Assessment of Atmospheric Emission Pollutants from the Thermal Power Plant: Case of Oyom-Abang Yaoundé-Cameroon

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Abstract: ***In the context of obtaining a real overview on the quantities of pollutants emitted in the thermal power plants of the engines WARTSILA VASA 18V32LN turbo alternators of 6.556 MW and running on heavy fuel oil, our participation is made on two plan. All First, the estimation of emissions by volumetric meter of fuel and the estimation of emissions by level of activities has this we have improved and associated equations to estimate of emissions. Throughout the years 2009-2010-2011 the following variations of each engine have a consumption of 22921, 3 Kg for Motor1, 25035, 6 Kg for Motor2 and 25467, 17 Kg for Motor3. With regard to the emissions of pollutants, for the first engine Motor1: 777,2kg Sulfur Oxides, 1390,5 kg of Carbon Monoxide, 2121,8 kg Nitrogen Oxides, 498,9 kg of Particulate matter 2.5µm and 1µm in diameter and 1995, 9 kg of particulate matter to 1µm in diameter. For the second engine: 844,1kg Sulfur Oxides, 1518,8kg of Carbon Monoxide, 2317,5kg Nitrogen Oxides, 912,3 kg of particulate matter 2.5µm and 1µm in diameter and 3649,3 kg of particulate matter to 10µm diameter. For the third engine: 858,6 kg Sulfur Oxides, 1545 kg of CO, 2357,5 Kg Nitrogen Oxides, 928,1 kg of particulate matter 2.5µm and 1µm in diameter and 3712,3 kg of particulate matter to 10µm in diameter. Of these results, it follows that the Engine 2 and 3 of the Central Thermal presents a huge pollution in particulate materials.***

Keywords: Heavy fuel oil, Emissions Air pollutants, Oyom- Abang, Atmospheric norm, Engines WARTSILA

1. Introduction

Cameroon is equipped with an extremely diverse ecosystem. It is a country that is signatory to several international environmental conventions [1] with the aim of limiting atmospheric pollution as well as sound pollution. For this, measuring stations and control of the quality of the air in the aim of ensuring compliance with the requirements defined by the national and international conventions.

The laws framework to the management of the environment is located in the sites where the pollution is assumed greater than the limit values laid down. Also, we are experiencing a significant pressure on biodiversity and its biological resources: 27.5% of forests are degraded; the rate of deforestation is 0.9%/year and is the highest in Central Africa [2]. Nowadays, the country is undergoing an explosion of industries to fossil fuels which generate a large amount of smoked, gas, dust, volatile particles (aerosols), harmful to health and the environment.

The combustion of fossil fuels in thermal power plants is one of the main sources and is a frequent source of pollution. This article is the contribution to the quantification of the emissions of pollutants emitted by the Central Thermal Power Plant of OYOM-ABANG I. It was installed in 2000 and was put into operation in 2002. It occupies 25% of the area of the site (Fig.1). This plant has an installed power of 19.66 MW, with an available power of 18 MW. It is equipped with three groups WARTSILA VASA 18V32LN turboalternators of 6.556 MW each at a voltage of 15 kV prepared in the engine rooms. It evacuates its energy through a 15/90 kV transformer on the 90 kV network.

Figure 1: Engine room at OYOM-ABANG I

Taking into account the ever-increasing demand, OyomabangI (OYO1) has undergone a conversion to fuel. This has led to the use of heavy fuel oil (HFO) which is more economic but more pollutant. To achieve our goal, the mastery of the daily consumption and the time of operation is necessary.

The thermal plant of OYOM-ABANG I (TPO) is located in the city of Yaoundé. Its geographical coordinates are (Latitude: 03.52 to 51.7 on Longitude: E 011°28'00.6" and at altitude: 775 m) [3]. Data was taken at the location of the site with a local GPRS.

2. Methods

The study of OYOMABANG I Thermal Plant (TPO) has allowed the collection of data on fuel during three years

(2009-2011). The target species are particulate matter PM (2.5µm and 1 µm) and PM (10µm), sulfur oxides SOx, nitrogen oxides NOx and organic compound Co. The estimation of these emissions is made by means of a database in which all information linking emissions have been compiled at the level of the base unit. It takes account of 7 parameters:

- The type of thermal engine
- The type of fuel,
- The geographical sector,
- The consumption of fuel per unit of electricity supplied,
- The time of operation,
- The percentage of chemical elements in the fuel oil
- And the technology of control of emissions of PM, SOx, NOx and CO.

The thermal plant is an entity that is associated with the emission factor used in the mathematical expression. It takes account of an issuing activity.

By considering separately the different categories of sources (areal, large point sources and possibly linear), the emissions are estimated for each of the elementary activities emitting deductions for the inventory.

A more detailed description of a substance, a time interval for operation and a geographical entity is illustrated by formula (1) [5]:

$$E_{s,t,z} = \sum_{a,i,f}\left[A_{a,i,f,t,z} \times \sum_{p}\left[F_{s,a,i,f,p} \times P_{a,i,f,p}\right]\right] \quad (1)$$

The emissions of a given activity are expressed by the general formula (2) [6]:

$$E_{s,a,t} = A_{a,t} \times F_{s,a} \quad (2)$$

E is the emission relative to the substance and activityat time t, and is expressed in CGE.

$A_{a,,t}$ and $F_{S,a}$ in (2) are determined by eight (08) more fine combinations of the activity generally involving an operation, a technology and a product.

