

ARTICLE

MEASUREMENT OF CARBON MONOXIDE (CO) AND ESTIMATION OF % COHB AT SELECTED HIGH TRAFFIC JUNCTIONS OF AHMEDABAD CITY

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ABSTRACT

The carbon monoxide (CO) is a vital criterion of pollutants, universal in environment. It generally produces due to incomplete combustion of fuels. Roughly, 80-90% of absorbed CO binds with hemoglobin to form Carboxy hemoglobin (COHb). The intimacy of hemoglobin with carbon monoxide is 200-250 times more than oxygen. The effect of CO poisoning on human health are headache, nausea to the loss of attentiveness and collapse, if the exposures are prolonged and with high concentration. The ambient CO exposure may affect various people such as drivers, traffic polices, street sellers, parking servants, pedestrians and cyclists [4]. Ahmadabad has become a mega city. In Ahmedabad, the rapid population growth rate and vehicular growth rate cause serious traffic congestion on streets and roads during peak hours leads to air pollution. Carbon Monoxide concentration is measured at high vehicular traffic junction in Ahmedabad city by using Carbon monoxide analyzer. CO Concentration is measured at 1.5 m height during the 10 AM to 7 PM of every 15 minutes. The CO investigation occurred during 21st April to 19th May 2015. The fifteen heavy traffic junctions had been selected in Ahmedabad city. Out of 15 traffic junctions, at 13 traffic junctions, CO concentration exceeds the one hour National Ambient Air Quality Standards (NAAQS) in peak hours due to heavy traffic of school time and office time and cumulate 8 hrs CO concentration exceeds the NAAQS at nine traffic junctions out of total 15 selected traffic junctions. Estimated %COHb is not more than 1%, so it is not contributed to any serious health effect.

INTRODUCTION

Carbon monoxide (CO) produces due to incomplete combustion of carbon fuels and vehicular emission is the major source of generation of CO. % contribution of cities' high traffic congestion in generation of CO is of 95. CO concentration inside vehicles is inversely proportional to vehicles' speed. CO concentration may increase from 25 ppm to 45 ppm, when vehicles stop. Various literature reviews reveal that in areas with high traffic density and the high retention of vehicular traffic on the road, CO concentrations are high [1].

In the last few decades, Ahmedabad city has seen a rapid growth in vehicular population, urban infrastructure and industrial sector resulted in rising pollution levels in the city. Vehicular pollution accounts for 60-70% of total air pollution loads in urban India. Unlike industrial emissions, vehicular pollutants are released at ground level and hence, their impacts are likely to be more significant. Out of total number of vehicles in Ahmedabad as on 31st December 2013, 19, 74,452 are motorcycles, 2,72,393 are mopeds, 1,52,168 are auto rickshaws, 4,56,778 are four wheelers, 36,305 are trucks and 52,663 are tempos. % wise graphical representation of the same is depicted as [Fig. 1].

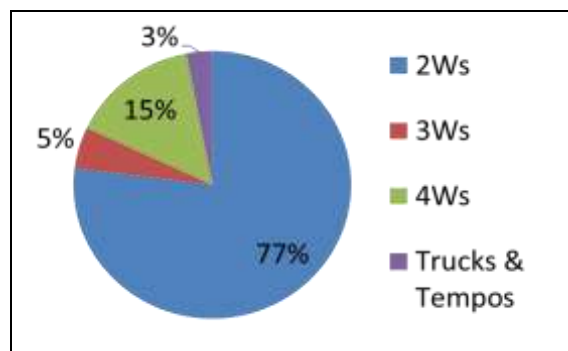


Fig. 1. Compositions of types of vehicles in Ahmedabad city

For the Ahmedabad city, % contribution of CO, HC, NO_x, SO₂ and PM is approximately works out to be 61%, 23%, 14%, 1% and 1% respectively. The graphical presentation of the same is depicted in [Fig. 2].

