

Assessing the Impact of Fuel Filling Stations on the Environment

In Ghana

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Abstract

Ghana's emerging oil and gas industry is creating new economic opportunities as anticipated. Even though the oil and gas industry is in its infant stages many downstream distribution channels are springing up. One of the main offshoots of the industry is the emergence of fuel (Petrol/Diesel and Gas (LPG)) filling stations across the country. The potential environmental impact of these stations on residential communities has raised concerns in recent times. The objective of the study was to assess the impact of the filling stations on the environment. Using GPS, data on fuel station locations and associated permitting, environmental and safety requirement was collected. Using ARCGIS, various analytical tools were employed to analyze the data. The paper presents a GIS based analysis on the effect of fuel stations location on the environment.

I. INTRODUCTION

Several studies have been conducted to look at environment and safety risks associated with filling (gas) stations. In a study conducted by Cezar-Vaz et al. on the risk perception of occupation accidents of gas station workers in Brazil, several risks factors were identified including psychological, physical and chemical risks [1].

In a similar study, Sergio et al [2] studied the impact of BTEX (benzene, toluene, ethylbenzene, and xylenes) emission from gas stations into the atmosphere. They concluded that concentrations of these gases were appreciably higher in filling stations than what is found in location with high vehicular flux. In fact, they concluded that the concentration levels at the gas station were similar to those found in tunnels. In the same paper, Sergio et al [2] citing Karakitsios et al. (2007) presented some results of a study conducted in Greece. Results indicated that people in the vicinity of gas stations have an increased risk of cancer from 3 to 21%.

The proliferation of filling stations in Ghana, and the location of some of the new filling stations warranted a study to determine the safety and other effects of the citing of these stations on the nearby homes and businesses.

II. RESEARCH METHODOLOGY

The study had three main objectives: 1) to determine whether practices at the fuel station conform to set down environmental requirements, 2) to measure safety perception of filling station attendants and 3) to determine whether the fuel stations in Ghana were using approved permitting methods in establishing and operating the fuel stations.

This study involved a comprehensive survey of 33 fuel stations, and 85 service station attendants, mechanics, sales persons, lube bay attendants and vehicle washers.

Both secondary and primary data was used for this study. Secondary data used included data from several agencies such as the National Petroleum Authority (NPA), the Ghana Environmental Protection Agency (EPA), the Ghana National Fire Service (GNFS), the ministry of Environment, Science and Technology, the Accra Metropolitan Assembly (AMA) and the Tema Metropolitan Assembly (TMA). Data collected from the NPA, the ministry, EPA, and the GNFS included requirement

for setting up of fuel station at various locations. Data such as building infrastructure and minimum plot requirements, underground tank locations and their relative distances from building boundaries, minimum length of vent pipes and their relative distance from dwelling places and fuel discharge locations were collected. These data were used as the benchmark data to determine station compliance as compared to what was measured in the field. Additional data collected across all agencies included other location, safety and fire standards such as height of fuel station walls, availability of pollution prevention and fuel spillage equipments.

Primary data was collected at three levels: 1) location survey using GPS of all the 33 fuel stations, 2) existing infrastructure measurement such as wall heights, relative location of vent pipes, etc. and 3) a questionnaire based survey of 85 persons measuring their perception of safety and environmental concerns on the proliferation of fuel stations in Accra.

After processing the position information in Excel, Arcmap was used to analyze permitting data. The GPS data provided the location information associated with the various fuel stations. All field data were brought to excel and processed.

III. RESULTS AND DISCUSSIONS

Data Characteristic: The study was designed to include a mix of most of the major oil companies in Accra. Companies surveyed included: Engen, Total, Goil, Shell, and Allied Oil. In all 33 stations were surveyed. Table 1 shows the distribution of the stations surveyed while table 2 shows the characteristics of the respondents.

