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ASSESSMENT OF AIR POLLUTION AND ITS IMPACTS OF THE MUNICIPAL SOLID WASTE DUMPING SITE AT KOSAVAMPATTY, NAMAKKAL, TAMIL NADU, INDIA

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Abstract

The generation of municipal solid waste (MSW) in Indian cities has resulted in acute environmental and health problems due to improper management. Air Pollution is one of the utmost environmental concerns in India due to open disposal and burning of MSW. In the present study, including particulate matter 10.0 ($PM_{10.0}$), particulate matter 2.5 ($PM_{2.5}$), Sulphur dioxide (SO_2), oxides of Nitrogen (NO_X) and Carbon monoxide (CO) were investigated during both pre monsoon and post monsoon season in four directions around Kosavampatty open dumping ground and inner site of the dump yard in Namakkal, India. The result was indicated that the concentration of SPM and RSPM in all the study area were higher than NAAQS (CPCB, 2009) and there is an urgent need to regulate and monitor the ambient air quality in Namakkal, especially around the dumping sites. The Air Quality Index (AQI) calculated for all study sites shows that moderately polluted which is a cause of critical health impacts to the habitants.

Keyword:- Air pollutants, Ambient Air, Municipal Solid Waste, Dumping Site, Impact, Environment, Human Health.

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Introduction

The problem of municipal solid waste management (MSWM) has become a global challenge from a local/regional/national issue, due to the rapid population growth, urbanization and industrialization. The problem has acquired an alarming dimension and increasing day by day especially in the developing countries during the last few decades which results into a direct threat to the environmental and public health [Chatterjee R. 2010]. MSWM is one of the major challenging issues in urban cities; the generation of huge quantities of solid waste culminates in a serious environmental pollution problem, threats to human health, which is a hindrance to the sustainable development of the urban areas [Kumar Sunil *et al* 2009]. Inadequate management of MSW in most cities of developing countries leads to problems that impair human and animal health and ultimately result in economic, environmental and biological losses [Sharholy M *et al* 2008]. The present carried out ambient air quality assessment around Kosavampatty open landfill site in Namakkal.

MATERIAL AND METHODS:-

Study Area

Namakkal or Namagiri is a city and a municipality in Namakkal district in the Indian state of Tamil

Nadu. It is the headquarters of Namakkal district and the first ISO 14001-2004 certified municipality in Asia for environmental management, specifically the provision and maintenance of water supply, solid waste and sewage management, town planning, lighting and other social services. As of 2011, this municipality had a population of 55,145 with 30 wards of 10.24 sq.km. Further, the municipality has been extended to 39 wards with an area of 50.24 sq.km by adding 9 villages namely Chinnamuthalipatty, Muthalipatty, Kosavampatty, Konduchichetty patti, Periyapatty, Kavateepatti, Nallipalayam, Ayyampalayam and Thumakurichi.

It was a town panchayat since 1943 and in 1970 it was upgraded to a Grade III municipality. Over the years, the town has been upgraded and in 1988, it was upgraded into a Selection Municipality.

METHODOLOGY:-

The present study was conducted to around Kosavampatty dumping area. In order to understand ambient air quality status around dumping ground, 5 ambient air samples (Northern, Southern, Eastern, Western and Inside the dump yard) were taken in the vicinity of Kosavampatty dumping ground. The parameters were assessed including particulate matter 10.0 (PM10.0), particulate matter 2.5 (PM2.5), sulphur dioxide (SO2) and nitrogen oxides (NOx).

For particulate matter analysis, the high volume air sampler (HVAS) 1700 (Zenith Eng.) was used. The concentration was measured using quantitative analysis with glass fiber filter paper (Whatman GF/A) PM10 and 2.5 range – 100 to 0.1 µg. The SO2 (sulphur dioxide) concentration was measured using iodine as absorbent and titrated with sodium thiosulphate, indicator-starch, and the NOx (oxides of nitrogen) concentration was measured as follows. Nitrite ion produced during sampling was determined colorimetrically (DR-2000), with a range of 20–740 µg/m³.