KEY WORDS

Measurement of CO;
Ahmedabad; Effect of
Pollution on Traffic
Polices; Air Pollution;
Vehicular Pollution

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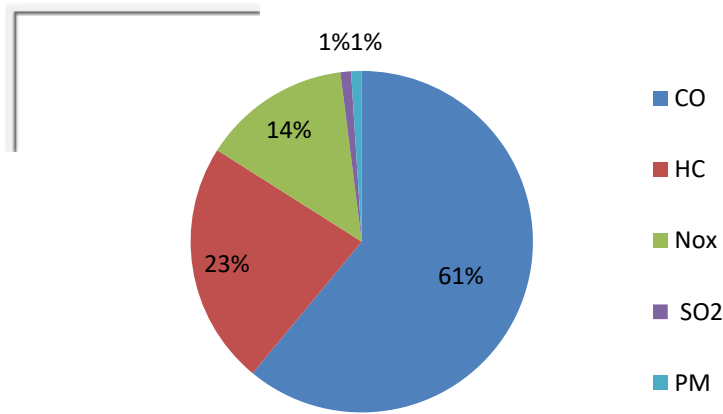


Fig. 2. % Contribution of air pollutants in total emission load due to vehicles for Ahmadabad City

Considering the nature and location of work place of traffic police, exposure of CO and resultant health risks are significantly high than the other people. In particular, traffic policemen are a population group under risk due to their inhalation for minimum 8 hrs. /day of CO [2, 3]. There is a severe effect of CO on human health only when CO concentration is higher than 10 ppm.

METHOD

Selection of high traffic junctions

Carbon Monoxide concentration is measured at high traffic junction in Ahmedabad city by using Carbon monoxide analyzer of HTC Company having range from 0 to 1000 ppm with 1 ppm resolution. The areas have been selected considering the residential, commercial, industrial and mixed zone. [Table 1] represents the list of selected traffic junctions along with CO measurement date and type of area. CO Concentration measured at 1.5 m height during 10 am to 7 pm. CO was measured every 15 minutes and cumulated the CO concentration of every hour. Every hour concentration was compared with 1 hour standard. Cumulated 8 hours (10am – 6pm and 11am – 7pm) CO concentration and compared with the 8 hours standard. The CO measurement has been done during 21st April to 19th May 2015.

Table 1: Selected traffic junctions of Ahmadabad city

Sr no.	Selected Junction	Measurement Date	Types of Area
1	Incometax Circle	21/4/2015	Commercial
2	Panchvati cross road	23/4/2015	Commercial are + Residential
3	Kalapur cross road	24/4/2015	Commercial
4	Anjali cross road	4/5/2015	Commercial + Residential
5	Astodiya Darwaja	5/5/2015	Commercial
6	Helmet circle	6/5/2015	Commercial
7	Visat junction	8/5/2015	Commercial + Residential
8	Memco cross road	9/5/2015	Commercial + industrial
9	Narol cross road	11/5/2015	Commercial + Industrial
10	Subhash bridge circle	12/5/2015	Commercial
11	Tilak baug	14/5/2015	Commercial
12	IskonCross road	15/5/2015	Commercial
13	Delhi Darwaja	16/5/2015	Commercial + Residential
14	Panjrapol cross road	18/5/2015	Residential + Sensitive

15	Kankariya Lake Gate No. 1	19/5/2015	Residential + Sensitive
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% COHb Estimation based on CO concentration

The percentage of COHb has been estimated as function of inhaled CO (in ppm), from the duration of exposure by using following formula;

$$\%COHb = [CO]_{air} KT$$

Where, $[CO]_{air}$ - Air concentration of CO in ppm

K - Constant that varies from 0.018 at rest to 0.048 at light work (usually depend on physical activity)

T - Duration of exposure in hours

RESULTS

Hourly concentration of CO at selected junction

Hourly concentration of CO is measured at selected area of Ahmedabad city during the 10 a.m. – 7 p.m. Each hour CO concentration has been compared with 1 hr National Ambient Air Quality Standard. 8 hours cumulate CO concentration, from 10 a.m. to 6 p.m. and from 11 a.m. to 7 p.m. has been compared with 8 hrs National Ambient Air Quality Standard.