Of this expression one returns to expression (1) In considering specific models such as that of the activity or the emissions is reported to a single parameter in the matter of the activity. The large point sources such as thermal power plants are studied individually. In Cameroon the hours of maximum load during intervals of time, thus allowing the continuous measurement of emissions of the study area. The method used is based on the principle of conservation of matter and can be applied to emissions of certain substances such as sulfur dioxide (SO2), sulfur trioxide (SO3), nitrogen dioxide (NO2), carbon monoxide (CO) by the material balance. This empirical expression is described by the following relationship (3) [5]:

$$E = Q_c \times T_{pe}(1 - R_p) \times \frac{M_{pf}}{M_{pe}} \quad (3)$$

In this expression, E the emission of the polluting substance P in the form f at the outlet to the atmosphere and is expressed in (Kg);

The annual emissions of each plant have been successively calculated on the basis of specific units of fuel oil consumption, of factors related to the precision, the representativeness and their lifespan, and then associate at the regional level. These emissions of PM, SOx, NOx and CO outcome of the stations have been estimated on the basis of equations (1) and (2), which has enabled us to obtain expressions (4)-(7) which are more suitable and more accurate for the study area [7] [8] [9].

$$E_{SO_X,i} = \sum_{j}\sum_{k}\sum_{l} A_{i,j,l} \times Scont_j \times (1 - Sr_k) \times (1 - \eta_j) \quad (4)$$

$$E_{CO_y,i} = \sum_{j}\sum_{l}\sum_{k}\sum_{m} A_{j,i,l,} \times Ccont_m \times (1 - Cr_k) \times \frac{M_{CO,m}}{M_{C,m}} \quad (5)$$

$$E_{NO_X,i} = \sum_{k}\sum_{m}\sum_{n} A_{i,k,m,n} \times EF_{NO_{X,k,m,n}} \quad (6)$$

$$E_{PM_y,i} = \sum_{k}\sum_{n}\sum_{l}\sum_{m} A_{i,k,l} \times AC_m \times (1 - ar_k) \times f_{k,y} \times C_{k,n} \times (1 - \eta_{n,y}) \quad (7)$$

Where the indices i, j, k, m, n and y are for each of these equations and its listing in the Table 1.

This distribution of the Indices applies on the diagram of the Fig.3. The characteristics of the residual oil Marin are listed in Table 2. These characteristics allow to better represent the information graphics.

Table 1: Value of indices according to a particular method [13], [14][15],[16],[17]

		Power Thermal Plant		***Source***
Geographical distribution		OYOM-ABANG 1		CAMEROUN
Type of technology		Moteur Wartsila Vasa 18V32LN		
Type of fuel		Light fuel	Heavy fuel	SONARA
Emission Control Technologies	SO_2 : Sulfur Dioxide Emission Control Technologies	Flue Gas Desulfurization	A post-combustion flue gas desulfurization (FGD) system uses an alkaline reagent to absorb SO_2 in the flue gas and produce a sodium and calcium sulfate compound.	EPA Base Case v.4.10 And Commission for Environmental Cooperation (CEC)
		Cleaner Fuel Substitution	SO_2 reductions can be realized simply by using distillate oil rather than residual oil. Based on published emission factors, SO_2 emissions would be 73% less if distillate oil were burned.	
	NO_X : Nitrogen Oxides Emission	Low-NO x Burner (LNB)	An LNB is a specially designed burner that is capable of controlling flame temperatures in such a manner as to minimize NOx emissions.	
		Selective Non-catalytic Reduction	A selective non-catalytic reduction (SNCR) system is an exhaust after-treatment device that utilizes the abilities of certain compounds, most commonly urea or ammonia, to react with NOx emissions to form benign chemical compositions.	
		Selective Catalytic	A selective catalytic reduction (SCR) system works in much the same way as an	

	Control Technology	Reduction	SNCR system. The difference between the two is that SCR systems also contain a mesh of precious-metal catalysts within the exhaust stack that facilitate a more efficient reaction at a wider temperature range.	
	PM : Particule Emission Control Technology	ESP (Electrostatic precipitators)	The precipitators consist of electrically charged plates or tubes installed inside an exhaust stack. PM, high capture efficiency, Reagent – None, Co-benefits	NESCAUM Andover Technology Partners Commission for Environmental Cooperation (CEC)
		Baghouse Pulse-Jet Fabric Filter (FF)	A baghouse consists of several layers of cloth-like material that the polluted exhaust gases are forced to flow through. Filtration of PM, highest capture efficiency Reagent – None, Typical Fuel Types , Gaseous fuels, Co-benefits	
		Scrubber (wet or dry)	Theoretically, wet scrubbers are a practical means of particle reduction for any application. Wet scrubbers spray mist into smoke stacks. The water particles collide with ash particles, and fall into a collection area.	
		Cyclone	A cyclone system simply accelerates the exhaust gas to high speeds, causing large particulates to separate from the gas,	
	CO: Emission Control Options Technology	Good Combustion Practices	While increasing the furnace efficiency will realize CO reductions, this practice will cause a steep increase in NOx emissions.	
		Oxidation Catalyst	Oxidation catalyst modules and pre-engineered packages are the cost-effective way to eliminate or reduce carbon monoxide and have a side benefit of also reducing unburned hydrocarbon emissions.	
		CO Spray Catalyst	Theoretically, the oxidation of CO to CO_2 could be achieved by adding the catalyst to the mist of a wet scrubber, if applied at the high temperature point in the exhaust stack.	

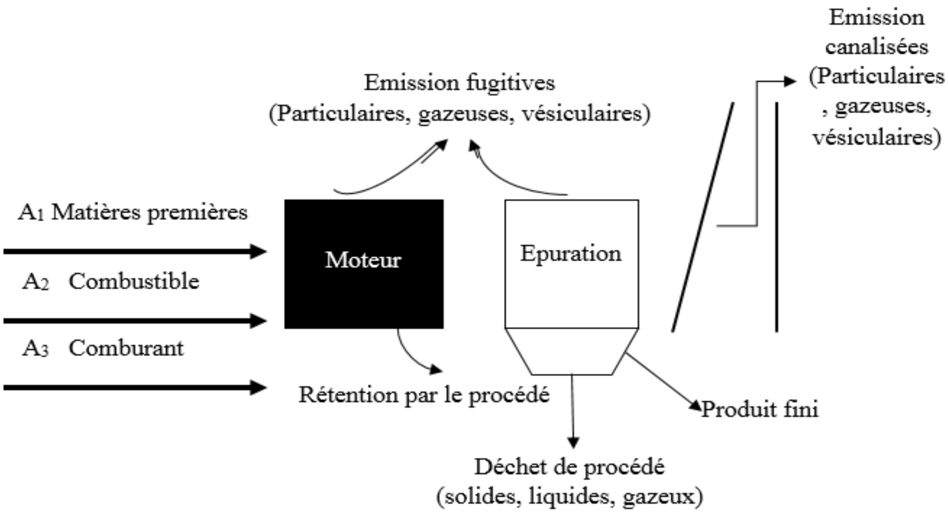

Figure 2: The balance of a combustion process industry in the Engines [5]

