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Analysis of air pollutants presents in a bricks factory at Carabayllo district, Lima

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Resumen

El objetivo del estudio fue analizar los contaminantes como dióxido de azufre, dióxido de nitrógeno, monóxido de carbono y sulfuro de hidrogeno; asicomo PM10, los cuales son expulsados por la empresa ladrillera “Cuadros “ ubicado en la localidad de san Pedro de Carabayllo, Lima, Peru. Los análisis para gases se hicieron mediante el tren de muestreo y para el PM10 se hizo con Hi-Vol. Los resultados analizados no exceden los estándares de calidad ambiental y la dirección del viento que se tomó predominan en SSW (Sur Sur Oeste) y la velocidad del viento es moderado

Palabras clave: contaminantes atmosféricos, ladrillera, análisis, Carabayllo.

Abstract

The aim of the study was analyzing pollutants such as: sulfur dioxide, nitrogen dioxide, carbon monoxide and hydrogen sulfide; as well as PM10, which they were expelled by the brick Factory "Cuadros " located in the town of San Pedro de Carabayllo , Lima, Peru . Analyses were made for gases by sampling train and for PM10 was taken by Hi-Vol. Analyzed the results do not exceed Environmental Quality Standards. The Wind direction predominate in SSW (South South West) and Wind speed indicate that moderate is.

Keywords: air pollutants, brick manufacturer, Analysis, Carabayllo.

1. Introduction

One of the most common environmental problems in the district of Carabayllo is the poor air quality caused by inadequate control and prevention of emissions into the atmosphere by the different types of emission sources present in affecting them climate change (MINAM , 2012) . One of these sources are brick factories that emit gases and particles (combustion product and raw materials) toxic pollutants (PRAL, 2014). In the district there are eight brick kilns. Some are located in the area of urban areas influence. In environmental terms, San Pedro de Carabayllo is one of the most critical areas at Northern Lima, introducing an urban environment very deteriorated of poor environmental quality , with little urban infrastructure (roads, sidewalks, retaining walls, stairs), with minimal basic services and few parks and gardens.

This study took into account the analysis of contaminants from an craft brick factory which operates in the urbanization La Esmeralda San Pedro de Carabayllo, which causes social problems (MINSA, 2016), economic and mainly environmental. To improve air quality, the

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implementation of national and local programs in air quality monitoring, emission control, air pollution prevention and information, training and public communication is necessary (Valverde, 2016).

The pollution backgrounds in the study area were submitted by the Management of City Services and Environment a memorandum No. 0208-2014- GSCMA / MDC , dated on 03 September 2014 and requested by SINADE- OEFA another memorandum No. 0216-2014- GSCMA / MDC, dated on 16th September 2014, requested by the procurator of the environmental ministry requesting technical report for alleged environmental pollution by black smoke and odors from the brick factories located in the area of urbanization La Esmeralda San Pedro de Carabayllo.

Materials and Methods

Study area

The town of San Pedro de Carabayllo is capital of Carabayllo district, province and department of Lima, it belongs at Northern Lima, in the central coast of Peru. The study area is the urbanization La Esmeralda, which presents climatic characteristics that are influenced by its location with the Humboldt Current and the presence of the Andean Mountains. Its climate is warm-temperate, with an average temperature of 21 °C.

Analysis method

Analyses were made by the sampling train in a certified laboratory (Valverde, 2015).
The method for determination of particulated matter until 10 microns (PM-10) was the NTP 900 030. Air Quality. Reference Method for the Determination of Breathable Particulated Matter as PM10 in the atmosphere.
The Method for determination of CO was the Methods air sampling and Analysis Intersociety Method Nº 43101-02-71T-1972.
The Method for determination of SO_2 was the method EPA 40 CFR Appendix A-2 to Part 50 2010 – Reference Method for the Determination of Sulfur Dioxide in the Atmosphere (Pararosaniline Method).
The Method for determination of NOx was the method ASTM DI607-91 Standard Test Method for Nitrogen Dioxide Content of the Atmosphere (Griess - Saltzman Reaction).
The Method for determination of H_2S was the method COVENIN 3571.