AIR QUALITY INDEX (AQI)

The Air Quality Index (AQI) was defined as a scheme to transforms the values of individual air pollutant into single number. AQI was calculated using the method suggested by Tiwari T.N and Ali M (1987) and improved by Kaushik C.P et al., (2006).

The concentration of each pollutant was used to calculate the following formula:

$$Q = 100\,\frac{V}{Vs}$$

where, Q represents of quality rating, V is the observed value of pollutant and Vs represents the recommended values of National Ambient Air Quality Standards (NAAQS) (CPCB, 2009). If total 'n' no of pollutants were considered for air monitoring, then geometric mean of these 'n' number of quality ratings was calculated in the following way:

$$g = anti\log\{(\log a + \log b + \log c + \cdots + \log x)/n\}$$

Where g is geometric mean, while a, b, c, and x represent different pollutant values of quality rating, and n is the number of values of quality rating.

RESULTS AND DISCUSSION:-

Air pollution is a major threat to human health and environment, especially pollution from unscientific disposal sites creates acute health problems to the surroundings habitants [Visvanathan C and Trankler J 2003]. The continues inhalation of particulate matters consists of dust, fumes, mist and smoke cause lung damage and respiratory problems [Winder C and Neil H Stacey 2004]. In this study, the concentration of pollutants like PM10, PM2.5, SO2, NOx and CO was carried out in five selected sites around Kosavampatty landfill (Table 1).

Table 1: STATUS OF AMBIENT AIR QUALITY DURING PRE & POST MONSOON

Sites	$PM_{10.0}$ (µg/m³)		$PM_{2.5}$ (µg/m³)		SO_2 (µg/m³)		NO_x (µg/m³)		CO (µg/m³)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Inside	156.2	148.2	65	48	27	18.2	43	28.2	1.6	1.0
East	112	106	52	29	14.2	12.1	38.6	23.4	1.3	1.2
West	146	133	46	21	9.6	8.3	16.2	8.2	2.6	1.8
North	168.2	120.6	52	31	13.4	10.4	31.4	30.2	1.4	1.2
South	98.5	56.4	18	6	9.5	7.3	23.4	18.4	0.4	0.03

(Standard limits NAAQS, PM10: 100 µg/m³, PM2.5: 100 µg/m³, SO2: 80 µg/m³, NOx: 80 µg/m³, CO: 4 µg/m³).

PM10 Scenario

The PM10 concentrations were found to be exceeding at all locations in both the season except the Southern side of the dump yard. The highest concentrations of PM10 were found to be 168.2 µg/m³ in pre monsoon at Northern side of the dump yard and 148.2 µg/m³ in post monsoon season at Inner side of the dump yard whereas in Southern side of the dump yard the lowest level of PM10 was found to be in range from 98.5 µg/m³ and 56.4 µg/m³ in pre and post monsoon seasons respectively. Except Southern side of the dump yard, the level of PM10 had exceeded in all other sites than the recommended standard (100 µg/m³) by NAAQS. The average PM10 values in both seasons were in decreasing order from Inner side (152.2 µg/m³) > Northern side (144.4 µg/m³) > Western side (139.5 µg/m³) > Eastern side (109 µg/m³) > Southern side (77.45 µg/m³).

