (Cd) | 0.03 – 0.3 | 0 | - | | | WSL |
| Loss on Ignation (Lol) | NS | NC | | | | NC |

### 7.4.3.2 Solid Waste Management System

Solid waste management facilities in ANAMMCO and NIGERGAS were also inspected alongside other general inspection/survey done by the valuer. The major components of the inspection are"

a. Inspection of solid waste collection processes or methods
b. Percentage of the waste that in non-biodegradable
c. Availability of recycling equipment in the industry and
d. Solid waste disposal process or method.

The model assigned 10 marks to this parameter, such that each element from a – d has a maximum of 2.5 marks. The valuer is then expected to score the industry as follows.

i. For 'a', 'c' and 'd' a weighted scale is used to score as follow
None - 0 mark, Poor - 0.5 mark, Fair - 1.0 mark, Good - 1.5 marks
Very good-2.0 marks, Excellent-2.5 marks

ii. For 'b' since non-biodegradable wastes are more difficult to manage, the percentage non-biodegradable wastes are scored as follows.
75% - 100% - 0.5 mark, 50% - 74% - 1.0mark
25% – 49% - 1.5 marks, 1% - 24%- 2.0 marks, None - 2.5 marks

The result of the solid waste management system in ANAMMCO and NIGERGAS is presented in tables 10 and 11.

**Table 10: Result of Inspection of Solid Waste Management System in ANAMMCO**

| S/N | Parameters | Maximum Points Obtainable | Points Obtained | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| 1. | Collection Methods | 2.5 | 2.5 | - | 8.5% | 1.5% | EXC |
| 2. | % Non Biodegradable | 2.5 | 2.0 | 0.5 | | | 1 – 24% |
| 3. | Availability of Recycling Equipment | 2.5 | 2.0 | 0.5 | | | V. Good |
| 4. | Disposal Method | 2.5 | 2.0 | 0.5 | | | V. Good |

**Table 11: Result of Inspection of Solid Waste Management System in NIGERGAS**

| S/N | Parameters | Maximum Points Obtainable | Points Obtained | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| 1. | Collection Methods | 2.5 | 1.0 | 1.5 | 4.5% | 5.5% | FAIR |
| 2. | % Non-Biodegradable | 2.5 | 1.5 | 1.0 | | | 25 – 49% |
| 3. | Availability of Recycling Equipment | 2.5 | 1.0 | 1.5 | | | FAIR |
| 4. | Disposal Method | 2.5 | 1.0 | 1.5 | | | FAIR |

### 7.4.4 Computation for Noise Pollution

Determination of noise level in ANAMMCO and NIGERGAS was done using a Radio Shack Sound level meter (or simply a noise detector). The radio shack meter is calibrated to read noise levels between 50 dBA to 120 dBA. Noise level is measured in decibels. Noise reading was taking from various areas in the industry such as administrative block, production area, distribution areas (warehouse) generator area, etc. The average results were then compared WHO/FMENV Standard having at the back of our mind that E-factor assigned 20 marks to Noise pollution. The result is presented in table 12 and 13.

**Table 12: Result of Noise Analysis Conducted in ANAMMCO**

| S/N | Location | Methodology | FMENV/Who Limit (dBA) | Result (dBA) | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1. | Administrative block | Radio Shack Sound Level Meter | 90 | 72 | - | 16.67% | 3.33% | WSL |
| 2. | Workshop Area | | 90 | 90 | - | | | WSL |
| 3. | Generator Area | | 90 | 98.6 | 8.6 | | | ASL |
| 4. | Distribution Area | | 90 | 82 | - | | | WSL |
| 5. | Security Post | | 90 | 80 | - | | | WSL |
| 6. | Waste Treatment Plant | | 90 | 78 | - | | | WSL |