At Income tax circle, hourly CO concentration was measured on 21st April 2015. The data obtained from CO measurement indicate that from 5 p.m. to 6 p.m. and 6 p.m. to 7 p.m., CO concentration is more than 1 hour standard. At Panchvati circle, hourly CO concentration was measured on 23rd April 2015. The data obtained through CO measurement indicate that for this location concentration of CO is within 1 hour standard. At Kalupur cross road, hourly CO concentration was measured on 24th April 2015. The CO measurement data indicate that from 10 a.m. to 11 a.m. and from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Anjali cross road, hourly CO concentration was measured on 4th may 2015. The data obtained through CO measurement indicate that from 6 p.m. to 7 p.m., CO concentration is more than 1 hour standard. At Astodiya darwaja, hourly CO concentration was measured on 5th may 2015. The data obtained through CO measurement indicate that from 10 a.m. to 11 a.m., 12 p.m. to 1 p.m., 5 p.m. to 6 p.m. and 6 p.m. to 7p.m. concentration of CO is more than 1 hour standard which is due to high vehicular traffic, narrow street roads and densely populated area. The graphical representation of hourly concentration of CO of above five traffic junctions (Income tax circle, Panchvati cross road, Kalupur cross road, Anjali cross road and Aastidiya Darwaja) in the form of bar chart is represented as [Fig. 3].

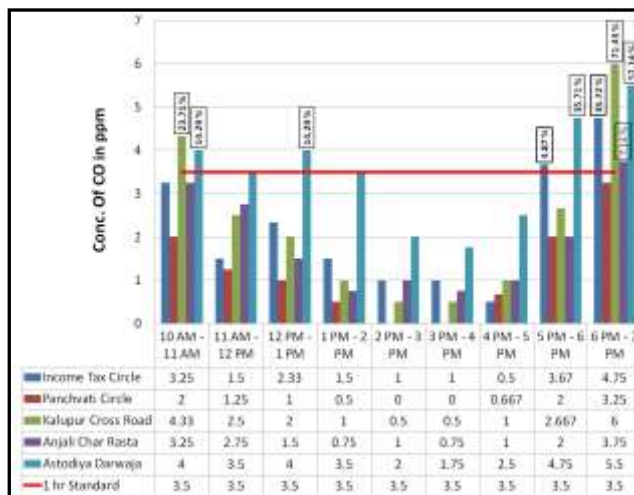


Fig. 3. Hourly Concentration of CO at Selected Junctions of Ahmedabad City

At Helmet circle, hourly CO concentration was measured on 6th may 2015. The data obtained through CO measurement indicate that from 6 p.m. to 7 p.m. concentration of CO is more than 1 hour standard. At Visat junction, hourly CO concentration was measured on 8th may 2015. The Co measurement data indicate that concentration of CO is within 1 hour standard at Visat junction. At Memco cross road, hourly CO concentration was measured on 9th may 2015. The CO measurement data indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Narol circle, hourly CO concentration was measured on 11th may 2015. The data obtained through CO measurement indicate that from 10 a.m. to 11 a.m., 11 a.m. to 12 p.m., 5 p.m. to 6 p.m. and 6 p.m. to 7 p.m., CO concentration is more than 1 hour standard. At Subhash bridge circle, hourly CO concentration was measured on 12th may 2015. The CO measurement data indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. The graphical representation of hourly concentration of CO of these five traffic junctions (Helmet circle,

Subhas bridge circle, Visat junction, Memco cross road and Narol circle) in the form of bar chart is represented as [Fig. 4].

