Determination of the Black Carbon in the Maysan province/Iraq

Atmosphere: Emissions from Brick kilns

Nayyef M. Azeez Huda A. Ruhma

University of Basrah, College of Science
E-mail: naifmohsenaziz@gmail.com

Abstract

Preliminary measurements of black carbon (BC) content at both 880 and370 nm , obtained in two sites in Maysan, southern Iraq by an aethalometer, have been analyzed. The sites are affected by different emission sources. In one case the main source of BC is related to manufacture of bricks kilns. In the second case, vehicular traffic from a nearby highway a fresh was main source of BC. Daily fluctuations were recorded for BC in the study area that the high peak was at about 6-7 O'clock in the morning for brick manufacture. At the other site, two daily peaks were noticed for the BC content, due to vehicles emissions. It can be concluded that the air of Maysan province is pollutes by BC emissions due to two major sources of air pollution included Brick kilns and vehicles emissions nearby highway.

الخلاصة

تم قياس كمية الكاربون الاسود في الهواء وضمن الاطوال الموجية المحصورة بين 370-880 نانومتر في موقعين في محافظة ميسان جنوب العراق واستخدم لهذا الغرض جهاز الاثيلوميتر . موقعي الدراسة متأثرة بمصادر تلوث هواء مختلفة ، ففي الموقع الاول كانت معامل صناعة الطابوق هي المصدر الاساسي لتلوث الهواء بالكربون الاسود بينما حركة السيارات في الطرق هي المصدر الاساسي لانبعاث الكاربون الاسود الى الهواء .

حددت كمية الكاربون الاسود في الموقع الاول ولمدة 24 ساعه مستمرة اذ تم ملاحظة ان اعلى للكاربون الاسود سجلت في الصباح ما بين 6و7 صباحاً بينما في الموقع الثاني فقد تم ملاحظة وجود ارتفاعين لقيمة الكاربون الاسود خلال اليوم الواحد وذلك تبعاً لحركة السيارات في المنطقة

ومن هذا نستنتج ان هواء محافظة ميسان ملوث بالكاربون الاسود المنبعث من مصادر مختلفة اهمها معامل صناعة الطابوق و حركة السيارات .

Introduction

Air pollution can be defined as any atmospheric condition in which substances (natural or man-made chemical compounds capable of being airborne) are present at concentrations high enough above their normal ambient level to produce a measurable effect on man, animals, vegetation, or materials. Air pollutants are hazardous to human health and at high enough concentrations can even be fatal.(1).

Atmospheric dispersion processes can bring the emission to the surrounding urban areas which can further worsen the air quality in adjacent cities. However, there is quite limited information on the emission factors and environmental impacts of brick making industry (12).

Brick manufacturing is a small-scale and unorganised industry which is mainly concentrated in the rural and peri-urban areas of developing countries (19). However, the adverse environmental effects from brick manufacturing are also significant and include loss of land, change of the land cover, removal of nutrients and humus from soil, increased erosion and environmental effects (2)(5)(17). Recently, the air pollution emission from brick kilns has gained international attention (3) (6). Simple kiln technologies used for brick firing and the lack of emission control devices often result in a large amount of released air pollutants. These pollutants include a wide range of incomplete and complete combustion products emitted during the brick firing process. They originate from both the fuel used for brick firing and the raw brick materials (19)(20).

Burning of coal in the kilns releases various pollutants in to the atmosphere including PM , Ash , sulfur dioxide(so_2), carbon monoxide (CO), carbon dioxide (CO2),nitrogen oxide (NOx) and hydrocarbons(PAHs)(4).

Aerosol Black carbon (BC) is the optically absorbing part of carbonaceous aerosols, primarily emitted from combustion. It is a major anthropogenic component of atmospheric aerosols, which has significantly different optical and radiative properties as compared to the other normal constituents. BC acts as an indicator of air mass affected by anthropogenic pollution (14) (18) .

BC affects environment at local, regional and global levels. A black carbon aerosol absorbs solar radiation and is the second largest contributor to global warming, after greenhouse gases (10).

The two most important sources for atmospheric BC are fossil fuel combustion (for example automobile exhaust, industrial and power plant exhausts, aircraft emissions, etc) and biomass burning (burning of agricultural wastes, forest fires).