Table 2: Specification of fuel marine residuals (Class F) [18]

Caracteristics		test Methode	RME25	RMF25	RMG35	RMH35
Density at 15°C, kg/m^3		ISO 3675/ ISO 12185	991	991	991	991
Kinetic viscosity	at 100°C, mm^2/s	ISO 3104	25	25	35	35
	at 50°C, mm^2/s	ISO 3104	225	225	390	390
Lighting point, °C		ISO 2719	60	60	60	60
Carbone residual, % (m/m)		ISO 10370	15	20	18	22
ashes, % (m/m)		ISO 6245	0,1	0,15	0,15	0,2
Sulphur, % (m/m)		ISO 8754	5,0	5,0	5,0	5,0
Water, % (V/V)		ISO 3733	1,0	1,0	1,0	1,0
Total sediments, potential, % (m/m)		ISO 10307-2	0,1	0,1	0,1	0,1

3. Operation Time, Energy Production and Consumption

At the TPO, motors operate in full speed in the range of 18-22 hours, periods during which the consumption and pollution are maximum. Following the different engines, total hours of operation of the thermal plant of OYOM-ABANG I throughout the respective years 2009, 2010 and 2011 are listed such as follows:

- The operation time of the engine M1 is 2066,8 h, 1405,24 h and 1587,06 H for a energy production of respective 11702757,05 MWh, 7630106.6 MWh and 8765910 MWh (fig. 4 and 5).
- The engine M2 whose time of operation is 2092,048 h, 2092,048 h and 1341,66 H for a energy production of respective 11964112,1 MWh, 80456669,5 MWh and 7342710,3 MWh (fig.3 and 4).
- Engine M3 in which the time of operation is 2131,15 h, 2131,15 h and 1358,1 H registers an energy production of 12269747,1 MWh, 8097817,1 MWh and 7587088 MWh respectively (fig.3 and 4).

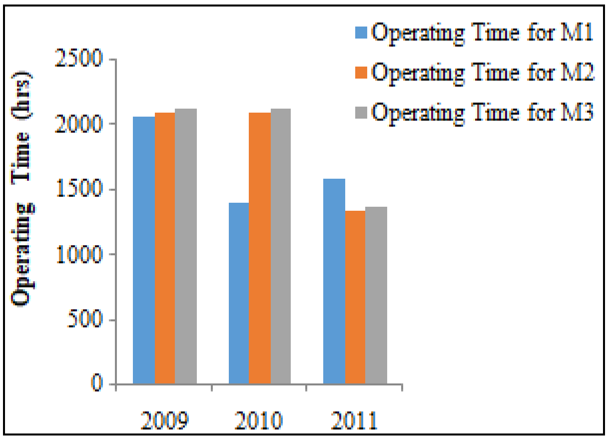

Figure 3: Operation time for each engine through the years 2009, 2010, 2011.

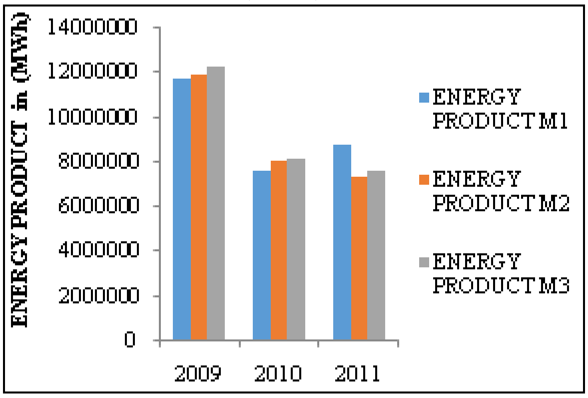

Figure 4: Energy Produced Each following engines the years 2009, 2010, 2011.

The energy produced by each engine is a function of the time of use. But, by comparing the energy produced and the operation time on a graph with two y-axes (Fig. 5), it is undeniable that in 2009 and 2010 the second engine has the same time operation as the third but produced distinct quantities of energy although they had the same characteristics when they were installed in the plant.

The energy of the first engine M1 decreases gradually between the years 2009 and 2010 then increases up to exceed 8 MW. This proportional variation of energy as a function of time remains in the logic of the manufacturer on the energy efficiency linked to the engine and the time **(Fig.5).**

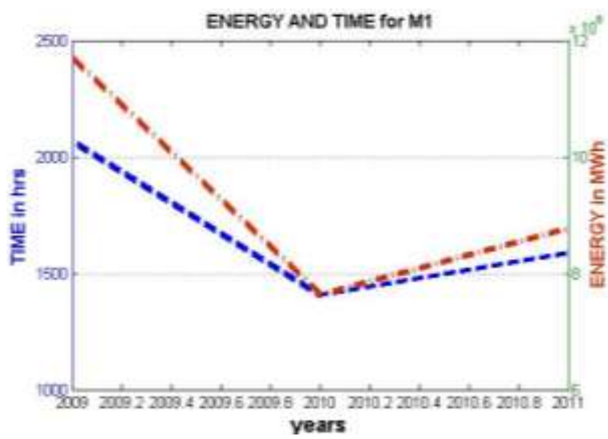

Figure 5: Variation of energy produced and operation time forengine M1

For the second engine M2 the energy produced decreases quickly from 12 MW in 2009 to 8MW in 2010.Thereafter a large decrease of energy is observed between 2010 and 2011 and reaches 7.5 MW in 2011. However, the operating time remains constant between 2009 and 2010 at 2100 hours. And subsequently there is a sudden lowering of the operating time to a value of 1300 hours. This figure shows us that indeed the second engine which ran normally in 2009 with a power of 12MW gradually loses its capabilities. It will produce for large enough operating time, small values of 8 MW in 2010 and 7.5 in 2010 (Fig.6).

