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Pollutants Emissions of Filling Stations and Their Impact on the Air Quality

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ABSTRACT

This study investigated pollutants emissions of filling stations and the impact they cause to the air quality. Gas monitors were employed to identify the different pollutants present in the ambient air of the study areas. The results shows that the most prominent pollutants present in the ambient air are the volatile organic compounds followed by methane, then carbon monoxide. Measurements were taken at the controls at distances between 20 to 200m. The pollutants concentration recorded at the study areas shows that the level of pollutants exceeded the Federal Environmental Protection Agency (FEPA) air quality guidelines. There are few exceptions in pollutants like the particulate matter which was found to be at concentrations within the FEPA limits. Regression analysis of the pollutants at the controls shows that only the volatile organic compounds and methane are the only significant pollutants present in the ambient air, primarily because of the presence of the filling stations. These two pollutants show a strong negative correlation with distance from the study area. Specifically, the regression curve for the volatile organic compounds (VOCs) shows a nearly perfect curve with exponential functions as its regression model trend line, while that of methane has linear model trend line. Both VOCs and methane have a correlation coefficient (R) that is above 0.9 for the study areas. Hence, a conclusion was drawn from the findings that the primary pollutants to consider when building filling station are the VOCs and methane. Similarly, the minimum safe distance to site a filling station is 80m away from residential areas.

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1. INTRODUCTION

The advent of industrial revolution resulted in the use of liquid petroleum as sources of fuel. Previously, the energy was provided by human and animal muscle, and later by the combustion of solid fuels such as wood, peat and coal. One problem associated with the use of these solid fuels is the amount of effort geared towards harnessing the energy. On the other hand, liquid petroleum has proven to be a cheaper source of energy. Oil was a much more concentrated and flexible source of energy than anything previously available. At the beginning of the 20thcentury, the industrial revolution has progressed to the extent that the use of refined oil primarily for illumination ceased to be of primary importance. The oil industry became a major supplier of energy largely because of the advent of the automobile industry. Although oil constitutes a major petrochemical feedstock, its primary importance can be seen in the fact that it is an energy source on which the world economy depends[1]. The production and consumption of oil are vital to any economy and have frequently been a decisive factor in the determination of foreign policy.

From the above fact, one can see how oil has played a major role in the advancement of technology in our time. But, just like every other technology, oil discovery has come with some of its disadvantages. One such disadvantage is its negative impact on the earth's biosphere, releasing pollutants and greenhouse gases into the environment and damaging ecosystem through events such as oil spillage [1], increase in NO_x emission [2, 3]and heavy metals [4]. This situation has resulted for the developed countries beginning to emphasize on a

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1. Joseph P., Riva, J. R. (2010). The history of the words petroleum industry. Newyork publisher, NY.

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cleaner and more environmentally friendly energy source. Nigeria with a large reserve of crude and natural gas has its energy needs met by these fossil fuels. The Nigerian economy is largely dependent on the exportation of crude. The recent population explosion in Nigeria triggered an increase in the demand for petroleum products. Here, more filling stations are being built in order to meet the increasing demand for fuel. The situation is such that it is becoming very common to see filling stations located very close to residential areas. The disadvantage seen from this development is the increased pollution caused by the continued emission of toxic gases into the air. These emissions originate from the following sources: gasoline delivery to the stations, tank breathing which occurs due to temperature and pressure changes, vehicle refueling, emissions from loosely closed tanks and mishandling of the petroleum leading to spillage. There is also the emission of combustion products from vehicle engines present in the station.