For comparison of results of air quality sampling, they have been taken as a reference both D.S. No. 074-2001-PCM, "Regulations of National Standards of Air Environmental Quality" for CO, NOx and PM10; as D.S. No. 003-2008 - MINAM, " Standards of Environmental Quality" for SO_2 and H_2S

2. Results and discussion

Emission sources were identified in the study area, which are described in the following table.

Table 1. Mobile and stationary sources of the study area

Mobile sources	Stationary sources
- Private light vehicles.	- Brick Factory “Cuadros”.

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- Formal and informal taxis. - Light trucks. - Medium trucks. - Heavy trucks. - moto taxis.	- Population burning solid waste in open pit. - Bakery. - Peddlers. - Farmers burning plant waste. - Drivers disperse powders on unpaved roads.

The study was carry out behind of brick Factory “Cuadros”, the day 23th february 2016 at 10: 00 am. (See figure 1).

Fig. 1: View of brick Factory “Cuadros”, located at San Pedro de Carabayllo.

The brick Factory “Cuadros” use combustión materials to heat kiln such as: sawdust, firewood and coal. The raw material for the brick manufacture does not contain pollutants; because of it basically contains clay with wáter. The cooking process takes between 14 to 16 hours and and remove excess wáter from the mass of raw brick to the tuning point where they begin clay chemical changes of components to achieve compaction and resistance characteristics. When temperatura achieve 250 to 380 °C, it generates toxic and harmful gases for the environment and health such as: sulfur dioxide, nitrogen dioxide de nitrógeno, carbón monoxide and volatile organic compounds.
For measuring wind speed anemometer WINGONER, on the outside of brick factory, which has the following coordinates used in Universal Transverse Mercator (UTM):

- Coordinates in UTM: 11°51'18.96"S and 77° 2'14.99"W.
- Height relative to see level: 200 m.a.s.l.
- Place of sampling: outside of brick factory “Cuadros” located on urbanization La Esmeralda, District Carabayllo-Lima.

The average wind speed was 2,74 m/s. The results of wind speed and direction are detailed.

Tabla 2. Data to determine results of wind speed and direction

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Sample	Hour	Latitude	Length	Cardinal direction	Azimut (degrees)	Wind speed	Wind direction
1	09:00	11°51'18.96"S	77° 2'14.99"O	S 30º W	210°	2.8 m/s	SSW
2	09:30	11°51'18.96"S	77° 2'14.99"O	S 45 º W	225º	3.8 m/s	SW
3	10:00	11°51'18.96"S	77° 2'14.99"O	S 20 º W	200º	2.8 m/s	SSW
4	10:30	11°51'18.96"S	77° 2'14.99"O	S 25º W	205º	3.6 m/s	SSW
5	11:00	11°51'18.96"S	77° 2'14.99"O	S 35º W	215º	2.0 m/s	SSW
6	11:30	11°51'18.96"S	77° 2'14.99"O	S 35º W	215º	3.0 m/s	SSW
7	12:00	11°51'18.96"S	77° 2'14.99"O	S 25 W	205º	2.7 m/s	SSW
8	12:30	11°51'18.96"S	77° 2'14.99"O	S 20 º W	200º	1.9 m/s	SSW
9	13:00	11°51'18.96"S	77° 2'14.99"O	S 25º W	205º	2.0 m/s	SSW
10	13:30	11°51'18.96"S	77° 2'14.99"O	S 35º W	215º	2.3 m/s	SSW
11	14:00	11°51'18.96"S	77° 2'14.99"O	S 35º W	215º	2.0 m/s	SSW
12	14:30	11°51'18.96"S	77° 2'14.99"O	S 45 º W	225º	2.4 m/s	SW
13	15:00	11°51'18.96"S	77° 2'14.99"O	S 25º W	205º	3.0 m/s	SSW
14	15:30	11°51'18.96"S	77° 2'14.99"O	S 35º W	215º	3.8 m/s	SSW
15	16:00	11°51'18.96"S	77° 2'14.99"O	S 30º W	210°	3.0 m/s	SSW

The wind measurement was performed in the urbanization La Esmeralda behind of brick Factory “Cuadros” where the predominance wind is South South West (SSW) representing 60% of calm winds.