**Table 13: Result of Noise Analysis Conducted in NIGERGAS**

| S/N | Location | Methodology | FMENV/Who Limit (dBA) | Result (dBA) | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1. | Administrative block | Radio Shack Sound Level Meter | 90 | 72 | - | 20% | 0% | WSL |
| 2. | Workshop Area | | 90 | 90 | - | | | WSL |
| 3. | Generator Area | | 90 | 80 | - | | | WSL |
| 4. | Distribution Area | | 90 | 85 | - | | | WSL |
| 5. | Security Post | | 90 | 85 | - | | | WSL |
| 6. | Waste Treatment Plant | | 90 | 85 | - | | | WSL |

### 7.4.5 Computation for Industrial Health and Safety

For industrial Health and Safety the factors discussed in section 5.5.4 (e) were used for the analysis. In order to score, the following scaling method was adopted bearing in mind that E-factor model assigned 20 marks to industrial Health and safety and each of the 10 factors were assigned 2 marks each.

Poor - 0.4 mark, Fair - 0.8 mark, Good - 1.2 marks, Very Good -1.6 marks

Excellent - 2.0 marks

The result of the analysis on industrial Health and Safety for ANAMMCO and NIGERGAS are presented in tables 14 and 15.

**Table 14: Industrial Health and Safety Analysis for ANAMMCO**

| Parameters | Methodology | Maximum Point Obtainable | Points Obtained | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| Availability of Clinics and First Aid boxes | Inspection Observation | 2.0 | 2.0 | - | 18.8% | 1.2% | EXC |
| Availability of Fire Fighting Prevention Equipment / System | Inspection Observation | 2.0 | 2.0 | - | | | EXC |
| Availability and use of industrial safety devices | | 2.0 | 2.0 | | | | EXC |
| Availability of Facility for solid waste management | Inspection observation | 2.0 | 1.6 | 0.4 | | | V.G |
| Establishment of pollution monitoring unit | Inspection observation | 2.0 | 2.0 | | | | EXC |
| Availability of list of Chemicals use in the Industry | Inspection observation | 2.0 | 2.0 | | | | EXC |
| Availability of pollution responses Machinery & Equipment | Inspection observation | 2.0 | 1.6 | 0.4 | | | V.G |
| Availability of NESREA discharge permit | Inspection observation | 2.0 | 2.0 | - | | | EXC |
| Availability of Pollution Prevention Equipment | Inspection observation | 2.0 | 1.6 | 0.4 | | | V.G |
| Evidence of Environmental Audit Report | Inspection observation | 2.0 | 2.0 | - | | | EXC |

**Table 15: Industrial Health and Safety Analysis for NIGERGAS**

| Parameters | Methodology | Maximum Point Obtainable | Points Obtained | Deviation | Rate of Compliance | Rate of Non Compliance | Remarks |
|---|---|---|---|---|---|---|---|
| Availability of Clinics and First Aid boxes | Inspection Observation | 2.0 | 0.4 | 1.6 | 5.6% | 14.4% | POOR |
| Availability of Fire Fighting Prevention Equipment / System | Inspection Observation | 2.0 | 0.4 | 1.6 | | | POOR |
| Availability and use of industrial safety devices | | 2.0 | 0.8 | 1.2 | | | FAIR |
| Availability of Facility for solid waste management | Inspection observation | 2.0 | 1.2 | 0.8 | | | GOOD |
| Establishment of pollution monitoring unit | Inspection observation | 2.0 | 0.4 | 1.6 | | | POOR |
| Availability of list of Chemicals use in the Industry | Inspection observation | 2.0 | 0.8 | 1.2 | | | FAIR |
| Availability of pollution responses Machinery & Equipment | Inspection observation | 2.0 | 0.4 | 1.6 | | | POOR |
| Availability of NESREA discharge permit | Inspection observation | 2.0 | 0.4 | 1.6 | | | POOR |
| Availability of Pollution Prevention Equipment | Inspection observation | 2.0 | 0.4 | 1.6 | | | POOR |
| Evidence of Environmental Audit Report | Inspection observation | 2.0 | 0.4 | 1.6 | | | POOR |

**7.4.6 Summary ot the Result for E-Factor Computation**

For the E-factor analysis, parameters for air, water, soil, noise pollutions and industrial Health and Safety were analyzed. Summary of the result is presented in table 16.