These gases emitted into the atmosphere are hazardous to human health. One of the most prominent of these gases is the volatile organic compounds (VOCs) which were reported by the world health organization as the major cause of cancer in humans [5]. Similarly, numerous studies found that all types of air pollutants at high concentration can affect the airways. Nevertheless, similar effects are also observed with long term exposure to lower pollutants concentrations. Symptoms such as nose and throat irritation, followed by bronchro constriction and dyspnosa, especially in asthmatic individual are usually experienced after exposure to increased level of sulphur dioxide and nitrogen and certain heavy metals such as arsenic or vanadium [6, 7]. In addition, particulate matter can penetrates the alveolar epithelium and initiate lung inflammation [8] in patients with lung lesions or lung diseases. Moreover, air pollutants such as nitrogen oxide increase the susceptibility to respiratory infections. The main focus of this study is to investigate the pollutants which are released from the petrol stations, its negative impact on the air quality and to proffer solutions necessary in arresting this ugly trend in order to protect the life of the general populace from the harmful effect of these pollutants.

2. RESEARCH METHODOLOGY

In this study, three different filling stations were studied in Umuahia. These filling stations are located at different parts of Umuahia namely;: Mission Hill Umuahia (U_1), Hospital road (close to FMC) (U_2), and Aba road (U_3). Umuahia is the capital of Abia state, located along the rail line which lies between Port Harcourt to Umuahia south and Enugu city to its north. Its coordinates is $5^0 32'N7^{01}$. Equipment used in the air quality monitoring and measurement include an AEROCET 531 particle mass monitor, a Garmin U10 map GPS equipped with a compass and an AEROQUAL Environmental gas monitor (300 series). The Aerocet 531 particle gas monitor was used in measuring the concentrations of the particulate matter. The garmin U10 map GPS measures the wind direction while the AEROQUAL environmental gas monitor measures the concentrations of products of combustion and the volatile organic compounds.

The ambient air quality was measured at different points of the filling station namely: the front of the stations, the dispenser area, the generator room, and the controls. The controls are points between 20m to 200m away from each filling station. The aim of the control is to ascertain how far the pollutants travel and to determine which of the pollutants is directly present in the atmosphere as a result of the activities in the study areas. Similar studies like the environmental impact of fossil fuel utilization in Neka thermal power plant [9] used distance to establish impact. The measurements were carried out twice in each sampling point and the average taken as the true reading. Nine different air pollutants were measured and their data collected from each filling station. These pollutants include the suspended particulate matters (PM_1, $PM_{2.5}$, and TSP), carbon monoxide, NO_2, SO_2, hydrogen sulphide, methane, and volatile organic compounds.

The data collected from each filling station were compared to the FEPA air quality Standard to determine whether the pollutants concentrations are within the acceptable limits. The data collected at the control were treated with regression and correlation analysis to determine the relationships that exist between the pollutant concentration and the distance from the filling stations. Correlation coefficient was calculated in order to determine the strength of the relation that exists between distance from the filling stations and concentration of the pollutants.

3. RESULTS AND DISCUSSION

The results of the air quality measurement at the study areas are summarized in Table 1.

Table 1 shows the average concentration of the pollutants at the study areas. Here, the volatile organic compounds are seen to be the most prominent pollutants recorded. This is because of the continuous emission of the fuel vapour into the ambient air as a result of mishandling of the fuel which may lead to spillage, the displacement of air carrying fuel from the tanks during

[1] Wikipedia (2014). Umuahia. www.wikipedia.org/umuahia. June 2014.

vehicle refueling and the evaporation of fuels from loosely closed underground tanks. More VOCs were recorded at the dispensing areas and the reason behind it is evaporation of fuel occurring during the refueling of vehicles. There is a wide gap in the concentration of VOCs recorded at U_1 (152.12mg/m^3) and U_2/U_3 (89.65/56.72mg/m^3), owing to the fact the U_1 is a very busy station compared to U_2/U_3 at the time of the measurement. The direct consequence of this is that more of the pollutant will be released into the ambient air at U_1 than U_2/U_3. Methane were also found to be in high concentration at U_1 and U_3, and this comes from leakages from the storage tanks for cooking gas and evaporation during the dispensing of the gas to buyers. Zero trace of methane was recorded at station U_2 because cooking gas was not sold in the area.