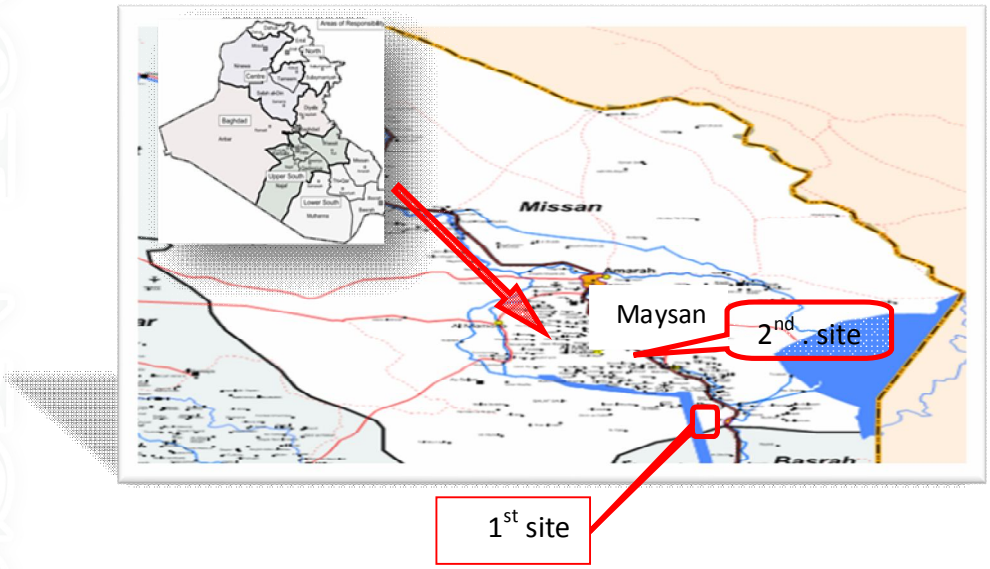
Atmospheric BC has received considerable attention because of its significant influence on climate change as well as its adverse effects on human health (11). BC is chemically inert and mostly in the accumulation (submicron) size regime, and has a long atmospheric lifetime (of several days to weeks) depending on the meteorological conditions (16).

The aim of this study was comparisons emissions from Brick kilns and other human activity using an aethalometer instrument in the southern part of Maysan province .

Material and Methods

Description of the study area

Maysan province located on the south-eastern of Iraq (figure 1), It is fertile land rich in oil .The first study site Al-Tapur is located in the southern part of Maysan with distance about 7 km away from the city center with an area of 24 km^2 and a population of about 4700 people. the area has 13 plant for the manufacture of bricks located at the middle of the first study site ,the second site is a small farm located on the middle of Amarah (the center of Maysan province).



Instruments used

The instrument used in this study to estimate BC content was an Aethalometer (Model AE-21, Magee Scientific, USA).

The Aethalometer is portable and easy to mount at any location, which is widely used for the real-time monitoring of BC aerosols in the atmosphere. The aethalometer use continuous filtration and a thermal optical transmission (TOT) technique to measure the mass concentration of BC in near- real- time (8) at two channels (wavelengths) 370 and 880 nm. The wavelength 880 nm represents the broad band wavelength response of the aethalometer detector , At wavelengths shorter than about 400 nm, certain classes of organic compounds (such as polycyclic aromatic hydrocarbons, and fresh diesel exhaust) start to show strong UV absorbance that refer to these compounds as '**blue**' carbon (refer to their value by UV) . Some of these compounds are photo-ionizable, others of them exhibit fluorescence at these higher energies of photon excitation (7).

The instrument aspirates ambient air through an inlet at a preset flow rate where, the particles in the air impinge on its quartz fiber filter tape. [BC] was estimated by measuring the change in transmittance of this quartz fiber tape consequent to the deposition of the particles on it. The Aethalometer has been operating with a flow-rate of 2 L/min and a time-resolution of 5 minutes. The Aethalometer was set in two study area the first site was Al-Tapur in 18 – April-2013 at 10 a m away 50 m from the brick kiln and programming it on registration reading every 5 minutes range air flow 2L/min ,the instrument continued working for 24 hour then stopped working at 11 am of 19- April . The other site was rural area where there is no industry the instrument was set in 24-May-2013 at 9 am and programming it on registration reading every 5 minutes range air flow 2L/min ,the instrument continued working for 24 hour then stopped working at 8am of 25-May-2013 , to explain the effect of brick kilns on the atmosphere and the amount of black carbon that result from it we set the instrument in this clean area for that's where car exhaust was the source of the pollution , Also ,It was taken group of filed parameter like temperature , wind speed and humidity in the site along the study period .

