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Environmental impact Evaluation of Brick factories on West of AL-Diwaneyha city _Iraq

Ozeair Abessi ^a, Mukhtar DH. Abbas ^{a,b*}

^a Babol Noshirvani University Of Technology, Iran.

^b Ministry Of Environment, Al-Qadisiyah Environment Directorate, AL- Diwaneyah – Iraq.

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ABSTRACT

The objective of this study is to evaluate the environmental impact of a brick factory complex in the west part of AL-Diwaneyha city. In the study, the site characteristics of the brick factories and compares them with the locational determinants in the Iraqi environmental laws were assessed. The Arc.GIS software has used to process the spatial data and displays. The spatial analysis show that the current site of brick factories does not conform to the current laws and regulations of Iraq. So, it eventually will create environmental problem to the city's expansion or factories development. Furthermore, air quality in the west of city has measured in some monitoring sites along the direction of wind, close to the brick factories. The gases concentration measurement has continued for 12 days and 24 hours per day in the monitoring sites. SO₂, NO₂, CO and NMHC were measured which showed that the maximum values of SO₂, NO₂ and NMHC were higher than Iraqi standard while the CO value was very low.

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1. Introduction

The environment consists of two series of factors, the biotic (microorganisms and living organisms) and abiotic factors (atmosphere, hydrosphere, and lithosphere). The pollution is the presence of energy or substances in the form that be harmful for humans and other living organisms. So, the pollutants can be any dangerous solids, liquids, or gases substances that has higher quantities than usual that inversely affected the environment. Manisalidis et al. [1].

Contaminated sites can be defined as “areas include human activities which have discharged or might discharge contaminants into soil, air, surface or groundwater, food-chain, causing or being able to cause impacts in human health” Drago et al. [2]. The clay brick manufacturing is one of the ancient traditional industries which widespread in the most regions of Iraq and are the most polluting source to the surrounding environment where the used fuel in brick kilns operating is residual fuel oil that remains after the distillate fuel oil and lighter hydrocarbons are

distilled away in refinery operations. Iraqi environmental determinants instructions of the projects establishment and monitoring the safety of their implementation No. (3) for the year 2011 specified that the brick factories must be far (5 kilometers) from both the cities municipalities borders and residential communities which more than (20 houses) and also must be far (1 kilometer) from roads.[3]

Brick's manufacturing has a negative impact on the natural and human atmosphere as a result of the pollution which has been caused from gasses, smoke, and mist Al-Khateeb et al. [4]. The most pollutants that have been discharged from the brick kilns are particulate matters, (VOCs), SOX, dioxins, (PAHs) and NOX [1] and are the essential sources of air pollutants and harmful to humans Misra et al. [5]. Where the contaminated industrial sites are responsible for outdoor air pollution which contribute in deaths more than four million premature worldwide Perrino C et al. [6]. studied the relationship of the exposure impact to

* Corresponding author.

E-mail address: mukhtardhaji@gmail.com (Mukhtar DH. Abbas)



chemical sand particulate matters from outdoor sources during prenatal, and postnatal which may lead to alterations in specific neural networks Herting M. M. et al. [7]. showed that the air pollution causes oxidative stress, neuro inflammation, neurodegenerative pathology and cerebral vascular damage Block, M. L. et al. [8]. worked Impact assessment of the brick kilns emissions on human health and the environment in Pakistan where the results showed that CO, CO₂ and SO₂ are the most harmful due to the environment. None the less, SO₂, carcinogenic dioxin and PM have affection on the human health adversely Khan, M. W. et al. [9], in Iraq, there are many researchers studied the environmental impact evaluation of brick factories in Baghdad which approved that the sulfur compound emissions that resulted from black oil burning caused soil and air contamination Al-Nuzal S.M.D. et al. [10], in Babylon which conducted heavy metals concentrations in air and soil that result from brick factories emissions Issa. M. J. et al. [11] and in Al-Diwaneayah which studied particulate matters and heavy metals and their effect on the nearby residential communities Al-Khateeb .A. H.N et al. [4]

In this study focuses on the environmental impact evaluation of brick industries in Al-Diwaneayah city by studying the brick factories site characteristics and measuring the ambient air quality in west of the city.