CO_2 was found in high concentrations in the stations especially at the generator room because of incomplete combustion of fuel in the vehicle and generator engines present in the station. Incomplete combustion occurs as a result of faulty engines or due to lack of oxygen necessary for complete combustion. H_2S, SO_2 and NO_2recorded in the ambient air of the stations are all products of the combustion of fossil fuel in the generator and vehicle engines present in the filling stations. SO_2 is found when fuel containing sulphur is burnt, while NO_2 is released from the engines exhaust as a result of reaction with other gases present in the exhaust and in the atmosphere. Particulate matters are dust carried by the vehicles as they gain entrance in the filling stations. It was also recorded in the generator room at high concentration owing to the release of soot from the exhaust of the generators. It is believed that particulate matter from a nearby eagle cement factory contributed to the particulate matter in the ambient air. Different particulate matters were recorded and this includes the PM_1, $PM_{2.5}$ and the total suspended particle (TSP) which is a combination of the other grades of particulate matters.

4. COMPARING THE POLLUTANTS CONCENTRATION IN STUDY AREAS TO THE FEPA AIR QUALITY GUIDELINES

The national agency whose responsibility is to set and maintain environmental standards in Nigeria has air quality standards/guidelines. Table 2 shows the Federal Environmental Protection Agency (FEPA) standards for the different pollutants.

The average concentrations of pollutants at the study areas to the FEPA air quality guidelines can be deducted from Tables 1 and 2. At U_1 PM_1, $PM_{2.5}$, SO_2 and H_2S are found to be within the FEPA specified limits while TSP, NO_2, VOCs and CO exceeded the FEPA limits. The situation at U_2 shows that PM_1, $PM_{2.5}$, TSP, SO_2 and H_2S are within the FEPA limits, while NO_2, VOCs and CO exceeded the FEPA limits. At U_3, PM_1, $PM_{2.5}$, SO_2, and CO are within the FEPA limits, while pollutant TSP, NO_2, VOCs and H_2S all exceeded the FEPA limits. The situation in all the stations show that the air quality is negatively affected as some of the pollutants exceeded the FEPA limits. This implies that the health of those in the station or within the surrounding of the stations is at risk owing to their exposure to polluted air. For example exposure to the VOCs is known to cause cancer in humans according to the World Health Organization reports which classified the volatile organic compounds as carcinogenic [5].

5. CONCENTRATION OF POLLUTANTS AT VARYING DISTANCES

The results of the air quality measurement carried out at varying distances from the study areas are shown in Tables 3 to 5. These results were analyzed using regression analysis. The aim of the regression analysis is to determine if there is a relation between distance and concentration of pollutants recorded at the varying distances from the study areas. The correlation coefficient shows the strength of the relationship between dependent and independent variable [10].

TABLE 1. Average concentration of pollutants at the study stations

Pollutants	U_1mg/m^3	U_2 mg/m^3	U_3 mg/m^3
PM_1	0.01	0.01	0.01
$PM_{2.5}$	0.07	0.02	0.09
TSP	0.36	0.03	0.25
NO_2	0.60	0.20	0.15
SO_2	0.18	0.13	0.23
VOCs	152.12	89.65	56.72
H_2S	0.03	0.07	0.10
CO	6.48	6.72	3.24
CH_4	6.51	0.00	7.74

TABLE 2. FEPA air quality guidelines

Pollutants	FEPA limits (mg/m^3)	Time Limit (min)
Suspended particles (PM1 & PM2.5, TSP)	0.15	30
NO_2	0.09	30
SO_2	0.5	30
VOCs	40	30
H_2S	0.08	30
CO	5.0	30

