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Mini Review

Modelization of Atmospheric Pollution to Green House Gase NO_x of Arzew Industrial Pole

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Abstract

Algeria, a Mediterranean country closer to Europe participates and covers a certain part of the world energy demand through its natural gas and petroleum poles among which Arzew industrial pole. The present paper focuses on the quantitative and qualitative evaluation of the atmospheric pollution issued from petroleum and petrochemical activities since 1963. The evaluations allowed modeling the pollution using Areal Locations of Hazardous Atmospheres (ALOA) code. In this regards, a nitrogen atoms balance analysis has been carried out for the nitrogen at the input and output of plants of Liquefied Natural Gas (GNL) , Liquefied Petrol Gas (LPG), Ammonia, Methanol, industrial Electricity and Water as well as the energy used for the transformation of these products. The elements used for this evaluation were the quality certificate of gas, final products and the exploitation of the recorded gas flow rates and products. This has allowed plotting the atmospheric emissions curves of NOX since 1963 up to 2015, with an extrapolation up to 2035 by integrating the new projects in the zone under consideration and taking into account the likelihood evolution of the world energy demand. It is worthy of note that it is impossible to accurately evaluate the emission of Green House Gases (GHG) by equipments such as furnaces, boilers, torches because of the variation of the flow rates, chemical composition and gas combustion colorific capability of the equipment. Thus a global analysis input-output is made for each production plant. The resulting deviation from these two analyses represents the total emission of Gas NOX. The present work has been modeled by simulations using ALOA software code.

INTRODUCTION

The risks of climate change have been considerably discussed during these last decades [1,2]. The majority of scientists of all disciplines are convinced that this phenomenon is linked to Green House Gases (GHG). A global politics has been adopted by the states aiming to stabilizing the GHG emissions [3,4], followed by the ratification of Kyoto protocol for contending these emissions with the objective of 5.2% reduction of six GHG between 2008 and 2012 [5,6]. Such atmospheric emissions generate a variety of polluting factors in the immediate natural neighborhood of des industrial pole under investigation. furthermore, since a proportion of these pollutants are transported, to certain distance [7], bay the wind movement the contaminated natural space becomes evidently more large witch necessarily worsens the pollution problem. The epidemiologic and toxicological studies affirm that the atmospheric pollution presents higher hygienic risks [8,9]. As consequence, there exists a direct relationship between the over mortality and the fluctuations of pollutant ratios [10]. Determination of the study zone The Arzew industrial platform covers an area of 2500 hectare (ha) where 935 ha are used for production plants and services. More than 900 ha are reserved for petrochemical industry and 400 ha are reserved for technical ways for canalization and passage of cables between the plants as well as between the plants and gaseous and petroleum gates. The platform has a number of gas liquefaction, refinery and petrochemical complex susceptible to generate atmospheric emissions. It also contains storage infrastructures for petroleum products (LNG, LPG, methanol, fuel, condensate...) localized in the different production plants. The industrial zone is characterized by an important number of atmospheric rejection waste points.

The main sources of atmospheric pollution are the industrial emissions of carbon dioxide (CO_2) and nitrogen oxide (NO_X) which is precursor of ozone (O_3) and nitric acid (HNO_3). Qualitative evaluation of the green house gases (GHG). The observations and appreciations made on the GHG - NO_X quality had been carried out by following up the composition of injected gases at some

Figure 1 Arzew industrial zone.

representative emission points present in the industrial zone. - Since 2005 a follow up of these emissions has been made at some combustion towers, gas turbines exhausts, at some boilers chimneys and furnaces.

This qualitative study has allowed noticing a greater instability of the chemical composition of the rejected gases to the atmosphere. Quantitative evaluation of the green house gases (GHG). In this study a quantitative and qualitative evaluation analysis is made on the atmospheric pollution of NO_X Gas generated by the industrial plants of Arzew industrial pole.

The following points are developed:

1. Qualitative evaluation of fumes released by Ammonia, methanol, LNG and LPG production plants.

2. Quantitative evaluation of NO_X generated by all the plants of Arzew industrial pole since 1963 up to 2035.

3. Quantitative estimation and extrapolation of Gas NO_X up to 2035. 4. Modeling atmospheric pollution of Gas NO_X 2030-2035. 5.

The quantitative estimation of Gas NO_X emissions has been obtained. Evaluation quantities of NO_x emitted by the production units of the industrial zone of Arzew. Originally the concept generally referred NO_X : NO, NO_2 later it appointed all gaseous nitrous oxygenated compounds: NO, NO_2, N_2O_3, N_2O and even HNO_3 [11,12].

Due to the diversity of sources of emissions of nitrogen dioxide which are entered in the Natural Gas LNG production complex [13-15], LPG [15,16], Ammonia and Methanol [17-19] or flares, boilers, gas turbines and furnaces, we have established a material balance on the nitrogen, which is a quantifiable element before converting the results into equivalent total NOx gas.