1.1. Methodology

- 1- Determining the spatial map of the brick factories site, neighboring cities, neighboring residential communities and roads by using Arch GIS Program.
- 2- Comparison between the brick factories site characteristics and the locational determinants in the Iraqi environmental legislations.
- 3- Study the ambient air quality in the west city by measuring the pollutants concentrations in the ambient air that result from brick kilns discharges.

2. Environmental Legislations

2.1. Instructions No. (3) for 2011.[13]

One of the most relevant laws and constructions which deals with the site characteristics of factories is Iraqi Environmental Determinants instructions of the projects establishment and monitoring the safety of their implementation No. 3 for the year 2011 which consists of 81 legal articles where the article No. 10 that has been stated the locations of brick factories establishment must be distant from

- 1- the city's municipalities borders and the residential communities (more than 20 houses) with a distance more than five kilometers.
- 2- the roads with distance more than one kilometer.

2.2. Regulation No. (4) for 2012.[12]

Regulation of ambient air protection from pollution No. (4) for 2012. Which consists of 22 legal articles where the article No. 8 which has been required that the chimney design and its height determining must be taking in the account the chemical and physical properties of emissions, the discharge size and its temperature, velocity and direction of winds, heights of the surrounding buildings and location topography. On the other hand, the article No.18 has stated that used fuel must be the natural gas or the liquid petroleum gas in addition to the natural gas as clean fuel due to the environment and also the sulfur content must be less than 2.5 % weight in the heavy black oil and maintained in work to use in any type of fuel that will protect the environment.

2.3. Instructions No. (3) for 2012.[13]

National Determinants Instructions of Emissions of activities and operations No. 3 for 2012 which consist of 18 legal articles for regulation, determination and control the emissions of air pollutants and

which deals with mobile and fixed sources. Where it stated that the gases concentrations of fixed sources which have been used hydro carbonic fuel must be as shown in the **Table 1** below.

Table 1. standards of fixed sourced emissions

Air Pollutants	Symbols	Source	Limits (mg/m3)
Smokes and Visible Pollutants		All sources	250
Nitrogen oxides (measured as NO ₂)	NOX	Kilns Gas Fuel	350
		Liquid Fuel	500
Sulfur Dioxide	SO ₂	All Sources	500
Total Suspended Particles	TSP	All Sources	250
Carbon Monoxide	CO	All Sources Old	500
		New	250

3. Productivity Process

There are two product processes of clay brick manufacturing, the manually which is not used nowadays and the mechanically process. The difference between these methods is in the preparation processes of the bricks which includes the mixing, grinding, and forming processes. The first process of bricks manufacturing is the excavating soil for preparation the raw material then transferring it into mixing, grinding, pressuring and forming machines and then the wet clay bricks will be produced which required spreading them in an open area for drying by sun temperature therefore the mentioned processes apparently are stopped or decelerated in the winter. After complete drying stage, the firing process is the final stage in which the dried bricks are transferred into the firing kiln where its size is (100 length * 20 width * 3 depth) as average. Each factory produces as average (64000 bricks per day) and the heavy black oil quantities which have been consumed about (120 –135 liters per 1000 bricks) [Environmental authority, 14]. The **Table 2** explains the manufacturing process details with potential environmental damages from each stage.

