

Research Article

COMPARISON OF CONCENTRATIONS OF CARBON MONOXIDE AND DIOXIDE BETWEEN URBAN AND RURAL AREAS AT BASRA CITY IRAQ

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ABSTRACT

In this work we present measurements of the concentrations of CO and CO₂ at Basrah city, 500km south of Iraq. The Measurement is compared with that in Aldorah village 85km south of Basrah. The comparison shows that in the center of the city the level of CO and CO₂ is higher than that in the village. The level of CO is measured also in different special places and show that people might meet unhealthy exposure if they stay for long time and care must be taken. We can consider that Basrah city is one of the contaminated cities in the world with average concentration of CO not less than 30ppm in the rush hours. CO₂ Level is about 400ppm in average and that is higher than the typical value but still within the accepted value.

Key Words: CO level, CO₂ level

INTRODUCTION

Although air pollution may seem like a modern concern, governments have been dealing with it since the late 13th century, when a commission was set up to investigate the problem in London (Beddow JK, 1980). Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment, into the atmosphere. Carbon monoxide was first discovered to be a minor constituent of the Earth's atmosphere in 1948 by Migeotte (Migeotte, 1949). While taking measurements of the solar spectrum, he observed a strong absorption band in the infrared region at 4.6 μm, which he attributed to carbon monoxide (Lagemann *et al.*, 1947). Carbon monoxide is a colorless, odorless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide. Carbon dioxide a greenhouse gas emitted from combustion but is also a gas vital to living organisms. It is a natural gas in the atmosphere.

CO is one of few ambient air pollutants for which we know its biologically toxic form (Miyagawa *et al.*, 1995), carboxyhemoglobin (COHb). Binding of CO in lungs with hemoglobin in the blood forms COHb, this reduces the oxygen-carrying capacity of the blood and impairs the release of oxygen from hemoglobin to extra vascular tissues. These are the main causes of tissue hypoxia produced by CO at low exposure levels. The toxic effects of CO become evident in organs and tissues with high oxygen consumption such as the brain, the heart, exercising skeletal muscle, and the developing fetus. Severe hypoxia due to acute CO poisoning may cause reversible, short-lasting neuralgic, deficits and severe, often delayed neuralgic damage. The mechanisms for effects of low-level exposure are unclear, but likely include reduced exercise capacity and exacerbation of cardiovascular symptoms in persons with coronary heart or lung disease. Reduced oxygen-carrying capacity of hemoglobin predisposes toward cardiac ischemia in persons with coronary artery disease. CO and traffic related co-pollutants have also been associated with alteration of the cardiac autonomic regulation in population-based studies and in panel studies.

For healthy adults CO becomes toxic when it reaches a level higher than 35 ppm (parts per million) with continuous exposure over an eight hour period (Gosselin *et al.*, 1984). When the level of CO becomes

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higher than that a person will suffer from symptoms of exposure. Mild exposure over 2-3 hours (a CO level between 35 ppm and 200 ppm) will produce flu-like symptoms such as headaches, sore eyes and a runny nose. Medium exposure (a CO level between 200 ppm to 800 ppm) will produce dizziness, drowsiness and vomiting in as little as 1 hour. This level of exposure is deemed to be life threatening once three hours has passed. Extreme exposure (a CO level of 800 ppm and higher) will result in unconsciousness, brain damage and death in as little as a few minutes. OSHA guidelines state that the maximum exposure over an eight hour time period is 35 ppm (WHO, 1992).

In this paper we will present, for the first time, our efforts of monitoring the levels of CO and CO₂ in Basrah/Iraq (3millions population) over a period of two years.

MATERIALS AND METHODS

We monitored the concentrations of CO₂ and CO for three years (2009-2012) at different places at Basra city center (47 50E, 30 30N). These concentrations were compared with that monitored in Aldorah village/Faw(48 22E, 30 08N) which is about 85km south of Basra city center to the west of Shatt-Alarab river 20km before Faw center. Aldorah village is an open farm, has very limited number of vehicles and has no industrial activities. The Abadan/Iran(48 20E, 30 22N) refinery which is the source of different types of pollutants is about 15km to the north while the main directions of the wind in this village is either from west or from south in most of the days of the year. This fact means that the diffusion of emitted gases will be diverted away from this village. On the other hand Kuwait city (47 30E, 29 30) is about 90km to the south and has negligible effect on the village.

The measurements were taken using FLUKE 975 AIRMETER made in USA as shown in picture 1. It is designed to measure temperature, Humidity, wind speed, Dew point, wet Bulb, CO and CO₂ concentrations in ppm. The recorded data can be stored in the memory and transferred to a computer (by software supplied with the device) at any time for analysis. The device is a portable one and convenient for carrying the measurements without any difficulties.