Rating flows : $F\text{-}_{NG}$ (natural gas to the complex entrance), $F\text{-}_{LNG}$ (Liquefied Natural Gas LNG case), $F\text{-}_{LPG}$ (Liquefied Petroleum Gas), F-C5 (Gasoline : secondary product), $F\text{-}_{GP}$ (Gas Process units, Boil-off ship and bins), $F_{G\ Fuel}$ (fuel gases to the boilers), F GN utilities (natural gas to utilities), $F_{GN\ driver\ torch}$ (gas to pilot flame torches), $F_{GP\ Torch}$ (gas flared from the process), $F_{G\text{-}Torch}$ (flashlight total gas).

NO_X flow from the combustion is generated by the torches (hot, cold, low pressure and high pressure), boilers and gas turbines. During combustion of fuel flow (GC) and torch flows (GT).

We set a record on the atom of nitrogen was achieved, entered (GN), LNG production output (for complex LNG) combustion system has been realized (flares, boilers, gas turbines).

$$\mathbf{F_{comb}*Y_{comb} = F_{GN}*Y_{GN} - [(F_{GNL}*Y_{GNL}) + (F_{SP}*Y_{SP})]} \quad (1)$$

The absence of nitrogen in the by-products, equation (1) becomes,

$$\mathbf{F_{comb}*Y_{comb} = (F_{GN}*Y_{GN}) - (*F_{GNL}\ Y_{GNL})} \quad (2)$$

In the case of complex production of ammonia, methanol, electricity the LNG flow F = 0.

Equation **(2)** determines the amount of nitrogen contained in the fuel up to the boilers, gas turbines and to the torches ($F_{comb}*Y_{N2}$); rest conversion to N_2O equivalent by multiplying by 44/14 (the case of N_2O); 46/14 (case of NO_2) and 30/14 (the case of NO) which are respectively the ratio of the molar mass of N_2O, NO and NO_2.

Total quantity of NO_X (N_2O, NO and NO_2) generated by each complex equal to the sum of emissions from combustion ($F_{comb}*Y_{N2}$). We proceed to the digital application, the results will develops in Figure 2, and modeling in Figure 3.Total quantity of NO_X (N_2O, NO and NO_2) generated by each complex equal to the sum of emissions from combustion ($F_{comb}*Y_{N2}$). We proceed to the digital application; the results will dévelllopés in Figure 2, and modeling in Figure. [20-22].

To facilitate the study, a specific computational code has been elaborated for each production unit of LNG, LPG, Ammonia, Methanol and electrical energy production [13]. In this conducted study, a computational code is developed on the background of materials balance for each investigated process as illustrated in figures 2 and 3. The results obtained are shown in figures 2.

RESULTS AND DISCUSSION

The Figure 2 shows the quantitative amounts of Gas NO_X injected from all the petroleum and petrochemical plants of Arzew industrial pole. The values show the increase of atmospheric pollution since 1963. Before 1963, there was absence of any industrial activities. There existed only a fish harbor, agricultural

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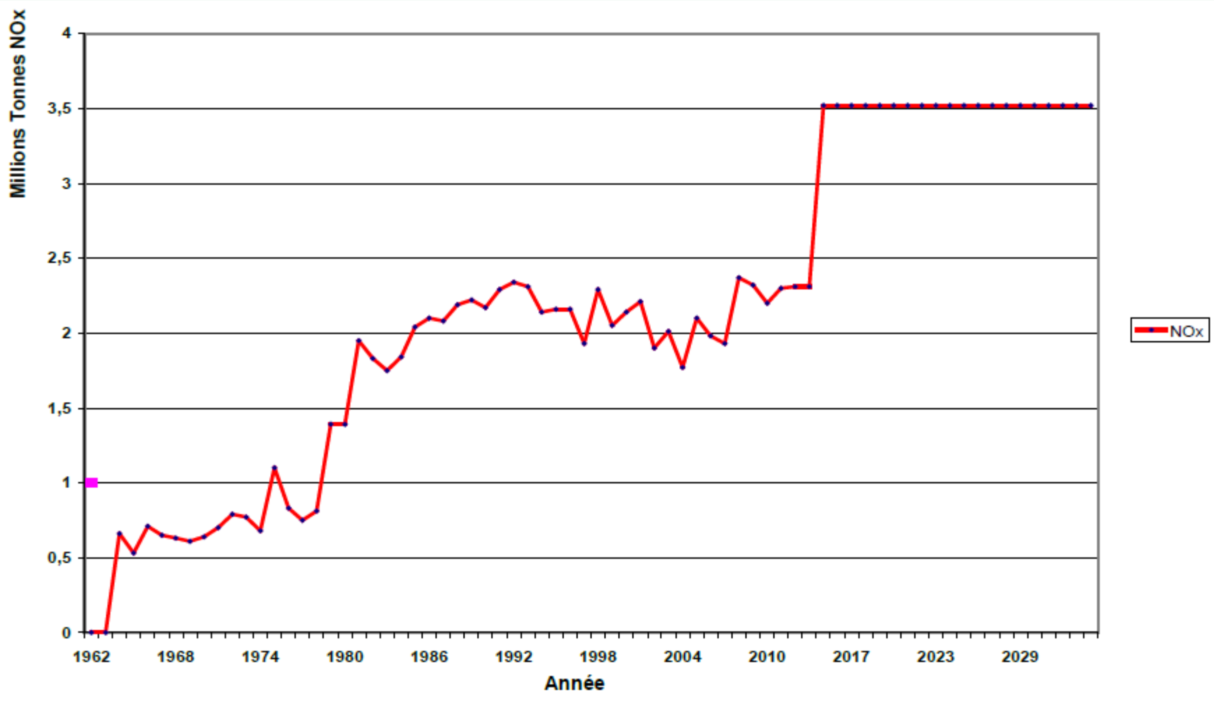