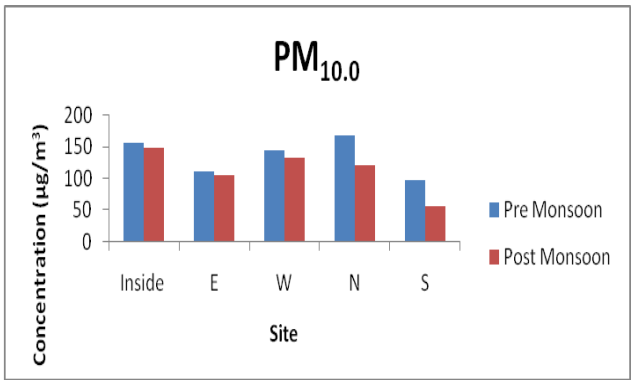

Figure 1: PM10.0 concentration in pre and post monsoon seasons

PM2.5 Scenario

The concentrations of PM2.5 in the study area ranged from 18 µg/m³ - 65 µg/m³ in pre monsoon and 6 µg/m³ - 40 µg/m³ in the post monsoon. The highest concentration was observed at Inner side sample site in 65 µg/m³ and 40 µg/m³ respectively by pre and post monsoon season, whereas the lowest concentration was found in Southern side ranging between 6 µg/m³ - 18 µg/m³ in pre and post monsoon seasons respectively. The concentration level of PM2.5 is within the limit at all the study sites than the recommended standard (100µg/m³) by NAAQS except at Inner side during pre monsoon season. The average PM2.5 values in both seasons were in decreasing order from Inner side (56.5 µg/m³) > Northern side (41.5 µg/m³) > Eastern side (40.5 µg/m³) > Western side (33.5 µg/m³) > Southern side (12.0 µg/m³).

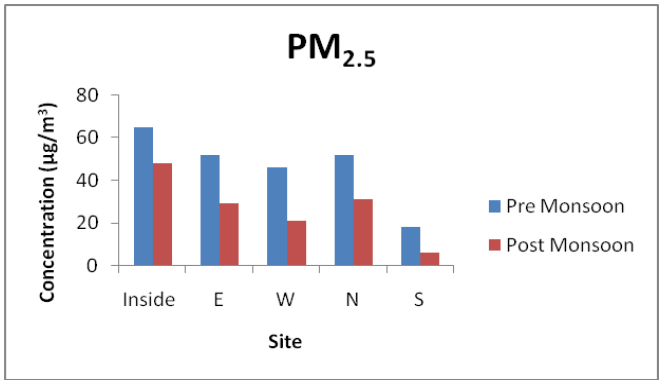

Figure 2: PM2.5 concentration in pre and post monsoon season

Gaseous pollutants

The measured concentrations of gaseous pollutants such as SO2, NOx and CO around the landfill are comparatively low in both the seasons compared with the recommended standard by NAAQS. The highest SO2 concentrations were observed at Inner side sample site on 27.0 µg/m³ in pre monsoon and 18.2 µg/m³ in post monsoon season. The NOx levels ranged from 16.2 µg/m³ – 43.0 µg/m³ and 8.2 - 30.2 µg/m³ respectively by pre and post monsoon seasons. The highest level NOx was observed at Inner side sample site (43 µg/m³) in pre monsoon season and in Northern side (30.2 µg/m³) in post monsoon seasons. In the present study, the concentrations of SO2, NOx and CO were found to be below permissible limit (80µg/m³ for SO2/NOx and 4µg/m³ for CO) as recommended by National Ambient Air Quality Standards [NAAQS, 2009] in all the sites for both the seasons.