Table 2. The productivity process stages of brick manufacturing with associated environmental damages (Researcher)

Manufacturing Stages of Bricks	Environmental Damages
Excavation of Earth	Soil Depletion and Ground Water Exposure to Evaporation
Mixing & Grinding of Soil	Electricity Consumption
Pressing into Desired Form	-----
Drying by Sun	-----
Firing in Kiln	Discharge Air pollutants
Bricks	Solid Wastes

4. Site Characteristic

Al-Diwaneayah city is the center of AL-Qadisiyah province where it is located about (180 km south of Baghdad), the location of brick factories is 5 kilometers west of the official borders of Al-Diwaneayah municipality and are surrounded with two others towns, AL-Shafiyaa and Saniyah, from south and north respectively. After 2003 and due to the change of the political system in Iraq, which leads to the economic improvement of Iraqi individuals, the need into construction has increased year by year and as result as the number of brick factories enlarged to cover this need,

where the number of factories became more than (15 factories) in this site and the total areas reached into (5.5 km²), also the habituated areas have been unofficially expanded in the direction of factories location and the actual distance between the cities and brick sites become 3 kilometers. Furthermore, if the expansion status continuous there many environmental crises faced in future, difficulty the living in the new residential regions because the ambient air quality which will be affected by air pollutant that produced from nearby brick factories, also difficulty of factories development because the proximity of residential communities. More of urbanization expansions were unplanned and uncontrolled because authority's weakness. The image 1 the spatial spreading of villages and towns due to brick factories site and the wind direction.

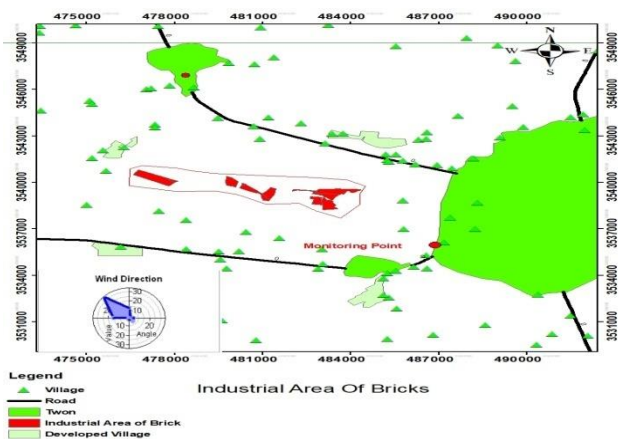


Figure 1. Site plan of the brick industrial region with surrounded towns and villages

5. Results and Discussion

The Mobile plant for Air Quality Monitoring which is manufactured by HORIBA Company where it contains modern analyzers for sampling and measuring air quality instantaneously. It measures 12 types of gases in addition to the condition parameters such as wind direction, temperature, air pressure, wind speed and humidity. this study has been focused on four gases (SO₂, NO₂, CO, and non-methane hydrocarbons NMHC) and for 12 days each day continues for 24 hours. The below Table shows the maximum and minimum values of gases.

Table 3. The values of gases emissions in study region [Environment Authority, 14]

Days	SO ₂ (mg/l)		NO ₂ (mg/l)		CO (mg/l)		NMHC (mg/l)	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	0.011	0.002	0.018	0.006	2	0.9	0.4	0
2	0.012	0.001	0.026	0.004	2	1.9	0.7	0
3	0.004	0.001	0.017	0.002	2	1.9	0.3	0.1
4	0.007	0.001	0.017	0.004	2	2	0.3	0
5	0.009	0.001	0.024	0.002	3	2	0.9	0.1
6	0.014	0.002	0.037	0.003	2	1.8	0.9	0.1
7	0.02	0.003	0.049	0.006	2	1.9	1.1	0.1
8	0.043	0.006	0.054	0.009	2	1.9	0.7	0.1
9	0.018	0.005	0.019	0.005	2	1.9	0.5	0.2
10	0.025	0.002	0.024	0.006	2	1.9	0.2	0.1
11	0.006	0.002	0.016	0.004	2	1.9	1.1	0.1
12	0.012	0.005	0.031	0.002	2	1.9	0.3	0.1
AVG.	0.015	0.003	0.028	0.004	2.083	1.825	0.617	0.083

Fig. 2 shows the Iraq standard of ambient air, the maximum and minimum values of NO₂ and SO₂ which measured by APNA 370-CE and ASPA 370-CE Analyzers respectively where the maximum value of NO₂ in most days is high than standard while the value of SO₂ is low.