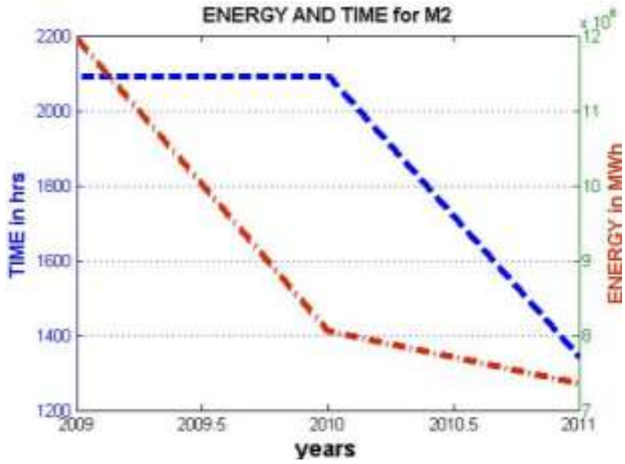

Figure 6: Evolution of the energy produced and the time for the functioning of the motor M2.

For the third engine M3, the energy produced decreases slowly from 12.5 MW in 2009 to 7.5 MW in 2010. Then it remains constant between 2010 and 2011. In contrast to the second engine, the operating time remains constant between 2009 and 2010 at a value of 2100 hours. And subsequently there is a sudden lowering of the operating time to a value of 1400hrs (Fig.7)

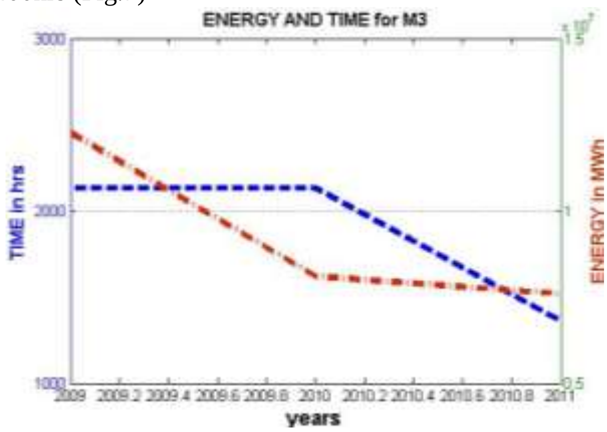

Figure 7: Variation the energy produced and the operation time for engine M3

This non-linearity of the energy produced as a function of time involves a loss of energy with time, during the trial of combustion and particularly to the consumption of fuel. This last indicator of power loss evolves according to the same rhythm as the hours of operation. But it is quantified in different ways. There are several methods for the assessment of the consumption of heavy fuel oil:

1) The Graduated rule it does generally not to have precise information, caused by an impossibility of detection of weak variations.

2) The Volumetric count based on a principle of oscillating piston. To measure the consumption of the engine, a counter usually placed downstream of the pump and upstream of the solenoid valves is used (Fig8). At this place the meter does not recognize that the volume of fuel actually consumed. Note that these HFO counters have anerror margin of less than 1%.

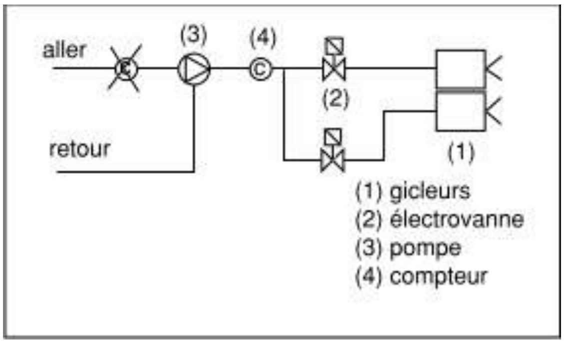

Figure 8: Installation of the meter downstream of the pump [11]

3) The measure on the consumption in liters based on the operation time of the igniter by means of a counter Schedule is given by the following equation (8).

$$C = 3,75 \times 10^{-3} \times D \times \sum_{i=1}^{n} H_i \times \sqrt{\frac{P}{7}} \qquad (8)$$

In addition to the hour meter, a counter of triggering the engine or triggering allows to detect malfunctions [11].

Finally the method of the level of activity that evaluates the consumption of fuel oil, taking into account the parameters related to the end of production of the chain. That is how expression of the activity equation (9) is reduced to the units of tonnage while knowing that in our plant. The consumption is expressed in units of volume after destuffing[7],[12]

$$A_j = 9,6 \times P \times C_{Sj} \times 10^{-6} \times \sum_{i=1}^{n} T_{i,j} \qquad (9)$$

Let's compare the consumption obtained by the methods of evaluation 3 and 4. These drinks highlight for each engine a quantity of fuel consumed over three years (36 months). Depending on the method of assessment by level of activity or by the Volume Meter we can compare following each engine the fuel consumption.

The consumption of heavy fuel oil by level of activities in all TPO throughout the 36 months presents several fluctuations (Fig.9). All the third month of each year, we observe that the values of consumption are maximum and reach 1090Kg. This period of the year corresponds to the period of low water, during which the hydroelectric potential is low, we appealed to the thermal power plants to supply the local electricity network. However, all 7 months of each year there is a low consumption of different engines (<200kg). This period corresponds to a rainy season in our ecosystem, or the floods are felt as well as the increase of the hydroelectric potential. Here there is a low demand by the Thermal plant.