TABLE 3. Concentration of pollutants at varying distances from U_1

Pollutants mg/m^3	Concentrations of Pollutants at Distance (m)									
	20	40	60	80	100	120	140	160	180	200
PM_1	0.02	0.03	0.02	0.01	0.010	0.06	0.08	0.04	0.06	0.01
$PM_{2.5}$	0.01	0.04	0.10	0.15	0.06	0.02	0.24	0.09	0.36	0.45
TSP	0.46	0.48	0.36	0.61	0.72	0.56	0.33	0.22	0.67	0.54
NO_2	0.16	0.17	0.22	0.17	0.13	0.14	0.21	0.29	0.15	0.09
SO_2	0.13	0.14	0.09	0.10	0.14	0.15	0.15	0.14	0.08	0.12
VOCs	100.67	80.32	40.43	20.43	10.17	7.87	7.66	6.98	5.42	5.00
H_2S	0.03	0.03	0.02	0.06	0.07	0.03	0.06	0.04	0.04	0.01
CO	3.44	2.00	2.89	4.78	1.23	3.90	1.22	1.00	2,89	0.99
CH_4	4.21	3.26	2.99	2.00	1.94	1.92	1.87	1.00	0.99	0.78

TABLE 4. Concentration of pollutants measured at varying distances (U_2)

Pollutants mg/m^3	Concentrations of Pollutants at Distance (m)									
	20	40	60	80	100	120	140	160	180	200
PM_1	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.03	0.02	0.02
$PM_{2.5}$	0.07	0.09	0.07	0.10	0.06	0.07	0.12	0.02	0.11	0.02
TSP	0.03	0.04	0.06	0.06	0.03	0.10	0.06	0.06	0.12	0.13
NO_2	0.18	0.16	0.20	0.18	0.27	0.25	0.45	0.17	0.33	0.28
SO_2	0.11	0.21	0.22	0.15	0.16	0.19	0.22	0.14	0.17	0.15
VOCs	60.23	35.23	20.43	9.35	3.91	4.76	2.96	1.99	2.74	2.77
H_2S	0.14	0.11	0.20	0.13	0.17	0.24	0.32	0.09	0.31	0.45
CO	4.00	2.14	4.12	2.43	3.12	3.22	2.67	3.98	4.89	2.98
CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 5. Concentration of pollutants measured at varying distances (U_3)

Pollutants mg/m^3	Concentrations of Pollutants at Distance (m)									
	20	40	60	80	100	120	140	160	180	200
PM_1	0.02	0.04	0.03	0.06	0.07	0.09	0.06	0.12	0.10	0.09
$PM_{2.5}$	0.10	0.11	0.10	0.09	0.11	0.09	0.10	0.07	0.19	0.05
TSP	0.23	0.19	0.31	0.24	0.27	0.30	0.42	0.39	0.47	0.35
NO_2	0.17	0.11	0.19	0.20	0.13	0.12	0.14	0.16	0.20	0.12
SO_2	0.15	0.18	0.18	0.14	0.15	0.13	0.15	0.17	0.15	0.19
VOCs	58.65	40.34	26.23	15.23	10.45	9.45	3.23	2.45	3.78	2.44
H_2S	0.14	0.11	0.20	0.13	0.17	0.24	0.32	0.09	0.31	0.45
CO	3.20	3.80	3.68	3.76	4.00	3.24	3.34	3.60	3.02	3.72
CH_4	4.21	3.24	3.10	2.93	1.61	0.99	0.44	0.34	0.43	0.00