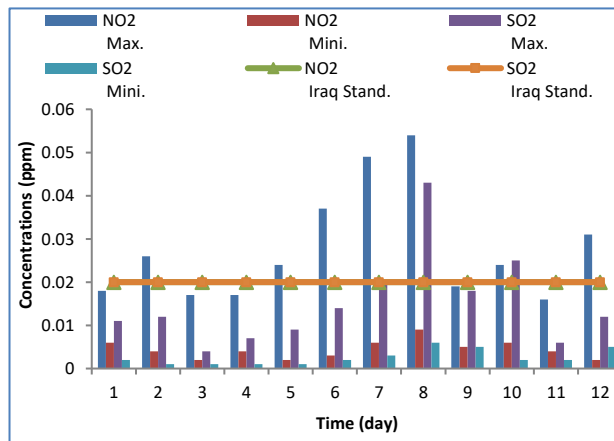


Figure .2 Concentrations of NO₂ and SO₂ in study region

Fig. 3 shows the maximum and minimum values of CO which measured by APMA 370-CE analyzer where the results seemed very stable and similar and in the same time lower than the Iraqi standard where this is positive indicator due to air quality.

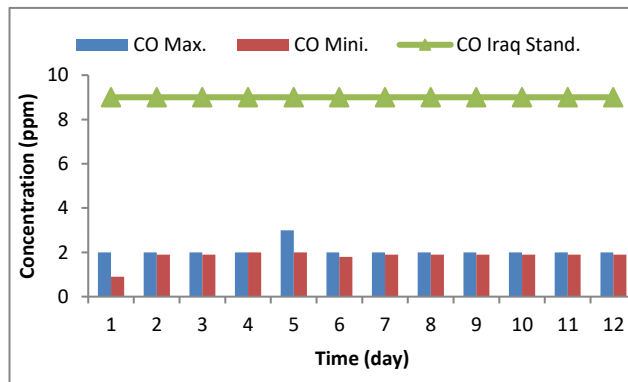


Figure .3 Concentrations of CO in study region

The measure of non-methane hydrocarbons in air quality by APHA 370-CE analyzer which is very significant indicator due to the pollutant sources and have been used petroleum derivatives such as heavy black oil as fuel for kiln operation. Fig. 4 displays the results of NMHC which have been showed their gap between the maximum and minimum values and also the maximum values very high than the Iraqi standard.

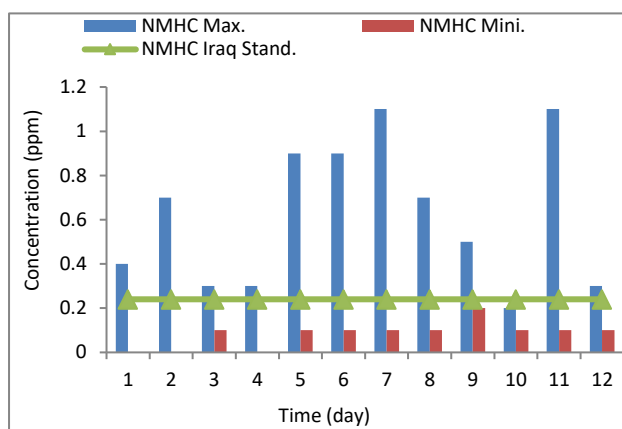


Figure. 4 Concentrations of NMHC in study region

Generally, there air pollution in the city's west that produced from the brick factories which located in the west and with prevailing wind direction therefore it is more harmful due to environment and human health.

6. Conclusions

*- The location of brick factories in the present is not suitable because it is surrounded from three directions and in the future will create environmental troubles due to the town's expansion.

*- This site of brick factories has been caused pollution of ambient air quality in the west Al-Diwaneyah city.

*- Appropriate and modern air pollution control devices must be installed for mitigation the emissions.

*- It is recommended to Follow especial strategies and continue environmental monitoring for this site.

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