Taking into account the consumption by volumetric meter we obtain Fig.10. It shows fluctuations similar to those of levels of activities, but with higher values of consumption (61.11%). In the 21st month the value of consumption of the first engine is low by 200kg while those of the engines 2 and 3 reach a value of 630kg, these values clearly explains the malfunction of engine 1 during this month. This phenomenon repeats for the engines 2 and 3 during the 31st and 33rd months respective.

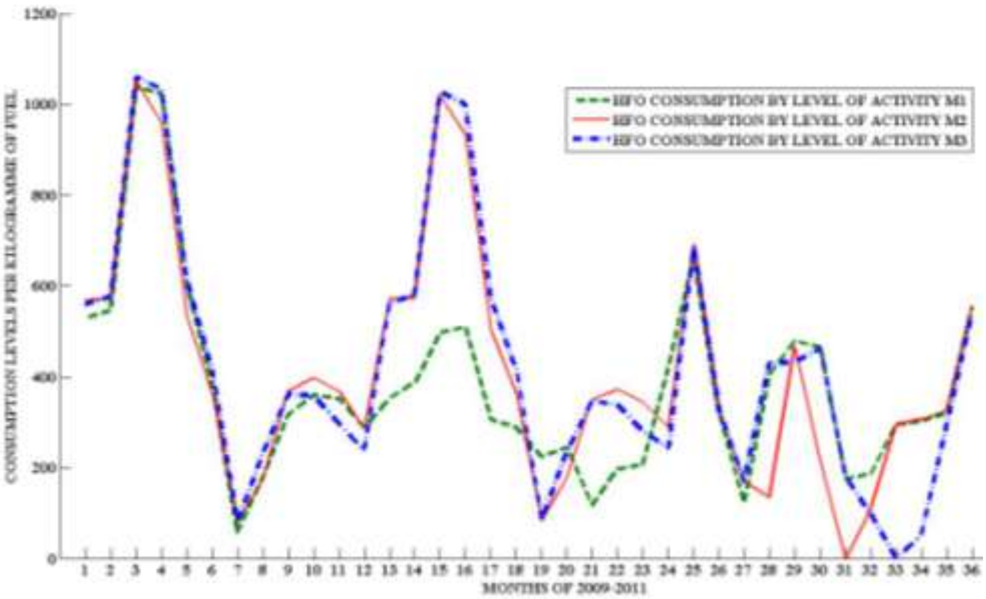

Figure 9: Consumption of engines by level of activities for the 36 months

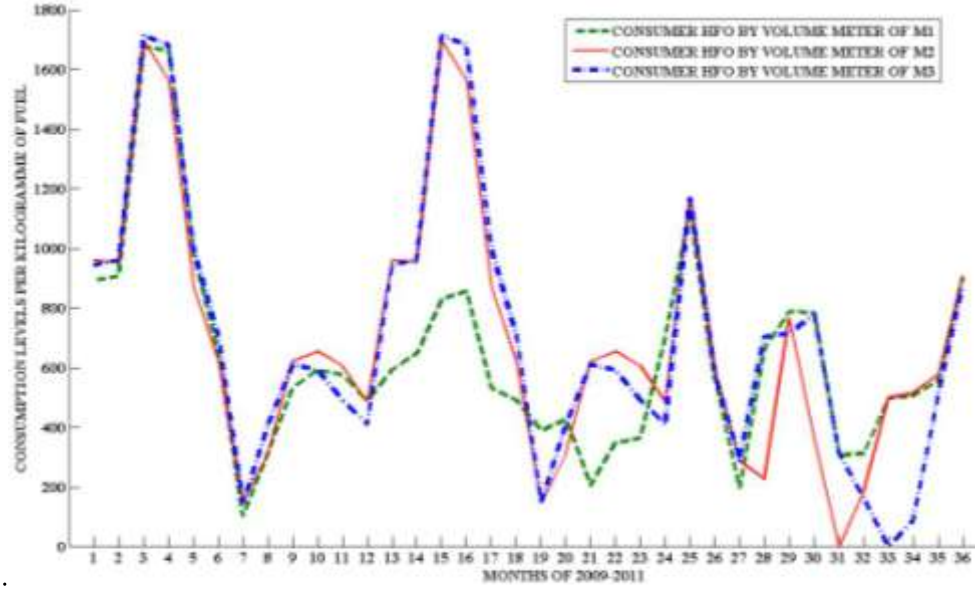

Figure 10: Consumption of engines by volumetric counters for the 36 months

Figure 9 and 10 present the annual consumption for 36 months of operation (3 years). The y-axis represent the consumption in kg. By overlaying these curves we can understand the difference that exists for the different methods of evaluation of the consumption.

The consumption by activity level of fuel presented in Figure 9 and compare with the volumetric consumption presented in Figure 10 are superimposed in Figure 11 and presents a considerable gap in three years, 256,36 kg for the first engine M1, 281,47 kg for the second engine M2, and 286.194 kg for the third engine M3. The method of assessment of consumption becomes paramount for the calculation of emissions. For a quantification of emissions using the method of level of activities or the method by volumetric meter a large gap will be felt.

The consideration of the consumptions for empirical quantifications which is more reliable and of emissions of pollutants will be in the two cases but all knowing that was linked to the volumetric meter is more accurate and allows us to have an excellent representation of emissions of pollutants. From a combustion technology to another, the trial is not always similar. It is therefore beneficial to reconsider this aspect involving the quantity of fuel injected at the inlet to the engine and the one actually ignited in the combustion chamber of the thermal engines. It would therefore be interesting for the experts to consider the level of consumption by volumetric meter putting in question the quantity of fuel really transformed into electrical energy.