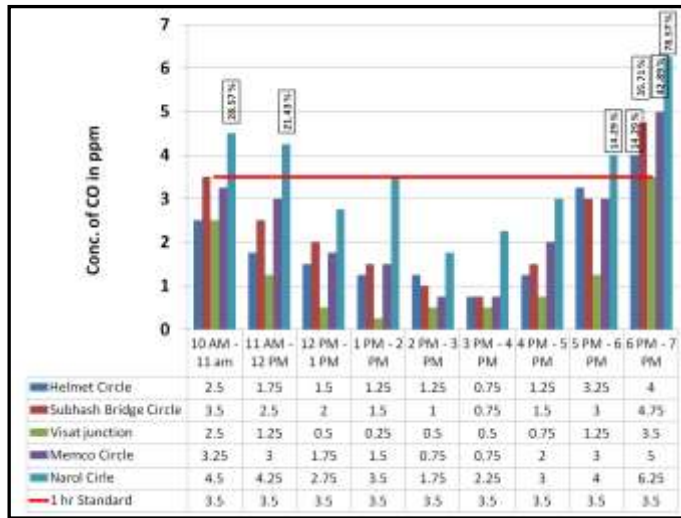


Fig: 4. Hourly Concentration of CO at Selected Junctions of Ahmedabad City

At Tilak baug, hourly CO concentration was measured on 14th may 2015. The data obtained through CO measurement indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Iscon circle, hourly CO concentration was measured on 15th may 2015. The CO measurement data indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Delhi Darwaja, hourly CO concentration was measured on 16th may 2015. The data obtained through CO measurement indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Panjrapol cross road, hourly CO concentration was measured on 18th may 2015. The data obtained through CO measurement indicate that from 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. At Kankariya Lake; gate no. 1, hourly CO concentration was measured on 19th may 2015. The data obtained through CO measurement indicate that form 10 a.m. to 11 a.m., 11 a.m. to 12 p.m., 5 p.m. to 6 p.m. and 6 p.m. to 7 p.m., concentration of CO is more than 1 hour standard. The graphical representation of hourly concentration of CO of these five traffic junctions (Tilak baug, Iscon circle, Delhi Darwaja, Panjarapole cross road and Kakariya Lake) in the form of bar chart is represented as [Fig. 5].

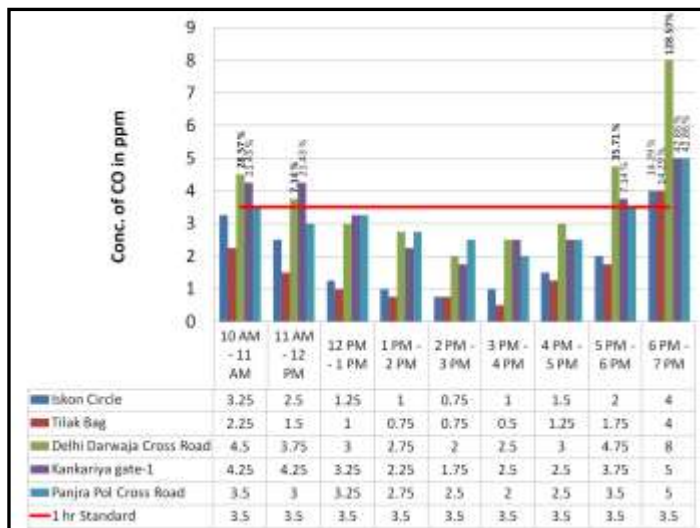


Fig: 5. Hourly Concentration of CO at Selected Junctions of Ahmedabad City

8 hours CO concentration at 15 selected junctions

The data obtained through CO measurement indicate that cumulate 8 hours (10 a.m. to 6 p.m.), CO concentration is more than 8 hours standard due to high vehicular traffic at Income tax circle (5.14%), Kalupur cross road (3.543%), Astodiya darwaja (85.71%), Subhash bridge circle (12.51%), Memco circle

(14.29%), Narol circle (85.71%), Delhi darwaja (91.09%), Kankariya Lake gate no 1 (75.03%) and Panjrapol char rasta (64.29%). So, total at 9 traffic junctions out of 15 traffic junctions, CO concentration exceeding the 8 hours NAAQS.

From the data obtained through CO measurement indicate that cumulate 8 hours (11 a.m. to 7 p.m.), CO concentration is more than 8 hours standard due to high vehicular traffic at Income tax circle (16%), Kalupur cross road (15.43%), Astodiya darwaja char rasta (96.47%), Subhash bridge circle (21.43%), Memco circle (26.8%), Narol circle (98.23%), Delhi darwaja char rasta (116%), Kankariya Lake gate no 1 (80.34%) and Panjrapol char rasta (75.03%).

The graphical representation of cumulative 8 hours (10 a.m. to 6 p.m. and 11 a.m. to 7 p.m.), CO concentration of 15 selected traffic junctions in the form of bar chart is represented as [Fig. 6].