Figure 2 Quantitative evaluation of NO_x emissions at Arzew pole 1962-2030.

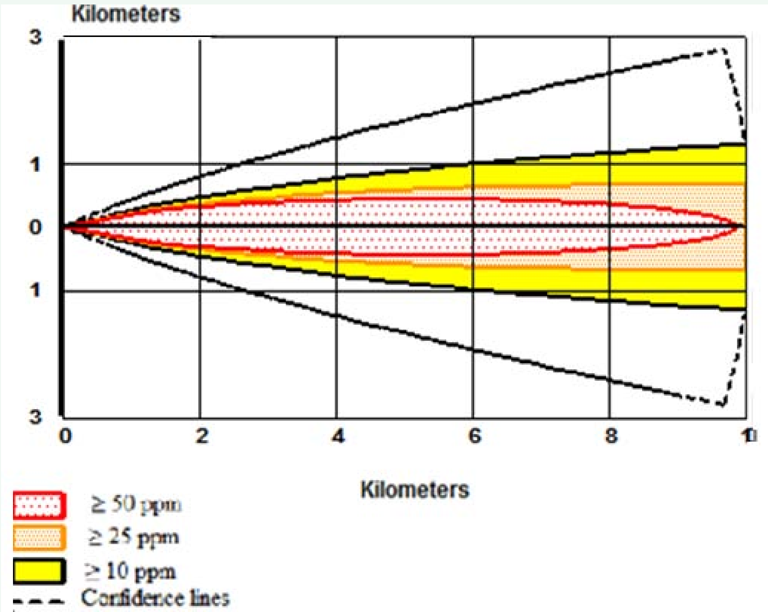

Figure 3 Projections of NO_x gases released by all the hydrocarbon and petrochemical units 2030-2035.

activities or animal breeding. The only source of atmospheric pollution was generated by domestic heating, using woods and burning of domestic wastes, which generated modest CO_2 and NO_x emissions.

Since 1963, four stages of the industrial emissions growth are observed:

The first [1964-1974] shows that the annual average quantity of NO_x gas emission is about 0.68 million tons .In the second [1975 - 1980], the quantity increased to 1.3 million tons of NO_x per year .In the third [1981-2013], it reached 1.9 million tons per year .The fourth [2014 and 2029], it will be between 3.3 and 3.6 million tons per year.

The results of the atmospheric pollution modeling, in this important step of the study, are the future attempts of pollution. In this simulation, the meteorological data of Arzew zone were taken into consideration for the period 2030-2035. In this period, the annual average emissions of GHG will be 4 million tons of NO_x, see Figure 3. [23]

The modeling results illustrated in Figure 3, show three levels of toxicity related to NOx gas. A toxicity of NO_x with 50 ppm of concentrations scattered on an area of 9.8 km in length and 1 km in width, with 25 ppm at a distance of 10 km and width of 1.2 km and with 10 ppm at a distance of 10 km and width of 2.5 km at a width.

CONCLUSION

1. Greenhouse gas (GHG) emissions of NO_x emitted by all Arzew Pole industries are the order of millions of tons per year.
2. The carbon dioxide diluted in the fumes of boilers, furnaces and gas turbines is not a subject for recuperation.
3. Some production units, which has de carbonation section, reject pure NO_x to the atmosphere
4. The burned gases in torches, at all industrial plants are not energetically valorized.
5. Lack of renewable energy sources due to the higher exploitation costs.
6. Arzew platform is not covered by a network of air quality measure.

RECOMMENDATIONS

From this investigation the following recommendations are made:

1. Review of the energy strategy by opting for two renewable energy sources "solar" currently at higher cost with a conventional low cost energy source "petroleum and natural gas". Inspiration from economical models for long term to regulating these emissions [26].
2. Investment in energetic valorization of torch gases before their combustion. Such as the installation of small gas turbines having as fuel the torch gases or their reinjection into the plant loading gas.
3. Evaluation of the global environmental impact of the industrial zone.
4. Predict in line counters and analyzers ahead of torches.
5. Arzew platform is not covered by a network of air quality measure. [27]

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