Table 1: Fuel Companies Surveyed

COMPANY	NO.
ENGEN	8
TOTAL	6
SHELL	4
ALLIED OIL	4
OTHER	11
TOTAL	33

Table 2: Characteristics of Survey respondents:

Gender		%
male	42	49.4
Female	43	50.6
Total	85	100
Level of Education		
Junior High	5	5.9
Senior High	60	70.6
College	10	11.8
Other	10	11.8
Total	85	100
Age (yrs)		
less than 19	1	1
19-30	55	65
31-45	18	21
46-50	1	1
greater than 50	2	2
No data	9	10
Total	85	100

A. FUEL STATION AND THE ENVIRONMENTS:

To evaluate the effect of filling stations on the environment, two approaches were used: 1) a field survey was conducted to determine whether the stations were in compliance with current regulations and 2) a questionnaire based study to peoples (station attendants and people living around filling stations) perception on safety and environmental effects. For environmental issues, threes key areas were addressed namely: vapor recovery and air pollution, spillage and leakages. The next few paragraphs present results and discussion from the study.

1. Vapor Recovery System and Air Pollution

Vapor recovery is the process of recovering the vapors of gasoline or other fuels, so that they do not escape into the atmosphere. This is often done (or required by law) at filling stations, in order to reduce noxious and potentially explosive fumes and pollution [3]. 49% of filling station surveyed did not have vapor recovery system. This suggest that various hydrocarbon are easily released into the air during fuel delivery. Certainly, this is an environmental hazard.

2. Spillage

The data revealed that 82% of the filling stations surveyed have adequate spillage measures to prevent spillage. 18% considered the spillage

system not adequate at their facilities. Considering the fact that spillage has the potential of causing serious fires, 18% appears to be too high.

3. Leakages

Leakage detection systems alert station attendants when there is a leak anywhere in the station. 28% of the stations surveyed do not have a leak detection system. On the issue of how regularly service lines are checked for leaks, only 35% of service stations do check their supply lines and other leakages (15% check at least once a month, 10% about every two months and 10% about twice a year). This means that 65% of the stations either do not have the means or do not check for leaks. This suggests that even if there are leakages at the stations, there is no way of knowing and this is a serious environmental threat. Leaks especially through underground storage tanks can pose a threat to the soil, surface water and ground water. There have been several instances where filling stations especially in the United States have been fined for not attending to leakage issues properly [4].

B. Fuel Station and Safety

This section of the paper looked at safety practices including safety training at the filling stations.

Also, perception of safety by fuel station attendants and people who live around these stations is discussed.

98% of the attendant surveyed indicated that they were trained on safety issues before they started working there. Only 2% did not get training. While at work, 88% of the workers surveyed affirmed they are trained often on safety issues. 12% did not get regular training on new safety measures. 74% percent felt protected as far as dangers like fire at the station were concerned. On protection from weather condition such as heat and rain, it was found that 89% of the station had canopies while 11% did not. On the topic of inhalation as a health hazard, 73% of the respondents who work at the various fuel station felt they inhale these vapors on a regular basis. Overall, 80 per cent of the respondents feel safe working at the service stations. This is a general response covering all the categories of workers there.

C. Compliance Issues (Permitting, etc) For Compliance issues, six factors were looked at to determine whether they satisfy the minimum

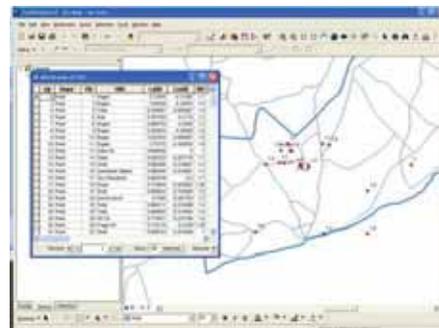


Figure 1:
Wall Height
Compliance
requirement
to

operate the filling stations. The factors looked were: 1) Wall Height (WH), 2) Length of vent pipe above ground level (MLVPGL), 3) Length of vent pipe away from dwelling place (MVPDP), 4) length of vent pipe away from loading point (MVPL), 5) Distance between station and closest house (DBHS), and 6) Distance between fuel tank and closest building (DBTB.)