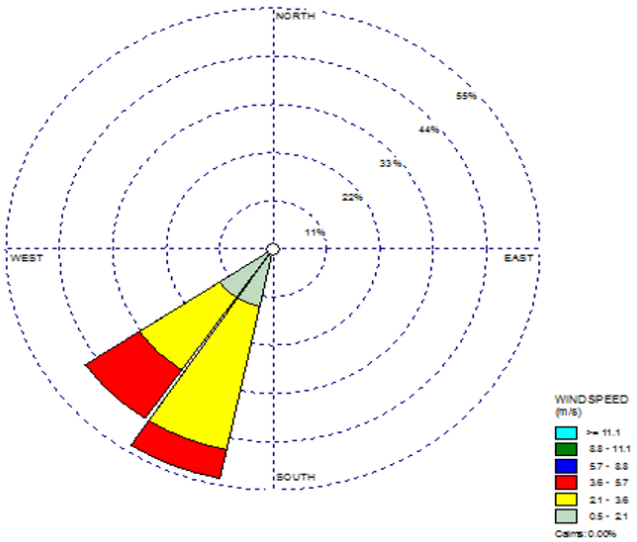

Fig 2. Wind Rose in the study area

To determine the air quality of the study area, a Enterprise was contracted to do air quality analysis in the study area.

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The results of CO are described in Fig. 3.

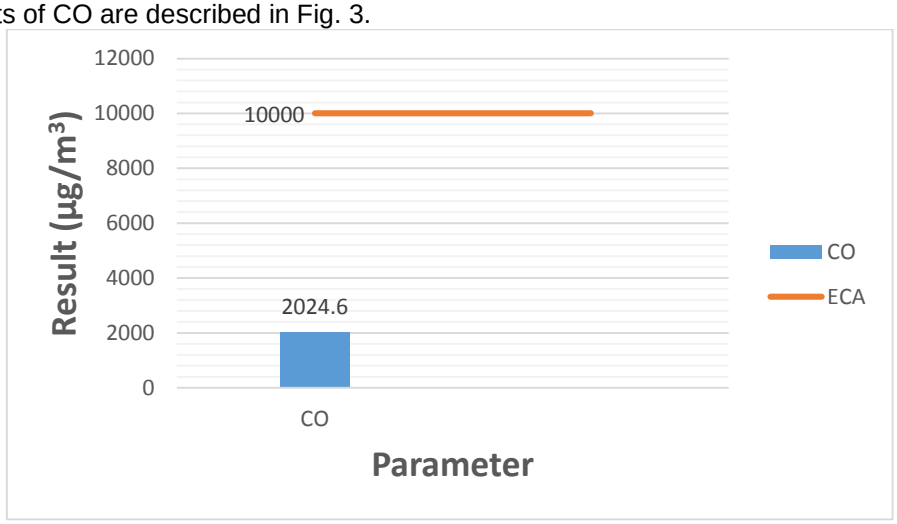

Fig. 3. CO of study area

The results of SO_2 are described in Fig. 4.