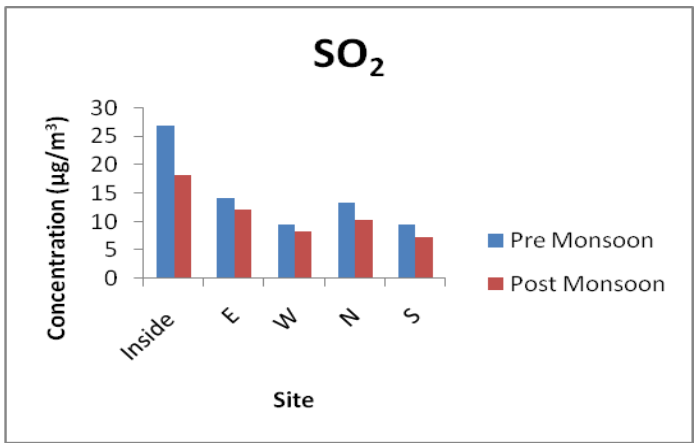

Figure 3: SO_2 concentration in pre and post monsoon season

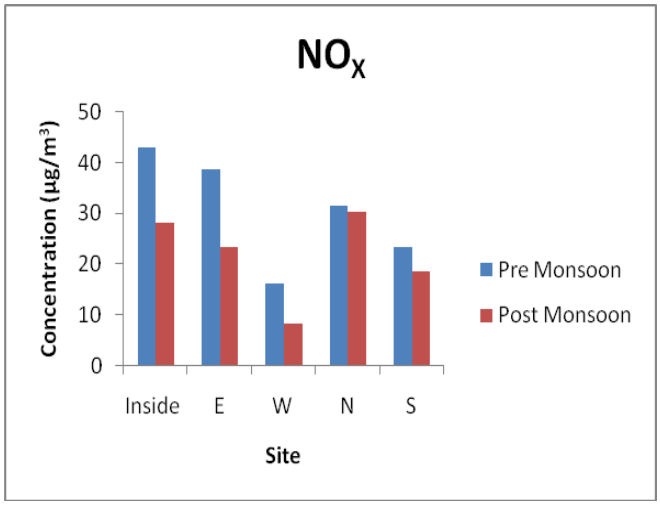

Figure 4: NOx concentration in pre and post monsoon seasons

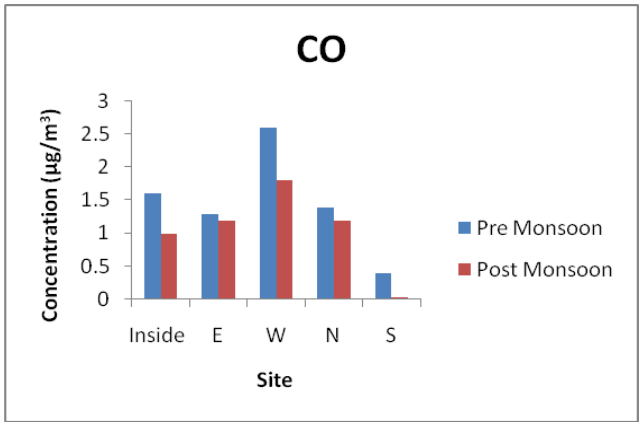

Figure 5: CO concentration in pre and post monsoon seasons.

Health risk

At elevated levels, all the air pollutants will have adverse effects on human and environment. The accumulation of pollutants in the human body through inhalation of air is an important route [Barman S.C et al 2010]. The results of the present study revealed higher levels of PM10 and PM2.5. The dust released from various sources can produce a spectrum of diseases ranging from a simple cold to deadly diseases like cancer as reported by Bency K.T et al (2003). The higher concentration of particulate matter causes acute and chronic respiratory disorders and lung damage in humans [Puikesia M et al 2006]. Population residing in the vicinity of polluted region by high suspended particulate matter was reported to have a higher risk of cardiovascular diseases [Nautiyal Jyoti et al 2007]. The high amount of PM10 are either in polluted or moderately polluted category and might be due to the harmful effect of the PM10 dwelling in the area.

Air quality index (AQI)

The Air Quality Index is developed to provide the information about air quality, which is an indicator or determine of some circumstance or property [Kaushik C.P et al 2005]. The observed concentration of air pollutants was calculated into the AQI using by standard formula. It was found that the Inner side site was highly polluted with other site was ranked as moderately polluted except Southern site in average of both pre and post monsoon. The study sites such as Inner side, Eastern side, Western side and Northern side remain found to be as moderately polluted status in average of both pre and post monsoon season, and Southern side was ranked as fairly clean and clean.

Conclusions:-

The study reveals that the high concentration particulate matter and other pollutants were observed higher level in pre monsoon season compare post monsoon season. The reason is due to the calm or light winds velocity during the pre monsoon season [Muneeswaran S et al 2012]. The concentration of PM10 and PM2.5 are found to be major air pollutants in all area except Southern side of dump yard in Namakkal. The gaseous pollutants like SO2, NOx and CO are considerably low. The particulate matters pose health risks either alone, or in combination with other pollutants. Hence, the high concentration of PM10 and PM2.5 are the most important concern of habitants who living surrounding of dumping site and there is an urgent need to regulate and monitor the ambient air quality in Namakkal, especially around the dumping sites.

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