**Table 16: Summary of the Result for E-Factor Analysis of ANAMMCO and NIGERGAS**

| S/N | Parameters | ANAMMCO | | NIGERGAS | |
|---|---|---|---|---|---|
| | | Compliance Rate % | Non Compliance Rate % | Compliance Rate % | Non Compliance Rate % |
| 1. | Air Quality | 16.67 | 3.33 | 16.67 | 3.33 |
| 2. | Effluent Discharge | 12.65 | 7.35 | 9.45 | 10.55 |
| 3. | Solid Waste Management | 8.50 | 1.50 | 4.50 | 5.50 |
| 4. | Soil Quality | 8.75 | 1.25 | 10.00 | 0.00 |
| 5. | Noise | 16.67 | 3.33 | 20.00 | 0.00 |
| 6. | Industrial Health and Safety | 18.80 | 1.20 | 5.60 | 14.40 |
| | Total | 82.04 | 17.96 | 66.22 | 33.78 |

**7.5 The E-Factor Model**

The E- factor model as developed by Aniagolu (2009) is as follow:

$DRC = V_L + V_{BI} + V_{FF} + [( V_{PME} + V_{MV}) \cdot \text{E-factor}]$

Where:

DRC=Depreciated Replacement Cost of the Industry

$V_L$=Value of Land

$V_{BI}$ =Depreciated Replacement Cost of Building and Improvements

$V_{PME}$ =Depreciated Replacement Cost of Plant, Machinery and Equipment

$V_{FF}$=Depreciated Replacement Cost of Furniture and Fittings

$V_{MV}$=Depreciated Replacement Cost of Motor Vehicles

E-Factor =Rate of Compliance of Industry to Environmental Standard

**8. Re-Valuation of ANAMMCO and NIGERGAS Using the E-Factor Model.**

Table 1 gave a summary of valuation of assets of ANAMMCO as carried out by Okolo, Okolo and Company in 1995. Re-valuation of the industry using E-factor model is as follows:

DRC = ₦90,396,000 + ₦2,171,571,200 + ₦70,362,300 + [(₦214,962,200 + ₦92,468,000) x 0.821]

=₦90,396,000 + ₦2,171,571,200 + ₦70,362,200 + [₦307,430,200 x 0.821]

=₦90,396,000 + ₦2,171,571,200 + ₦70,362,200 + ₦252,092,764

=₦2,584,422,264

This represents about 2.09% loss of value as a result of ANAMMCO's non compliance to Environmental Standards. Thus the loss of value is because of the pollution tendency of the company.

Similarly, table 2 gave a summary of valuation of Assets of NIGERGAS as carried out by Frank Maluze and Associates in 2001. Revaluation of the industry using the E-factor Model is as follows:

DRC= ₦10, 608,000 + ₦44,106,000 + ₦7,517,000 + [(₦39,595,000 + ₦10,020,000)

x 0.662]

= ₦10, 608,000 + ₦44,106,000 + ₦7,517,000 + [₦49,615,000 x 0.662]

= ₦10, 608,000 + ₦44,106,000 + ₦7,517,000 + ₦32,845,130

= ₦95,579,980

This represents about 14.54% loss of value as a result of NIGERGAS's non-compliance to Environmental Standards.

**8.1 Summary of Valuation Using the Conventional and E-Factor Models**

The summary of the valuations for ANAMMCO and NIGERGAS using the conventional cost approach to valuation and the E-factor model is as presented in table below:

**Table 17: Summary of the Valuations for ANAMMCO and NIGERGAS**

| S/N | Parameters | ANAMMCO | NIGERGAS |
|---|---|---|---|
| | Valuation | | |
| 1 | DRC Model | 2,639,759,700 | 111,846,000 |
| 2. | E-Factor Model | 2,584,422,264 | 95,579,980 |
| 3. | Decrease in Value | 55,337,436 | 16,266,020 |
| 4 | Rate of Decrease | 2.09% | 14.54% |