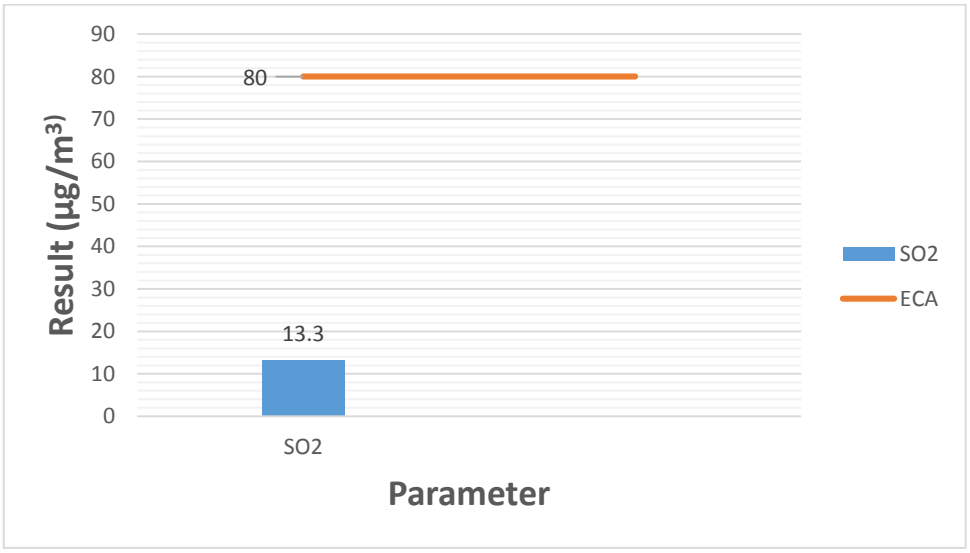

Fig. 4. SO2 of study área

The results of NOx are described in Fig. 5.

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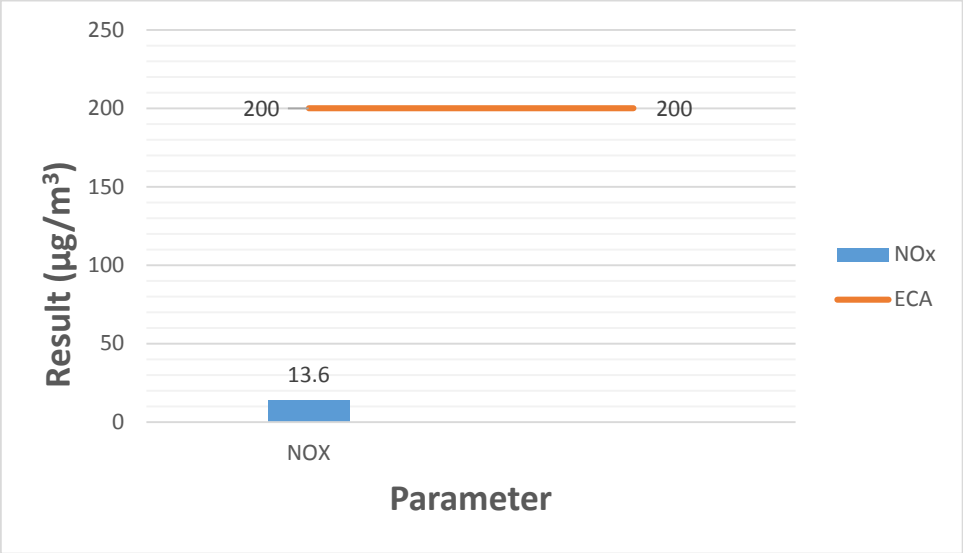

Fig. 5. NOx of study área

The results of H_2S are described in Fig. 6.

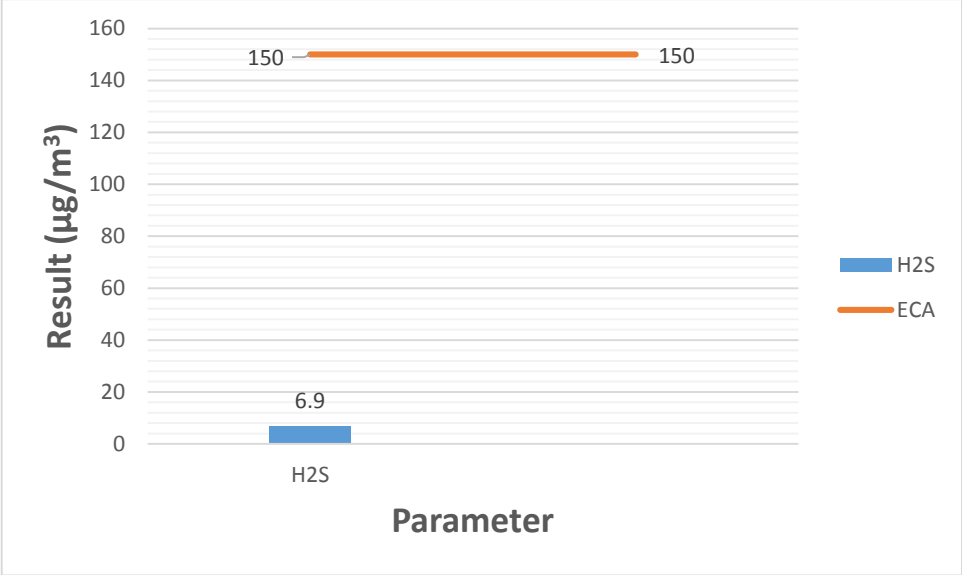

Fig. 6. H_2S of study área

The results of PM-10 are described in Fig. 7.