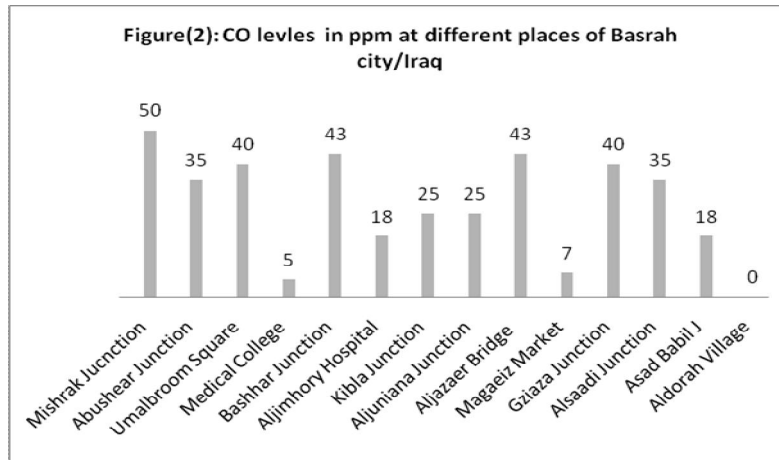
Figure 1: FLUKE 975 AIRMETER

The CO level was recorded at traffic junctions both during the rush hours and normal situations. Also we monitor the CO level near certain engines and devices like electric generators motorbike, car batteries, kerosene heaters and gas cookers. In addition to some special positions like poultry farms, internet cafes and public coffee bars. The concentration of CO₂ is measured in the same time automatically.

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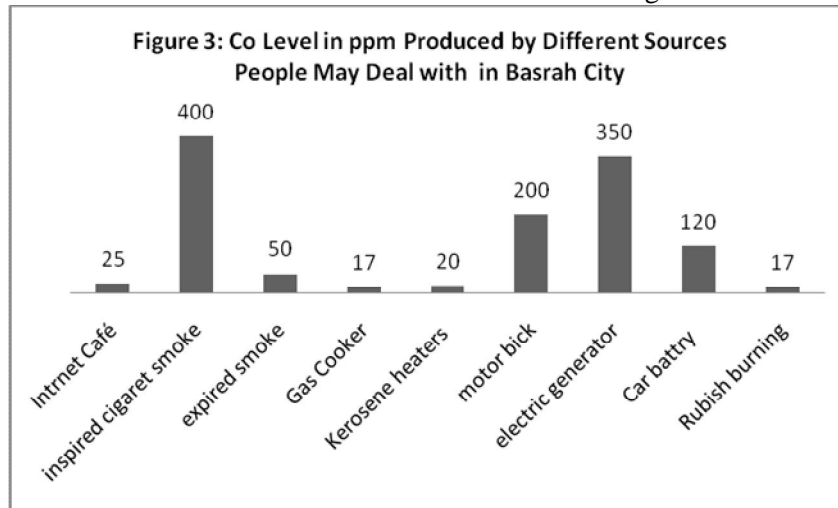
RESULTS AND DISCUSSION

Figure 2 shows the average value of CO level at different places during rush hours. Each bar is the average of 90 readings separated by one minute and repeated in four different seasons on a period of two years. It is clear from this figure that at junctions the level of CO is higher due to the increment of the number of cars. At the same junction the level of CO is different from one position to another and that depends on the direction of the wind and its speed. We observed that CO level is increased at certain point when the wind is still. At moderate wind speed the level of CO concentration is 20% less and at higher speed is 40-60% less. The measurements, in some places of Basrah city, indicate that the concentration of



CO became a bit less in the end of the second year due, probably, to the improvement of car qualities which reflect the improvement of people incomes and reduction of the number of old cars, but we cannot generalize this at the moment and we need some more investigations to prove that as a fact.

Figure 3 shows CO levels (as average) as produced by different items used by people: let us start from the left of the figure, in internet cafe measured value was taken in a smoking area.