TABLE 6. Summary of Observation from the Scatter Graphs

Pollutants	U_1	U_2	U_3
PM_1	Y = 0.0001x +0.06	$Y=5e^{-0.5x}+0.01$	Y= 0.0001x+0.017
	R=0.35 Low positive correlation	R=0.47 Some positive correlation	R=0.86 high positive correlation
$PM_{2.5}$	Y= 0.001x – 0.060	Y=-0.000x+0.089	$Y=2e^{-0.5x}+0.1$
	r=0 .78High positive correlation	R=0.43 Some negative correlation	R=0.032 no correlation
TSP	Y= 0.0002x + 0.483	y-0.000x+0.022	Y=0.001x+0.183
	R = 0.0316No correlation	r=0.76 High positive correlation	R=0.81High positive correlation
NO_2	Y=-0.0002x + 0.189	Y=0.0001x+0.156	$Y=5^{e-0.5x}+0.159$
	R=0.11 Low negative correlation	R=0.55Some positive correlation	r=0.083 No correlation
SO_2	$Y=-3e^{-0.5x}+0.127$	Y=-0.0003x+0.205	$Y=3e^{-0.5x}+0.155$
	R=0.07No correlation	R=0.49Some negative correlation	R=0.001 No Correlation
VOCs	$Y= 106.3e^{-0.01x}$	$Y= 53.51e^{-0.01x}$	$Y=75.49e^{-0.01x}$
	R=0.945High positive correlation	R=0.922 High positive correlation	R=0.967 High positive correlation
H_2S	$Y= 1e^{-0.5x}+0.448$	Y=0.001x+0.073	Y=0.001x+0.075
	R=0.031No correlation	R=0.69 High positive correlation	R=0.69 High positive correlation
CO	Y=-0.002x+2.575	Y=0.001x+3	Y=-0.001x+3.642
	R=0.12Low negative correlation	R=0.69 Some positive correlation	R=0.18 No correlation
CH_4	Y=-0.024x+4.377		Y=0.017x+4
	R=0.964High negative correlation		R=0.952 High negative correlation

There is an exponential relationship between the concentration of VOCs and distance from U_1. The greater the distance from U_1, the lesser the concentration of VOCs recorded, moving in exponential manner (see Figure 1). Here, the correlation coefficient R is 0.945, while the coefficient of determination (R^2) is 0.893. As the correlation is close to 1, it indicates that the trend line model which is $y = 106.3e^{-0.01x}$ is a good prediction model for future outcomes. Figure 2 shows that there is a strong high negative exponential correlation between distance and concentration. Here, it is seen that the greater the distance from U_2 the lesser the concentration of VOCs recorded. The value of the correlation coefficient R= 0.923. The R^2 value is 0.851 while the trend line model is $y = 53.51e^{-0.01x}$.

Figure 3 shows a strong negative exponential correlation between distance and concentration. Here, the greater the distance from U_3, the lesser the concentration VOCs recorded. The correlation coefficient (R) which stood at 0.967 confirms that there is a strong negative correlation between distance from U_3 and the concentration of VOCs recorded. The formulated exponential relationship obtained is $y = 75.49e^{-0.01x}$.

Figures 4 and 5 show a strong negative linear correlation between distance and concentration. The greater the distance from U_1 and U_3, the lesser the concentration of CH_4 recorded in each case. The correlation coefficient (R) which stood at 0.964 and 0.952 for U_1 and U_3, respectively, confirms that there is a strong negative correlation between distance from the U_3 and the concentration of CH_4 recorded. The formulated linear relation are $y = -0.024x + 4.377$ and $y = 0.017x + 4$ for U_1 and U_3, respectively. It has earlier been noted that CH_4 concentration was high in U_1 and U_3, which comes from leakages from the storage tanks for cooking gas and evaporation during the dispensing of the gas to buyers. Zero trace of methane was recorded at station U_2 because cooking gas was not sold in the station.