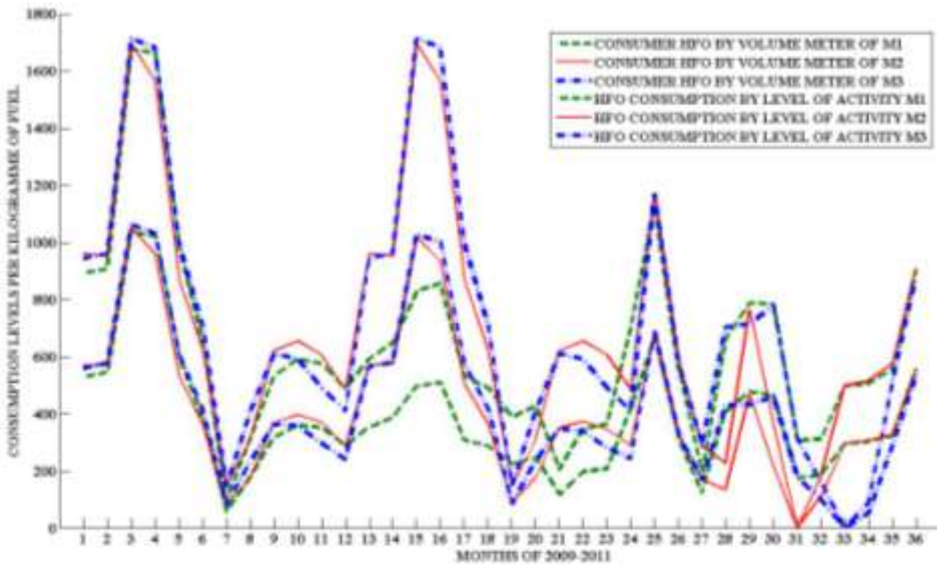

Figure 11: Superposition of HFO consumption of engines by activity level and by volumetric counters for the 36 months

The time intervals corresponding to the entry of the fuel oil in the engine and the one corresponding to the ejection of gas burned and unburned shows that for some technologies the course of fuel oil is not the same and for aging technologies, the loss of fuel oil by leaks in pipes is very evidence thus causing accidental spills of hydrocarbon and other chemicals in the environment (Fig.12).

Figure 12: Dumping of products in the receiving environment due to a leak in the coolant-oil heat exchanger coming out of the bleed (TPO)

Consequently he appears a real emission of pollutants resulting from the combustion of fuel oil. Taking into account the quantity outcome of leaks of the Auxiliary and the engine of combustion, we can improve the quantity of emissions of pollutants assessed by the level of activities.

4. Results and Discussion

These studies have been possible thanks to the empirical values identified in the thermal plant. As well the determination of the volumetric consumption of heavy fuel oil for each engine is performed analytically and has enabled a quantification of emissions of pollutants following a digital code implement in MATLAB vs R2012A (7.14.0.739) 32-bit(Win32).

The emissions of the ss pollutants are presented according to each engine (M1, M2, M3) for three years (36 years). The emissions of SOx, NOx, CO and particulate thermal plant are represented (Fig.10) as a function of the mathematical equations incorporating of consumption levels volumetric, emissions factors and especially of the indices giving a precision on the quantity to assess.

The emissions of pollutant for the first engine present on the 36 months NOX as a pollutant of the majority of the emissions (Fig.13). Throughout these months, the periods of low water arise as a period during which the pollutants are discharged into the atmosphere at large quantity. It corresponds to the third month of each year. For this engine emissions of particles of 2,5µm in diameter are the most small throughout our study by against those of 10µm in diameter are the second most issued.

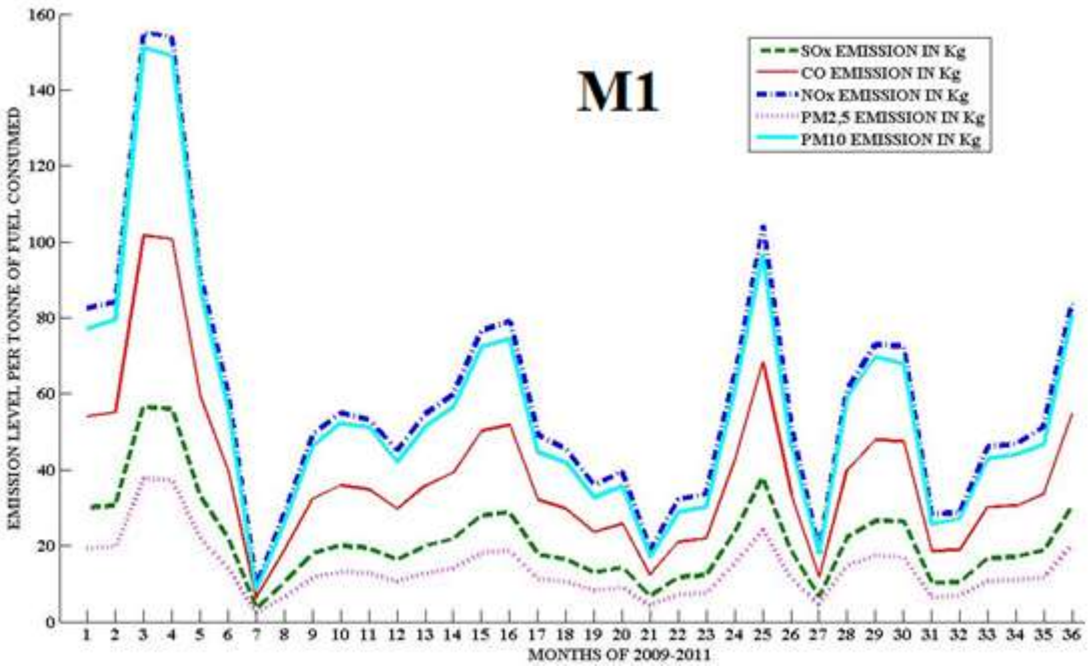

Figure 13: Comparison of emissions of pollutants for each engine

These information by the engine, provide information on the type of combustion which is taking place in the cylinders. Taking into account the type of pollutant characteristics emitted, the properties of fuel remains verified. The different pollutants from combustion show fluctuations similar to those observed at the level of the consumption of fuel.

The second engine alone is a major pollutant on 36 months of particulate matter of 10µm diameter (fig.14). Having a higher peak of 100 kg in the second peak that is the NOx. The minimum value of emission here is that of the SOx, always less than 60 kg.