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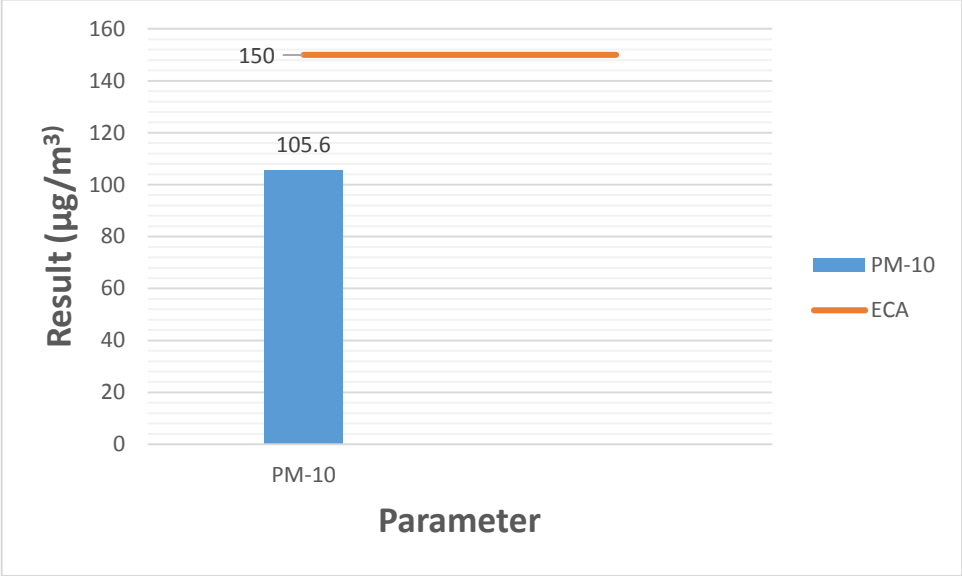

Fig. 7. PM-10 of study area

Finally the results are summarized realted to capturing solutions Analysis to CO, SO_2, NOx and H_2S (See Table 3) and Analysis of filter weights PM-10 in the study área (See Table 4).

Tabla 3. Analysis of capturing solutions to CO, SO_2, NOx and H2S

Parameter	Result (µg/m³)	detection limit (µg/m³)	Environmental Quality Standard (EQS)	
			Value (µg/m³)	Normativity
CO	2024,6	45,0	10 000	D.S. N°074-2001-PCM.
SO_2	13,3	2,5	80	D.S. N° 003-2008-MINAM
NO_X	13,6	0,2	200	D.S. N°074-2001-PCM.
H_2S	6,9	0,06	150	D.S. N° 003-2008-MINAM

Tabla 4. Analysis of filter weights PM10 in the study area

Parameter	Result (µg/m³)	detection limit (µg/m³)	Environmental Quality Standard (EQS)	
			Value (µg/m³)	Normativity
PM-10	105,6		150	D.S. N°074-2001-PCM.

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3. Conclusions

- The wind direction predominate en SSW (South South West) and velocity vary between 1,9 and 3,8 m/s.
- The monitoring results of CO were of 2024,6 µg/m^3, NOx of 13,6 µg/m^3 and PM10 of 105 µg/m^3. These values are within the National Standards of air environmental Quality D.S. N° 074-2001-PCM.
- The monitoring results of SO_2 were of 13,3 µg/m^3 and H2S were of 6,9 µg/m^3. These values are within the National Standards of air environmental Quality D.S. N° 003-2008-MINAM.

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