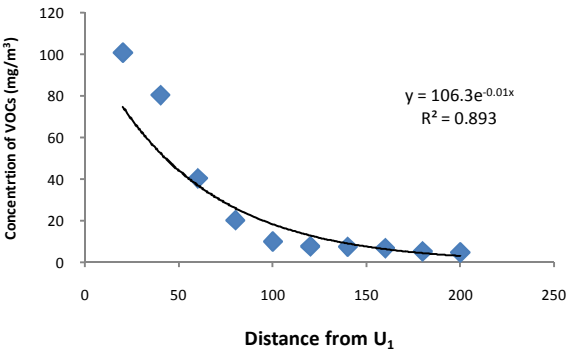

Figure 1. Concentration of VOC_S vs Distance from U_1

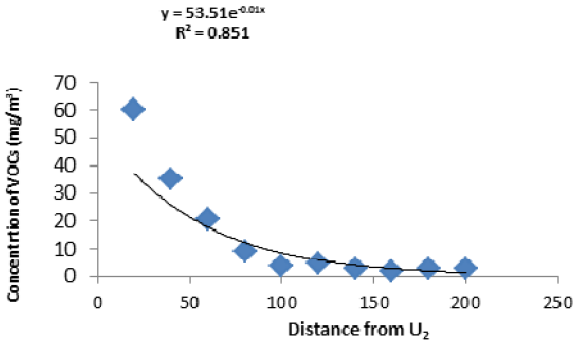

Figure 2. Concentration of VOCs vs Distance from U_2

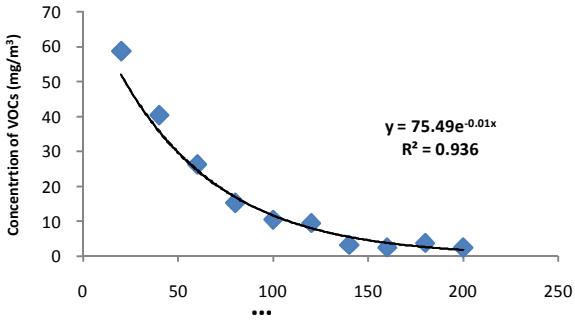

Figure 3. Concentration of VOCs vs Distance from U_3

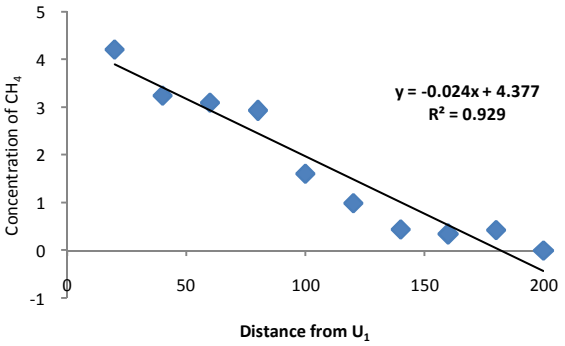

Figure 4. Concentration of VOCs vs Distance from U_3

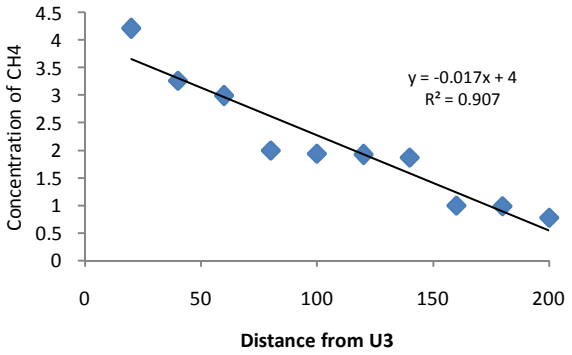

Figure 5. Concentration of VOCs vs Distance from U_3

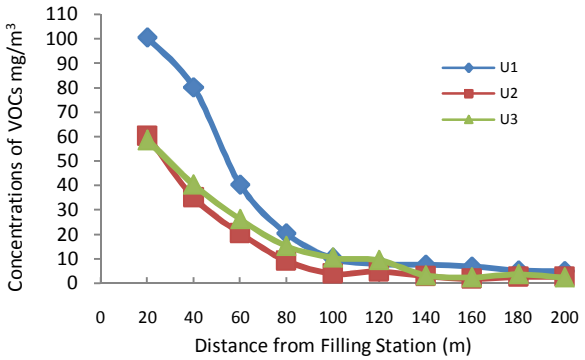

Figure 6. Concentration of VOCs at varying distance from U_1, U_2 and U_3

The results of the relationships are summarized in Table 6. It is important to note that positive correlation means that the higher the distance from the study area, the greater the concentration of pollutants recorded. Its implication is that the study area is not responsible for the presence of the pollutant in the atmosphere. Here, some other sources may be responsible for such pollutants.