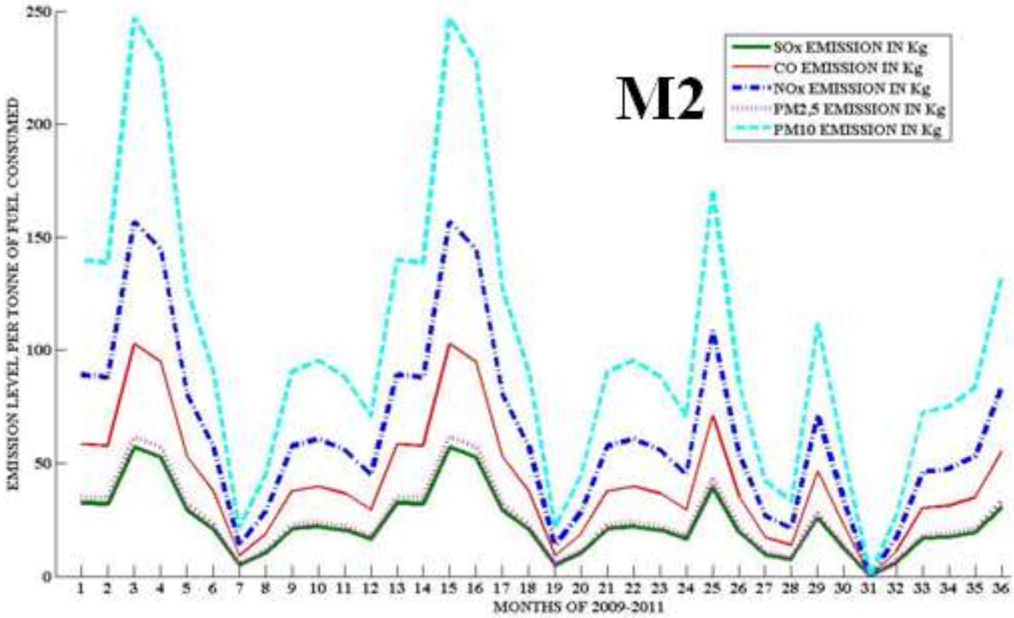

Figure 14: Comparaison des Emission de polluants pour chaque moteur M2

Of all the foregoing, the third engine does not escape the different seasonal variations that affect the engines. The level of emission of organic compound on this engine joined to the other two and reaches a maximum value of 100kg through all 7th month of the year. This value preponderant on the quality of combustion reflects the fact that, on the third engine combustion is incomplete (See Fig.15)compared to the other two. It is important to note that this quantity of organic compounds depends on the treatment procedures of fuel before the enter in the combustion chambers of engines. The position occupied by the PM to 10μm diameter in the last two cases compared to the NOx informs us about the failure of the first engine with regard to the systems for the supply of air and ejection of gas. In contrast, the last two engines allow us to look on the system of ejection of gases and retentions combustion residues in the trays of pre-combustion.

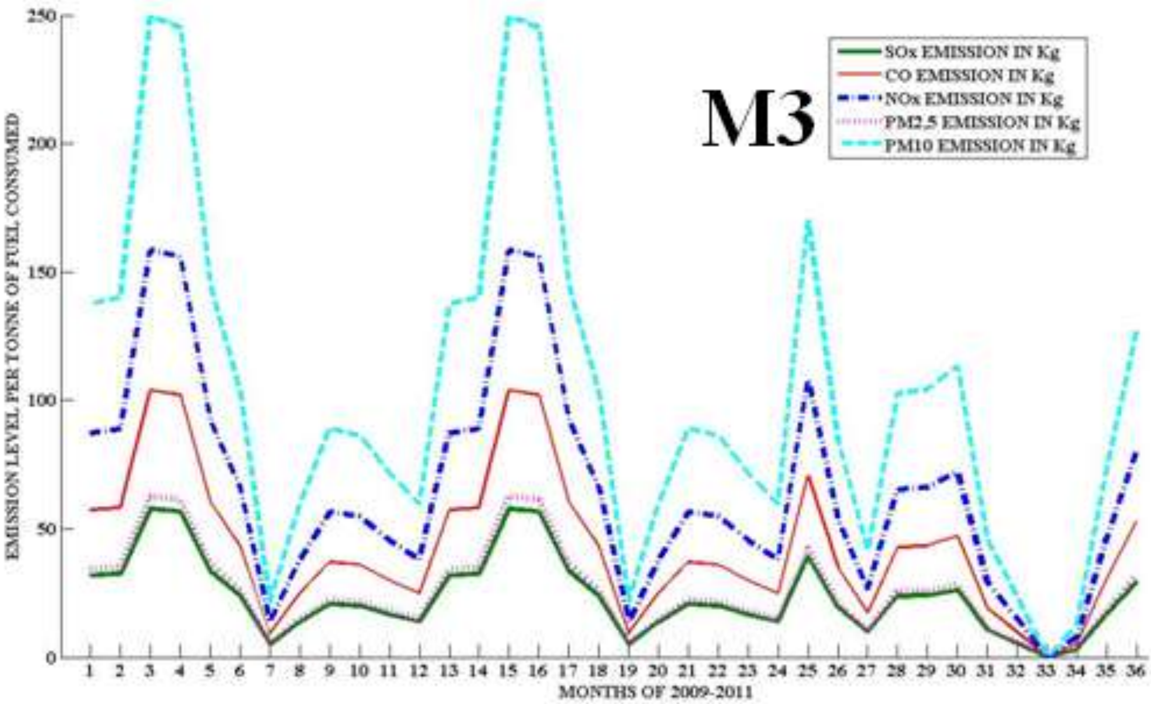

Figure 15: Comparison of emission of pollutants for each engine M3.

