ABSTRACT

A notable impact of the industrial revolution on people's lives has been the manufacture of automobiles. Air pollution is a serious public health problem in most of the metropolitan areas around the world. Rapidly growing vehicle fleets, with poor quality emission and poor maintenance, are significant contributors to air pollution in cities.

The rapid growth of motor vehicles in Indian cities are causing serious health, environmental and socio-economic impacts. Vehicular pollution is the major contributor of urban air pollution in most of the cities in India and estimated to account for approximately 70% of CO, 50% of HC, 30% of SPM and 10% of SO_2 of the total pollution load of which two - thirds is contributed by two wheelers alone.

This research work focuses on the urban air quality monitoring and modelling for Coimbatore city. Since Coimbatore city is experiencing an exponential industrial and population growth, it has a high potential for air pollution. In addition, the prevailing meteorological conditions in this city are not favourable for the dispersion of the pollutants. In order to monitor the ambient air quality near busy road junctions in Coimbatore city, 6 busy road junctions were selected. They are :-

AAQMS 1: Near Gandipuram bus terminal junction

AAQMS 2: Near Railway station junction

AAQMS 3: Near Ukkadam bus terminal junction

AAQMS 4: Near Hope college junction

AAQMS 5: Near Lawley road junction

AAQMS 6: Near Mettupalayam road bus terminal junction

In all these stations, ambient air quality monitoring was conducted for a period of 2 years from January 2011 to December 2012. Air quality monitoring was conducted on two selective days for each month, during January 2011 to December 2012. The concentration of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, O_3 and NH_3 were measured during monitoring at all stations. The results were recorded. The Air Quality Index (AQI) for all the six stations was arrived.

The concentrations of PM_{10}, $PM_{2.5}$, O_3 and NH_3 at AAQMS 6 were found to be the highest among all the stations investigated. The concentration of PM_{10} at all stations varied from 98.5 $\mu g/m^3$ to 152.5 $\mu g/m^3$. The concentration of $PM_{2.5}$ at all stations varied from 16 $\mu g/m^3$ to 49.8 $\mu g/m^3$. The concentrations of O_3 at all stations varied from 6.2 $\mu g/m^3$ to 32.5 $\mu g/m^3$. The concentrations of NH_3 at all stations varied from 5.4 $\mu g/m^3$ to 29.8 $\mu g/m^3$.

The concentrations of SO_2, NO_X and CO were highest at AAQMS 1. The concentration of SO_2 at all stations varied from 5.3 $\mu g/m^3$ to 35.0 $\mu g/m^3$. The concentration of NO_X at all stations varied from 7.3 $\mu g/m^3$ to 41.0 $\mu g/m^3$. The concentrations of CO at all stations varied from 500 $\mu g/m^3$ to 779 $\mu g/m^3$.

The Air Quality Index (AQI) for all the AAQMS listed under Light Air Pollution except AAQMS 1 and AAQMS 6. Both of the AAQMS 1 and AAQMS 6 listed under Light and Moderate Air Pollution.

One-way ANOVA was tested for monitoring station wise variation of pollutants concentrations. The concentration of air pollutants as compared to the sampling sites showed significant variations of $p < 0.0001$. The values of F vary as pollutants vary. At all the monitoring locations, the

concentrations of the AAQ parameters showed an increasing trend in 2012 compared to 2011 and the values were within the threshold value, as in NAAQS at all the places except Particulate Matter (PM_{10}).

In all these 6 busy road junctions, traffic survey was also conducted from January 2011 - December 2012. During traffic survey, AAQMS 3 registered the maximum two wheelers flow, accounting for 73% among the traffic volume surveyed. The minimum two wheelers flow recorded was 34% at AAQMS 2. The highest heavy vehicle flow, light vehicle flow and auto tri-cycle flow were recorded at AAQMS 2 and the lowest were recorded at AAQMS 3 in all the stations.

During the traffic survey, the highest average vehicles count was recorded at AAQMS 6. Hence, AAQMS 6 holds the highest Passenger Car Unit (PCU). The lowest vehicles count was recorded at AAQMS 2. Hence, AAQMS 2 holds the lowest Passenger Car Unit (PCU).

Long term continuous meteorological survey was conducted for a period of two years from January 2011 to December 2012. Integrated Sensor Suite was used to observe and record the meteorological parameters such as Wind Speed, Wind Direction, Rain, Temperature and Humidity. The meteorological equipment was kept on the roof top of an office building at R. S. Puram, Coimbatore which is representative of all the six sampling stations. The meteorological parameters were recorded every hour.

The monthly wind roses were drawn for the period from January 2011 to December 2012. The most predominant wind directions which prevailed during the observation periods was South South-West (SSW) and the next predominant wind direction was West South-West (WSW). The highest percentage frequency of wind speed which occurred in the WSW direction

was 67.5%. The lowest percentage frequency of wind speed which occurred in the ENE direction was 17%. The wind speed classes were in the range of 0.5 to 2.1 m/sec to 8.8 to 11.1 m/sec. The highest wind speed class of 8.8m/sec to 11.1m/sec which prevailed in the South - West (SW) direction during the months of November and September 2012. The percentages of occurrence of calm condition were in the range of 0.0% to 31.82%.

The prediction and simulation of atmospheric dispersion of CO at nearby road junctions in Coimbatore city using CALINE-4 model was attempted.

In order to ascertain the reliability of CALINE-4 model for predicting CO concentrations, the validation of CALINE-4 model was essential by comparing the observed concentrations of CO with predicted concentrations of CO. The R^2 value was obtained from the scatter diagram for all the AAQMS. The higher correlation of 0.99 was existed for AAQMS 6 and AAQMS 3 recorded the lowest value of 0.82.

The concentrations of CO along the busy roads junctions in the Coimbatore city for each month of the year 2012 were simulated by using CALINE- 4 model. The buffer distances, say 100 m, 250 m and 500 m from the centreline of the road have been considered in this study. Twenty receptor positions, including 6 major junctions and 14 buffer positions were incorporated in the analysis of dispersion of CO along the roadways.

The dispersion patterns of CO along the major road of the Coimbatore city for each month of the year 2012 have been drawn. It reveals that the concentrations of CO are higher in the stretch of Gandhipuram to MTP road and MTP road to Lawley road. The measured and modelled concentrations of CO were well within the National Ambient Air Quality Standards.

In order to forecast the concentrations of CO at nearby road junctions in Coimbatore City, Artificial Neural Network (ANN) was attempted after evaluating the performance of the ANN model. The 3-layer perceptron model was used. There were seven neurons in the input layer including seven variables such as Tmax, Tmin, Wind speed, Wind direction, Relative humidity, Atmospheric pressure and Per Car Unit pertains to Coimbatore City during the year 2011-2012. MATLAB Neural Network tool box was used for development of the air quality forecasting model because it is flexible and easy to apply. The ANN Network was first trained and tested subsequently by the test input data assuming that the odd and even numbers of the input data as training and testing respectively. Artificial Neural Network modeling was done for all the six AAQMS busy road junctions in Coimbatore. The concentration of CO was modeled at nearby each road junction separately by giving respective input data.

The ANN model was validated against measured CO concentrations. The values predicted by ANN were compared with the measured values. The R^2 value was obtained from the scatter diagram for all the Ambient Air quality monitoring stations. The higher correlation of 0.995 was existed at AAQMS 5 and AAQMS 6 recorded the lowest value of 0.959. It indicates that the ANN model performs better for all the six busy road junctions. The ANN model will be used to forecast the future concentrations of CO at nearby road junctions in Coimbatore city.

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