Results and Discussion

This is the first attempt to monitor BC aerosol in AL-Tapur valley using Aethalometer. Data were collected from 18 to 19 April 2013.The hourly average of BC concentration was determined. The study observation shows that the mean value of BC was 11563.4 ng/ $m^{3,}$ UV was 10018.8 ng/ m^3 .The lower

boundary for the mean was 2140.83 ng/ m^3 to BC, 1860.42 ng/ m^3 to UV and the upper boundary was 33405 ng /m^3 to BC, 29779.3 ng/ m^3 to UV .

From figure 2, it is clear that the diurnal variation of BC is pronounced on working day with high peak at about 6-7 O'clock in the morning . There is a strong effect of wind with dispersion of aerosols in AL-Tapour valley. The comparison of wind speed and BC aerosol clearly shows inverse relation between them.

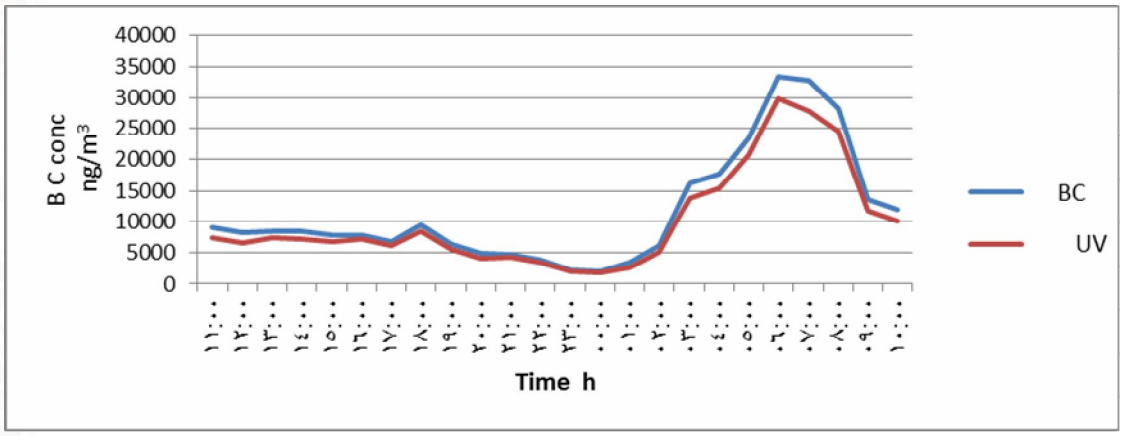


Figure 2: diurnal variation of BC, UV in AL-Tapur valley

Kicks off the smoke from the chimney to follow the direction of airflow As style spread the pattern of spread depends on the pattern of change of atmospheric temperature with height of the chimney on the one hand and on the current pattern of the airflow on the other hand, while the effect of heat depends on the pattern of atmospheric change degree.

When the sun starts heating the ground near the air is heated and therefore working on a change in temperature of the layer in contact with the land leading to an air currents cyclones are mixing the air in this class In this case, the form will consist smoke from a factory chimney knows as Fumigation spread the features of this type can smoke up to the ground quickly after leaving the chimney and this explains the reason for the rise in concentrations of black carbon Between surfaces ,Also that the movement of vehicles and other human activities have a role in adding black carbon in to the environment.

During the period between noon and between the hours13-17 o'clock the values of black carbon were between8409.17ng/m^3 to BC 7212.83 ng/m^3 to

UV the highest And 6737.08ng/m^3 to BC , 6093.83 ng/m^3 to UV the lowest value during this period. while the lowest value recorded in the study period was2140.83 ng/m^3 to BC , 1860.42 ng/m^3 to UV at the midnight, In the evening when the temperature decreased above the chimney compared with temperature of the chimney below In this case, the form will consist smoke from a factory chimney knows as Lofting spread and the pollutants going away and didn't reach the earth just a little amount .