1. Wall Height (WH) Compliance

As shown in figure 1, 21 out of the 33 filling stations do not comply with the WH requirement. Since the wall height are designed to protect the residential neighborhood, it appears most of the filling station represent environment hazard to their neighbors especially in cases like fire.

2. Vent Pipe Above Ground level (MLVPGL),

As shown in figure 2, 16 of the 33 filling stations did not comply with the height of vent pipe

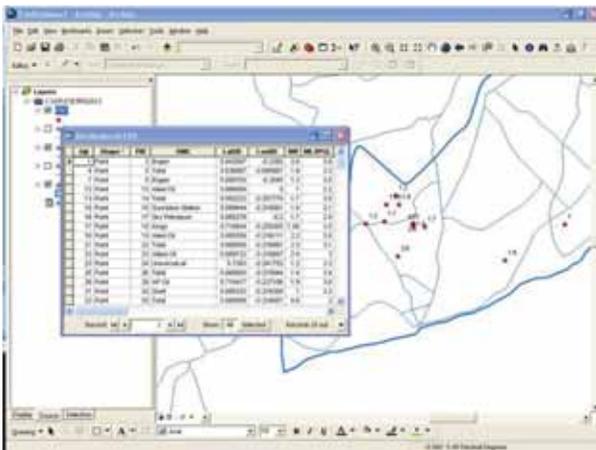
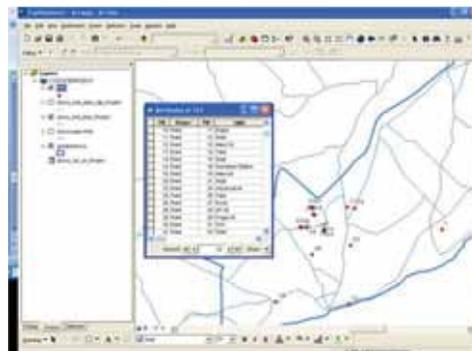


Figure 2: Height of vent pipe.

requirement. Since most of the stations have shorter pipes, exposure to residential communities may be considered to be above standard since a shorter vent pipe will mean early discharge of the vapor.

3. Length of vent pipe away from dwelling place (MVPDP),



21 out of the 33 stations were also found to violate this requirement. Figure 3

presents location that are affected.

Figure 3: Distance of vent pipe and closest building.

With similar analysis, it was found that 23 filling station violated the Distance between station and closes house (DBHS) requirement, 29 violated the length of vent pipe away from loading point (MVPL) requirement and only 1 station out of 33 filling station violated requirement for Distance between fuel tank and closest building (DBTB).

Based on the above results, it is evident that most of the stations over 60% of them are violating the principal permitting requirements needed to prevent serious environmental hazards and also on safety issues.

III. CONCLUSION

Based on the results and discussion presented so far, it can be concluded that on the issue of environmental concern, while most vapor recovery systems are not adequate in about half of the filling station, leakages seem to be a major concern since systems to check is not adequate and the frequency of leakage check is also very low. On safety, even though about 80% of the people surveyed feel safe, it appears the data from the permitting and compliance section do not support their argument. The simple reason may be that, they do not know and understand the scientific implication of the absence of such systems in place. Results from the compliance section present a whole different picture. For all the six critical compliance factors studied, most of the stations violated all the requirements. One can speculate that perhaps, the permitting requirements are just on paper or the regulating bodies are not cracking down on violators. Such practice put the community at risk at all levels including environmental hazards condition and safety condition. It has to be stated here though that to generalize results, an expanded study is required to expand the scope to cover a significant part of the region or perhaps across the whole country.

IV. REFERENCES

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