Negative correlation on the other hand implies that the greater the distance from the study areas the lesser the concentration of pollutants recorded. It can be concluded that negative correlation means that the study area is responsible for the presence of the pollutant in the ambient air. In other words, as one moves away from the study area the concentration of the pollutants reduced. In Table 6, it can be seen that only VOCs and CH_4 are present in the atmosphere as a result of activities in the stations. This is because the level of VOCs and CH_4 concentration were found to decrease in the ambient air as the distance from the stations increases. Hence, VOCs and CH_4 concentrations have a strong negative relationship with distance from the study areas. Special interest is paid to VOCs due to reports from WHO labeling VOCs, especially benzene, as being a carcinogenic substance capable of causing cancer in human [5].

6. FINDING THE SAFE DISTNCE TO SITE A FILLING STATION

From the result of the measurements carried out at the controls, it was discovered that VOCs and CH_4 are the primary pollutants which are found in the air as a result of the activities in the filling stations. Therefore, in siting a filling station, it is important that a distance is maintained between the stations and residential areas. Using the result of the measurements carried at the control, and comparing it with the FEPA air quality standards, the safe distance to site a filling station can be established. The safe distance is that point which the effect of the pollutants from the stations has been reduced to tolerable minimum. At this point, the value of pollutants recorded must be within the FEPA acceptable limits of exposure. In finding the safe distance, methane was not considered, because there is no FEPA limits of exposure for methane. However, it is important that the station is sited at a distance where the concentration of methane is very low. To make this comparison, Figure 4 was employed.

Figure 6 shows that the distances away from the filling stations of U_1, U_2 and U_3 for the concentration of VOCs at FEPA's acceptable limit (i.e. 40mg/m^3) stood at 60m, 35m and 40m, respectively. Considering errors of measurement, and the fact that there may be some filling stations that might emit higher concentrations, a factor of safety of 20m was added to the filling station (U_1) that emitted the highest VOCs from the case studies. Hence, it is suggested that the safe distance to site a filling station is 80m away from residential areas. After this distance, all the emitted volatile organic compounds must have been absorbed into the higher atmosphere

7. CONCLUSION

This study of gas emissions from filling stations and their effect on the air quality showed that filling stations located in our cities have the tendency to constitute health hazard risk owing to their contribution to air pollution.

Different pollutants were recorded at the study areas namely: particulate matters, nitrogen dioxide, sulphur dioxide, volatile organic compounds, hydrogen sulphide, carbon monoxide and methane. Comparing the average concentration of pollutants at the study areas to the FEPA air quality guidelines showed that many of the pollutants concentration exceeded the FEPA limits of exposure.

The data obtained from the controls were evaluated using regression analysis and the results showed that the major pollutant to be considered when citing filling stations is the volatile organic compounds and methane. From the regression analysis, the safe distance to site filling station is a distance of about 80m. At this distance, volatile organic compounds emitted from the station must have been evaporated into the higher atmosphere thereby eliminating the possibility of harm to people living in the residential areas. From the results of the study, it can be concluded that the air quality in our towns and villages is negatively affected due to emissions of pollutants from petrol stations into the ambient air. Therefore, urgent actions should be taken to arrest this ugly trend.