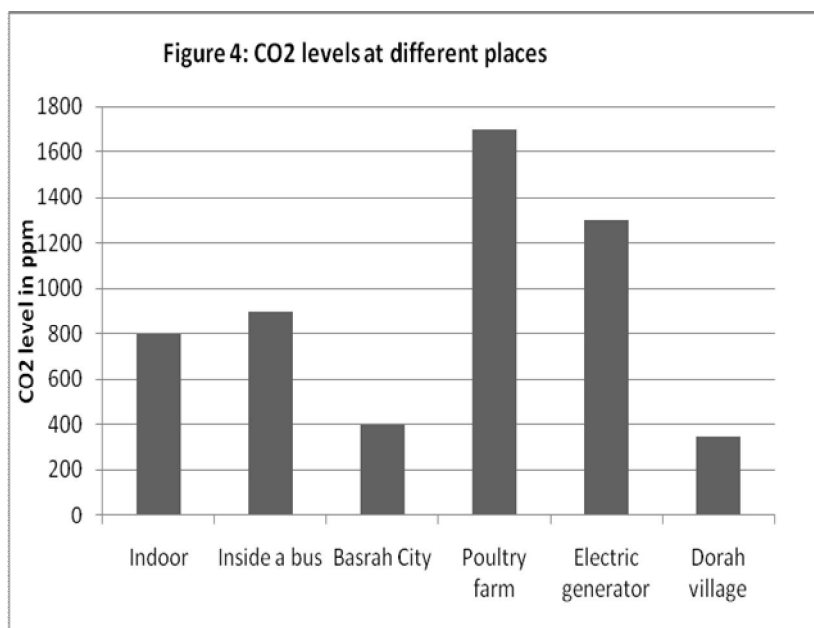


It is well known that any person will sit in the internet cafe one hour at least, therefore a good ventilation should be supplied to such places but unfortunately the room was filled with smoke. The next two bars represent the CO level in a smoke of a cigarette before inspiration and after expiration. These also indicate how danger is to sit next to a smoker. It is clear that the level of CO is higher in the smoke before inspiration, and less in the expired smoke which indicates probably to the ability of the blood to absorb CO. The next two bars show the CO level as produced by Kerosene heaters and Gas cookers which are widely used in Iraqi houses during winter. Again the measured value appear to be danger and a good

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ventilation need to be done in the houses but we must mention that most of Basrah's houses are not well ventilated during winter. Bar number 6 shows the level of CO one meter behind a motorbike. Sometimes we see boys talking together while their motorbikes working and that clearly is not good for them. Next bar represents the level of CO as emitted from an electric generator. In Iraq national electricity is available only for 6-8 hours daily, this forced people to buy electric generators to sustain their needs of electricity. Some people do not know how to choose open area for their generators and instead they put it near the windows and doors of their houses so the CO level increases indoors. Bar 8 shows quite interesting phenomenon, acidic car battery during charging period emits CO! We discovered that by accident while we were talking about CO level in Aldorah village to a visitor from the city and how it is always approximately zero and to prove that for him we put the airmeter on, but for our surprise it indicates 44ppm indoors while zero outdoor. We discovered that as we approach to a battery connected to an inverter inside the house, the CO level increased so we decided to make full studying and we concluded that during charging process the acidic battery emits CO and stops when the battery reaches to its full charge or works as a current supply. Finally we measured CO level two meters away from burnt rubbish. The rubbish was just a sum of two day's rubbish of one house, so what can we say about CO level that is

Figure 4 shows CO_2 levels at different places of Basrah city and compared also with Aldorah village where we find the typical value of 350ppm.



At home we measured the concentration of CO_2 (first bar in the figure) in a room with closed windows in the morning after one night sleep of two persons. This is the average value of twenty nights. We do believe that to wake up healthy and fresh in the morning one must make some type of ventilation in the sleeping room. The same can be seen in a bus with closed windows and doors (in winter). If we compare bar no.3 with bar no.6 we find that in the concentration of CO_2 in the city is 1.14 times more than in Dorah village and that of course enhances the idea that the human is the reason of global warming. Workers in poultry farms should take care because the concentration of CO_2 inside the farm (say with two thousands birds) may make them dizzy particularly if we add the effect of the other gases such as HC_4 and H_2S .

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CONCLUSION

We can conclude that the main source of CO at Basra city center is vehicle exhaust emissions, secondary important sources are industry, electric generators, heating and fires. The concentrations of CO as well as their fluctuations are related to a large extent to the circulation of cars and to the wind speed. CO concentrations are spatially heterogeneous within a city, with higher concentrations on busy roads and especially at junctions where cars accumulate. In addition, CO concentrations in cars and buses are much higher than ambient levels, and can account for an important part of exposure. Because of the spatial variability. Indoor air can also be contaminated with high levels of CO, because space heaters fueled with oil., gas, or kerosene, gas stoves, and tobacco smoking cause significant emissions of CO. On the other hand measurement of CO level at Aldorah village show zero level always which give good explanation that the increment in CO level in the city is manmade also due to civilization needs. The level of CO_2 in the city is higher than that in the village which also give a clear sign that the man is the main cause of global warming. Therefore if do need that civilization then we have to put solutions otherwise the problem will be more complex and our next generation will meet severe health problems. We do believe it is quite important to issue restricted traffic laws concerning cars checking procedure to reject most old cars, and there must be a solution to the nation electricity problems to decrease the number of electric generators used. Also we advice to use the modern techniques to reduce CO emission. For people who works in places with high CO and CO_2 concentrations we advice them to make good ventilation in the site where they work and to breathe fresh air between time to time.

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