**9. Merits and Demerits of the E-Factor Model**

**9.1 Merits of the E-Factor Model**

The E-factor has the following advantages:

a. It is best used for the valuation of special purpose industrial properties and other facilities generating wastes

b. Again the method is inevitable where the market approach and the income approach cannot be applied.

c. The method has also excelled because it combines the cost and labour theories of values.

d. The method has succeeded in examining the effect of Air pollution tendency of an industry on the value of the industry.

e. The model has equally considered the effect of effluent discharge of an industry on the value of the industry.

f. The model also tries to determine the effect of the soil pollution tendency of an industry on the value of the industry.

g. Again, the model considers the effect of the ability of the industry to generate noise on the value of industry.

h. Finally, the model makes the value of the industry to be dependent on the ability of the industry to adhere to stipulated health and safety standards.

### 9.2 De-Merits of the E-Factor Model

The demerits of the E-factor model arise from the traditional problems of the Depreciated Replacement Cost Approach. They include:

a. The model is based on the cost theory of value and we know that cost and value are not the same.

b. Also the model does not consider historical cost of properties since a property that may have depreciated physically may have acquired some historical cost.

c. Finally, the method cannot accurately determine accrued depreciation of industry.

## 10. Discussion of Findings

ANAMMCO and NIGERGAS companies have been valued using both the conventional cost approach to valuation and the environmental factor adjusted cost approach (E-Factor model) to valuation. The results show that ANAMMCO is 82.04% compliant to environmental standards and 17.96% non-compliant. Similarly, NIGERGAS is 66.22% compliant to environmental standards while the company is 33.78% non-compliant.

When interpreted in terms of value, ANAMMCO on one hand recorded a ₦55,337,436 loss of value when the valuation figures for the conventional cost approach was compared with of the E-factor model. This represents a loss of value of 2.09%. On the other hand, NIGERGAS recorded a loss of value of ₦16,266,020 when the valuation figures from the two models were compared. This equally represents a 14.54% loss in value.

When the results are placed side by side, it could be seen that ANAMMCO is more environmentally friendly than NIGERGAS. Also ANAMMCO has more valuable assets when compared to that of NIGERGAS since assets of NIGERGAS represent only about 4.24% of that ANAMMCO. Hence, in size ANAMMCO is a bigger company than NIGERGAS.

Further, ANAMMCO is only about 17.96% away from attaining international best practices on Environmental Standard while NIGERGAS is about 33.78% away from same. This shows that NIGERGAS still has a lot of work to do in terms of installation of pollution of abatement equipment in the company. This is very necessary in terms of Air and Water pollutions and solid waste management system. The noise and soil quality levels need to be conserved properly since they are so far excellent.

Finally, in terms of industrial health and safety, NIGERGAS is still very far behind when compared to ANAMMCO. Safety precautions in terms of hand gloves, helmets, boots, overalls, ear plugs, nose masks, fire alarms, respirators, firefighting equipment, clinics, etc need to be embraced by management of the company and a safety manager be employed for enforcement.

## 11. Recommendations

The E-factor model was used to value MB-ANAMMCO and NIGERGAS and the results show 2.09% and 33.78% reduction in the value of the factories due to their environmental pollution tendency. It is therefore recommended that the model should be adopted by the Nigerian Institution of Estate Surveyors and Valuers (NIESV) for the valuation of industries and other facilities generating wastes in Nigeria. Also the model should be integrated into the academic curriculum of tertiary institutions offering Estate Surveying and Valuation in Nigeria. Again, effort should be made by the valuer in practice to accept this model since it is not a highly academic model. Finally further research should be conducted for the integration of environmental consideration into other valuation models.

## 12. Conclusion

In conclusion, the Estate Surveyor and Valuer should continue playing her role as an environmental protection advocate in Nigeria. The E-factor model should be adopted in the valuation of industries and other facilities generating waste in Nigeria. This will help reduce the general over-valuation of properties that are not environmentally sound in Nigeria.

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