The study results agreed with (15) which concluded during their study on Anantapur city in Southeast India (it's a city surrounded with factories specially brick kiln) that the highest value of BC was in the morning between 7-8 am and the registered lowest value was in the 21 pm .

The second site shows that two daily peaks(figure 3) were found for the BC&UV content, typical of vehicles emissions, with maximum values 3503.75 ng /m^3 to BC, 3936.58 ng/ m^3 to UV and the minimum values 50.33 ng/ m^3 to BC, 97.5 ng/ m^3 to UV, and the mean value of BC was 1064.98 ng/ m^3 and UV was 1194.81 ng/ m^3 .

This results agreed with (13) which concluded during their study on in two sites located in Basilicata (South-Italy) affected by different sources of carbonaceous particles: in one case a freeway close to the measurements site is the major BC source, in the other a fresh-oil pre-treatment plant produces BC.

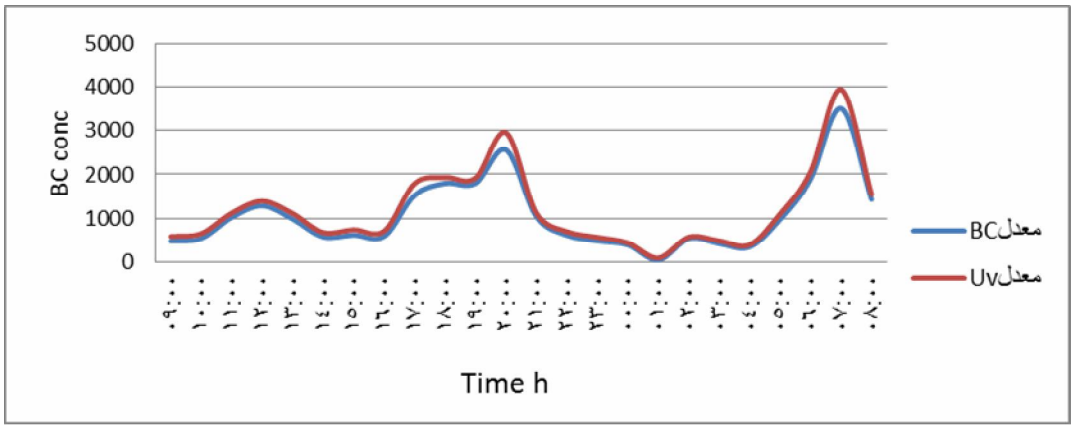


Figure 3: Two peaks of BC and UV during 24h in the second (clean) site

While figure 4 compares the concentration of black carbon between the two sites ,as appear on the figure the amount of black carbon result by brick kiln was higher 9 times thin the black carbon result by cars .

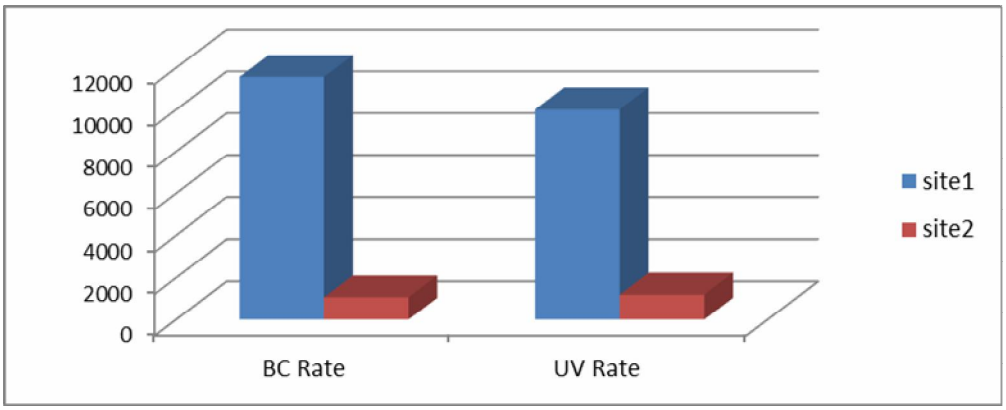


Figure4:different BC,UV concentration between the two study sites

CONCLUSIONS

This study has shown BC data collected in two sites located in Maysan affected by different sources of carbonaceous particles: a brick kilns produces BC higher than that measured in 2nd site when the major BC source is car movement , also the wind speed has a role in dilution of the pollutant produces by different sources.