8. REFERENCES

1. Timothy, P.M., "Health and environment effect of air pollution", USEPA Publications, (2006), 23-25.
2. Tabejamaat, S., " Numerical Study of Reduction of NO_x Emmission by High Temperature Air Combustion Technology", ***International Journal of Engineering Transactions B: Application***, Vol. 16, No. 3, (2003), 301-310.
3. Pirouzpanah V., Sami S. M. and Ajabshirchy Y., " The theoretical and experimental investigation fot eh effect of variation of thermodynamical parameters of egr fluid on NO_x emissions in S-I engines", ***International Journal of Engineering Transactions B: Application***, Vol. 14, No. 3, (2001), 263-272.
4. Vossoughi, M., Moslehi, P. and Alemzadeh, I., "Research note some investigation on bioremediation of sediment in persian gulf coast", ***International Journal of Engineering***, Vol. 18, No. 1, (2005), 45-53.
5. Sergio M., "The impact of btex emission from gas stations into the atmosphere", ***Air Pollution Research Journal***, Vol. 23, (2008), 12-14.
6. Kagawa, J., "Evaluation of biological significance of nitrogen oxides exposure", ***The Tokai Journal ofExperimental and Clinical Medicine***, Vol. 10, No. 4, (1985), 348-353.
7. Ghio, A.J. and Huang, Y.-C.T., "Exposure to concentrated ambient particles (caps): A review", ***Inhalation Toxicology***, Vol. 16, No. 1, (2004), 53-59.
8. Chauhan, A., Krishna, M., Frew, A. and Holgate, S., "Exposure to nitrogen dioxide (no2) and respiratory disease risk", ***Reviews on Environmental Health***, Vol. 13, No. 1-2, (1997), 73-90.
9. Najafpour, G., Mehdizadeh, S. and Asadi, M., "Environmental impact of fossil fuel utilization in neka thermal power plant", ***International Journal of Engineering, Transactions B: Applications***, Vol. 23, No. 2, (2010), 115-120.
10. Egbe E, Odili G.A. and Ugbebor O.O., "Further mathematics", ***Africana First Publishers Limited***, (2000).

Pollutants Emissions of Filling Stations and Their Impact on the Air Quality

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چکیده

این مطالعه با هدف بررسی انتشار گازهای گلخانه‌ای آلاینده از پمپ‌های بنزین و گاز و تاثیر آنها را به کیفیت هوا انجام شده است. مانیتور گاز برای شناسایی آلاینده‌های مختلف موجود در هوای محیط از مناطق مورد مطالعه استفاده شد. نتایج نشان می‌دهد که مهم‌ترین آلاینده‌های موجود در هوای محیط ترکیبات آلی فرار و پس از متان، و سپس مونوکسید کربن می‌باشد. اندازه گیری در دو نقطه‌ی کنترل در فاصله‌های ۲۰ و ۲۰۰ متری گرفته شد. غلظت آلاینده‌های ثبت شده در مناطق مورد مطالعه نشان می‌دهد که سطح آلاینده بیش از حد تعیین شده در دستورالعمل های کیفیت هوا توسط آژانس حفاظت از محیط زیست است. چند استثنا در آلاینده‌ها وجود داشت، از جمله: ذرات معلق که در محدوده‌ی غلظت مجاز بودند. تحلیل رگرسیون آلاینده‌ها در نقاط کنترل نشان می‌دهد که ترکیبات آلی فرار و متان تنها آلاینده‌های قابل توجه در هوای محیط هستند که در درجه اول به دلیل حضور پمپ‌های بنزین و گاز هستند. این دو آلاینده یک همبستگی منفی قوی با فاصله از منطقه مورد مطالعه نشان می‌دهد. به طور خاص، منحنی رگرسیون برای ترکیبات آلی فرار (VOCs) یک منحنی تقریباً کامل تابع نمایی را نشان می‌دهد، در حالی که خط روند مدل رگرسیون متان خطی است. هر دو VOCsو متان یک ضریب همبستگی (R) بالای ۰.۹ برای مناطق مورد مطالعه دارند. از این رو، نتیجه گیری از یافته‌های لین پژوهش این است که آلاینده های اولیه در تعیین محل ساختمان پمپ‌های بنزین و گاز VOCsو متان هستن. به طور مشابه، حداقل فاصله امن پمپ‌های بنزین و گاز از مناطق مسکونی ۸۰ متر است.

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