Table 3: Summary of emissions of pollutants for each engine within the three years

	ENGINE 1				
	Emis Sox Kg	Emis CO Kg	Emis Nox Kg	Emis PM 1µm; 2,5µm (Kg)	Emis PM 10µm (Kg)
2009	315,7089286	568,0871932	866,8457642	206,3244065	825,2976259
2010	214,653965	386,2487166	589,3779474	136,5592201	546,2368805
2011	242,4274299	436,2243375	665,6358808	156,0887229	624,3548916
	ENGINE 2				
	Emis Sox Kg	Emis CO Kg	Emis Nox Kg	Emis PM 1µm; 2,5µm (Kg)	Emis PM 10µm (Kg)
2009	225,826285	406,3522086	620,0539195	145,1099528	580,4398112
2010	210,5036787	378,7806843	577,9824571	134,1397267	536,5589067
2011	445,9930887	802,5207368	1224,568534	290,0463366	1160,185346
	ENGINE 3				
	Emis Sox Kg	Emis CO Kg	Emis Nox Kg	Emis PM1µm 2,5µm (Kg)	Emis PM 10µm (Kg)
2009	214,6554925	386,2514652	589,3821415	137,114722	548,4588879
2010	229,0401982	412,1353296	628,8783993	147,003283	588,0131322
2011	1047,821253	1885,451379	2877,015291	675,9186087	2703,674435

Many factors can affect the process of combustion in diesel engines, the number of which the engine load, its adjustment and the ability to inflammation of the fuel, as many factors that also affect the trends of a given fuel to form solid deposits, liquid and gaseous.

In general way figures 13, 14, 15 show the variations of the main pollutants, which evolve simultaneously with the consumption of fuel oil. The values of the annual emissions are listed in Table 3. Concerning the first engine the maximum value of a pollutant is that of nitrogen oxides NOx (866,85 kg) during the year 2009, and the May polluting is that of particulate matter PM of 2,5µm and 1µm diameter (206,32 Kg). On the other hand, for the second and the third engine the maximum values of pollutants are those of particulate matter PM to 10µm diameter (2703,67 kg) and of nitrogen oxides NOx (2877,02kg) during the year 2011 and in a similar manner to the values of pollutants by the engine first those of the second and third engine can pollutants are particulate matter PM of 2,5µm and 1µm diameter (137,12 kg) and sulfur oxides SOx 214,66 (Kg).

In brief these results in correlation with the evolution of the energy produced allow to understand that for an engine fulfilling the conditions of production maximum energy and minimum pollution provided by the designer, the value of the emission of pollutant is majority for Nitrogen Oxides NOx for a system for the supply of air in perfect state and minority communities for the particulate matter as present on the results of the first engine. This implies a high pollution of the motor 2 and 3 in particulate matter evidence of poor combustion and of the failure of the system of ejection and retention of residues

in taking into account the year 2009 as a reference one realizes a considerable reduction of 31,97% in fuel consumption and pollutants but not excluding the fact that the central thermal has had to make a great effort in the reduction of pollutants through pretreatment of fuel and the use of light fuel oil for the startup. That would not stop, the aging mechanization led to engines no longer works to big consumption and operation times high.

All the times it is to be noted that this decrease does not impact on the variation of pollutants for the same year. The engines 2 and 3 do not comply with this quantitative order, because already presents signs of failure. It will therefore be wise to take account of the cumulative effects that may arise under forms of secondary pollutants such as acid rain, ozone, which have a very important impact on the environment.

Such results are consistent with those of Yu Zhao [5] and Dongmei Li [6] and allow to say that the improvement on the mathematical methods has empirical radical also operate on the organic compounds (CO). More the average quantities by years of each pollutant (Table 4) show us as regards the pollutants SOx and NOx, that the quantities émisses are below the limit values recommended by the MINEP-Cameroon [19] [20]. In contrast to quantities of PM types emitted and CO are greater than the limit values recommended.

These different values allow us to say that the releases of air pollutants on the C.T.O. are of four types: particulate matter PM of 2,5µm, 1µm and 10µm diameter and the organic compounds. With regard to the other, such as SOx, NOx, they are the thresholds of the limit values recommended. One can ask a number of question on all thermal power plants of the INTER Network connected of Cameroon with respect to the quantity of pollutants emitted. Is it measurable? Can we define a scenario on 20 years to master and control this pollution? If yes what are the measures to be taken to reduce or partially mitigated its impacts on the environment.

Table 4: Annual average values of emissions for each engine

Emission	*Emis Sox Kg*	*Emis CO Kg*	*Emis Nox Kg*	*Emis PM 1µm; 2,5µm (Kg)*	*Emis PM 10µm (Kg)*
Average M1 /yr	21,46639787	38,62667354	58,94054423	13,86034304	55,44137217
Average M2 /yr	23,446478	42,18963315	64,37727381	25,34291855	101,3716742
Average M1 /yr	23,85065271	42,91690582	65,48702112	25,77978445	103,1191378

5. Conclusion

The methods for the estimation of emissions Use leaves us affirm that the indices used to better control the quantification of the consumption and emissions are good and allows you to better understand the methods of assessment of consumption at the entrance to the engine.

As a solution to the reduction of the huge quantities of pollutants discharged into the atmosphere, we advocate a supported more regular and more rigorous study of the maintenance system. The pretreatment of the fuel prior to injection into the cylinders and finally the large-scale application of the methods related to the control of technology of emissions.

These strategies of control should already be put on foot in some power plants in operation and in the future in the implantation of new thermal power plants, cement, boilers in soap factories.

However, the emissions of SOx, NOx, CO and particulate matter of the electricity sector would likely increase with the growth of the energy consumption of as much more that our country is in the process of development and running with the strategy of the emergence. It will be faced with an exponential growth of fossil industries.

The permanent increase in the content of these gases at the rate of 0.5% per year is actively involved in the increase in the rate of morbidity and mortality in the home, the greenhouse effect and global warming [21]. The well-being and the fate of future generations and its environment will become a new challenge for the Cameroonians based on the fight against air pollution. Therefore a policy of reduction of emissions of pollutants must be set up as soon as possible.

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