REFERENCES

1. Ahmmed, K. M. Tanvir and Begum, D. A. Air Pollution Aspects of Dhaka City. *Proc. of International Conference on Environmental Aspects of Bangladesh* (ICEAB10), Japan. (2010)

2. Brick Industry Association. Technical notes on brick construction. Manufacturing of brick. (2006) http:// www.bia.org/BIA/technotes/t9.htm

3. CAI-Asia .Clean air initiative for Asia cities. Clean brick making technology—success of VSBK in Kathmandu (2008). http://www.cleanairnet.org/caiasia/1412/ article-70695.html.

4. ESMAP. Energy Sector Management Assistance Program. Introducing Energy-efficient Clean Technologies in the Brick Sector of Bangladesh (2011) Report No. 60155-BD.

5. FAO .Regional Wood Energy Development Programme in Asia. Status and development issues of the brick industry in Asia. Bangkok: FAO(1993).

6. Ferdausi, S. A., Vaideeswaran, S., & Akbar, S.Greening brick making industries in Bangladesh. Presentations at the Better Air Quality Conference, Nov. 12–14, 2008, Bangkok, Thailand.

7. Hansen, A.D.A. The Aethalometer ™ Magee Scientific Company Berkeley, California, USA .(2005)

8. Hansen, A.D.A., Rosen, H. and Navakov, T. The Aethalometer: An Instrument for the Real Time Measurements of Optical Absorption by Aerosol Particles. *Sci. Total Environ.* 36: 191–196.(1984).

9. Hansen, J., Sato, M., Reudy, R., Lacis, A., Oinas, V. Global warming in the 21st Century: an alternative scenarios. Proceedings of the National Academy of Sciences 97, 9875–9880, 2000.

10. Jacobson M.Z. Control of fossil fuel particulate black carbon and organic matter, possibility the most effective method of slowing global warming, *J. Geophys. Res*.,107(D19), 4410,2002.

11. Kim, K.H., Sekiguchi, K., Kudo, S. and Sakamoto, K.Characteristics of Atmospheric Elemental Carbon (Char and Soot) in Ultrafine and Fine Particles in a Roadside Environmental, Japan. *Aerosol Air Qual. Res*, 2011.

12. Le, H.A & Oanh ,N.K). Integrated assessment of brick kiln emission impacts on air quality, Environ Monit Assess , 171:381–394, 2010.

13. Pavese , G ., Calvello ,M .and Esposito ,F. Black Carbon and Organic Components in the Atmosphere of Southern Italy: Comparing Emissions from Different Sources and Production Processes of Carbonaceous Particles. *Aerosol and Air Quality Research,* 12: 1146–1156, 2012.

14. Penner, J.E. Carbonaceous aerosols influencing atmospheric radiation: black and organic carbon. In: Charlson, R.J., Heintzenberg, J. (Eds.), Aerosol Forcing of Climate. John Wiley and Sons, Chichester, pp. 91–108, 1995.

15. Reddy, B.S.K .,Kumar ,K.R., Balakrishnaiah , G., Gopal , K,R., Reddy , R.R., Reddy , L.S.S., Ahammed , Y.N., Narasimhulu , K.N., Moorthy , K.K., and Babu , S.S. Potential Source Regions Contributing to Seasonal Variations of Black Carbon Aerosols over Anantapur in Southeast India Aerosol and Air Quality Research, 12: 344–358, 2012.

16. Reddy, M.S. and Venkataraman, C. Direct Radiative Forcing from Anthropogenic Carbonaceous Aerosols over India. Curr. Sci, 1999.

17. RERIC, Regional Energy Resources Information Center .Small and medium scale industries in Asia: Energy and environment, brick and ceramic sectors. Bangkok: Asian Institute of Technology. 2003.

18. Saha ,A& Serge ,D. Seasonal and diurnal variations of black carbon aerosols over a Mediterranean coastal zone , Atmospheric Research 92: 27–41,2009 .

19. Singh, A. L., & Asgher, M. S. (). Impact of brick kilns on land use/landcover changes around Aligarh city, India. The Journal of Habitat International, 29, 591– 602, 2005.

20. Zhang, Z. (). Energy efficiency and environmental pollution of brick making in China. *Energy, 22*(1), 33–42, 1997.