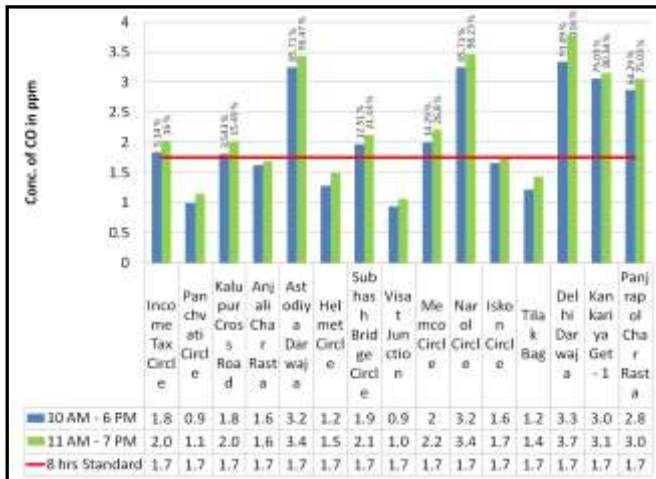


Fig. 6. 8 Hours concentration of CO at selected junctions of Ahmadabad city

3.3. % COHb Estimation in Blood

Based on cumulative 8 hours CO concentration, % COHb in blood of human beings has been estimated using the formula shown in method for 15 selected traffic junctions and tabulated as [Table 2].

Table 2: Level of % COHb in Blood Due to Exposure of CO for 8 hours

Sr. No.	Areas	10 A.M. – 6 P.M.		11 A.M. – 7 P.M.	
		Conc. in ppm	% COHb	Conc. in ppm	% COHb
1	Income Tax Circle	1.84	0.29	2.03	0.3248
2	Panchvati Circle	0.99	0.158	1.146	0.183
3	Kalupur Cross Road	1.812	0.2899	2.021	0.352
4	Anjali Char Rasta	1.625	0.26	1.688	0.27
5	Astodiya Darwaja	3.25	0.52	3.438	0.55
6	Helmet Circle	1.28	0.205	1.5	0.24
7	Visat Junction	0.9375	0.15	1.063	0.17
8	Memco Circle	2	0.32	2.219	0.355
9	Narol Junction	3.25	0.52	3.469	0.555
10	Subhash Bridge Circle	1.9	0.304	2.125	0.34
11	Tilak Baug	1.219	0.195	1.437	0.2299
12	Iskon Circle	1.656	0.265	1.75	0.28
13	Delhi Darwaja Char Rasta	3.344	0.535	3.78	0.605
14	Panjrapol char rasta	2.875	0.46	3.063	0.49
15	Kankariya Gate-1	3.063	0.49	3.156	0.505

CO measurement, it was observed that at most of the traffic junctions, hourly concentration of CO exceeding

the National Ambient Air Quality Standards during peak hours (10:00 a.m. to 11 a.m., 5:00 p.m. to 7:00 p.m.). This is due to high vehicular traffic, traffic congestion, more vehicular retention period, more no. of heavy duty vehicles and narrow street roads. So, to reduce the vehicular air pollution, heavy duty vehicles should not be allowed to congested areas during peak hours (Office Hours). The % COHb has been determined based on 8 hours CO concentration which comes out to be less than 1% in all selected traffic junctions, so no severe health effect due to CO concentration. To reduce the CO concentration in the atmosphere, more no. of trees should be grown on roads in highly populated areas, in the industrial areas and high vehicular traffic areas. To reduce the CO concentration, public transport facility should be improved and people should be encouraged to maximum use of public transport.

CONCLUSION

From the study it concluded that

- 1) It is observed that out of the fifteen selected heavy traffic junction of Ahmedabad city, at thirteen traffic junctions, CO concentration exceeds the 1 hour standard and places are Income tax circle, Kalupur cross road, Astodiya darwaja char rasta, Subhash bridge circle, Memco circle, Narol circle, Delhi darwaja char rasta, Kankariya Lake gate no. 1, Panjrapol char rasta, Anjali char rasta, Helmet circle, Iskon circle and Tilak baug.
- 2) It is observed that out of the fifteen selected heavy traffic junction of Ahmedabad city, nine traffic junctions, CO concentration exceeds the 8 hours standard and places are Income tax circle, Kalupur cross road, Astodiya darwaja char rasta, Subhash bridge circle, Memco circle, Narol circle, Delhi darwaja char rasta, Kankariya gate-1 and Panjrapol char rasta.
- 3) It is observed that in most of the selected traffic junctions, during peak hours 10 a.m. to 11 a.m. and 5 p.m. to 7 p.m., CO concentration exceeds the 1-hr standard.
- 4) Based on the results CO, 1 hour concentration and 8 hours concentration not more than 10 ppm. So that it is not occurred any sign & symptoms on health (based on table 1).
- 5) The level of % COHb in blood for 8 hours, level of % COHb is not more than 1%. So it is not contributing any serious health effect.

CONFLICT OF INTEREST

There is no conflict of interest.

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