Journal of Environmental Science and Engineering

(http://www.neeri.res.in) ISSN 0367-827 X

Volume 55 No. 1 January 2013

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J Environ. Science & Engg. Vol. 55, No. 1, p. 1-8, January 2013

Trip Time Comparison of Conventional and Exchange Container Mode for Solid Waste Collection A Case Study of Ilorin, Nigeria

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The use of hauled container system for municipal solid waste collection and transportation often results in socio-economic and environmental impacts which are linearly related to trip time. In this study, trip times for the conventional and exchange container mode of solid waste collection by the hauled container system were evaluated. A trip time model was developed for this evaluation through field studies. The model was applied on ten trips to collect solid waste bins and its transportation to disposal site in the city of Ilorin, Nigeria. The results of the model for both modes were compared and showed that at 5 % significance level, the trip time for the conventional mode was greater than the trip time for the exchange container mode. Also, the exchange container mode resulted in haul distance reduction by 3 to 15% and trip time reduction by 2.5 to 13 %. This reduction could help in improving logistics and also reduce the negative impacts associated with collection operation.

Key words: *Solid waste, hauled container, conventional mode, exchange container mode, trip time*

1. Introduction

The management of solid wastes within a community has being a challenge to municipal authorities, especially during the 21st century due to intensified industrial and economic activities[1]. The concept of municipal solid waste management is essentially to control the generation of solid wastes, store, collect and process or dispose of the resulting solid wastes in accordance with best principles. Within these interrelated activities, collection of solid waste is usually the most visible, expensive, labour intensive and important part of the management system[2,3]. Several studies have been done for improving Municipal Solid Waste Collection (MSWC) in different countries[4].

In developing countries with vehicle accessibility problem and large turnout of wastes, municipal authorities have resorted to the use of large containers for the storage of wastes prior to collection operation[5]. This type of system (hauled container system) begins with the placement of large moveable containers at designated service points along the shoulders of accessible roads. These large containers are prominent in areas like residential drop-off centres or collection points, markets and high density urban areas. The waste generator pre-collects the generated solid wastes and later drops them into the nearest container. Finally, it is the responsibility of the municipal authority to collect and dispose of the contents of the containers.

However, the use of the hauled container system presents several other challenges such as coping with limited funds available for solid waste collection. For example, total collection costs may require about 0.5% to 2.5% of per capita income (as Gross National Product) for developing countries [6]. Also with the global economic recession and rising pump price of diesel, developing countries are under additional economic

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Utilization of Rice-husk and Coconut Shell Carbons for Water Disinfection

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In the present study, experiments were conducted to investigate the feasibility of using carbon derived from rice husk and coconut shell for the decontamination of water containing *Escherichia coli (E. coli)*. The effects of silver impregnation on these agro-waste carbons were also investigated. All the carbons showed >99% removal of *E. coli*. Among the four carbons studied, rice husk based carbon (RHC) showed better removal than the other carbons investigated. However, silver impregnated carbons showed only marginal increase in the decontamination experiments. SEM and BET results reveal that the carbons were mesoporous in nature. FTIR shows the presence of functional groups viz. C=O and –OH that might be responsible for adsorption of *E. coli* on the carbon.

Key words: *Silver impregnated carbon, drinking water, de-contamination, E. coli, water purification*

Introduction

Safe drinking water is one of the mankind's most basic needs. Safe drinking water has to have chemical, microbial and physical characteristics complying with the latest World Health Organization (WHO) and national standards. Bacterial contamination of water is a public health concern because it causes numerous diseases. Organisms such as *Escherichia coli (E. coli)*, *Shigella* spp., *Salmonella* spp., *Vibrio* spp., and *Cryptosporidium* are known to be transmitted by water and cause ill health in communities consuming water contaminated by bacteria and other pathogens.

Hence, it is of utmost important to purify water before its use. There are several methods used for the decontamination of water, like chlorination, iodination, ozonation, UV-purification, reverse osmosis, using silver catalysts etc.[1-5]. Chemical purification, like adding chlorine or iodine or applying ozone to kill the bacteria has several disadvantages. For example, chlorination may lead to the formation of hypochlorous acid which can in turn react with natural organic matter, such as humic acid/fulvic acid to form disinfection by-products. These byproducts include trihalomethanes polychlorinated biphenyls and other halogenated hydrocarbons. Some of these halo-hydrocarbons are known as carcinogens and endocrine disruptors, and are difficult to remove from the water[6]. Other methods like UV-purification and reverse osmosis are not cost effective[7]. Ozonation may result in hazardous intermediate substances[5].

Adsorption using activated carbons find widespread use in removing pollutants from wastewater and water[8-14]. An effort has been made by Gupta et al. (2009)[15] to give a brief idea of an approach to wastewater treatment, particularly discussing low-cost alternative adsorbents. There is a lot of literature reported for the removal of dyes[16-18], pesticides[19], fluoride removal[20] and phenolics removal[21] using agricultural waste products and carbons derived from them. The reason is their outstanding adsorption properties and high specific surface area. Activated carbons remove contaminants via two main mechanism viz., adsorption, and catalytic reduction. The former

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J Environ. Science & Engg. Vol. 55, No. 1, p. 17-34, January 2013

Organic Speciation of Fine Aerosol to Assess Sources in Mumbai City

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Increasing ambient levels of fine particles due to anthropogenic activities are leading to adverse effects on human health and climate change. The present study on $PM_{2.5}$ carbonaceous characterization for different land use patterns attempts to improve spatial understanding of sources in Mumbai city. The average of $PM_{2.5}$ mass concentrations at Control (C), Kerb (K), Residential (R) and Industrial (I) site were 69±20, 84±31, 89±33, and 95±36.01 µg/m^3 respectively. The average OC contributions at C, K, R and I sites were 30, 34, 35 and 31%, respectively and EC contributions were 7, 11, 9 and 8%, respectively. Organic marker contains useful information of the sources especially of combustion origin. About 40 PAHs, 24 alkanes, 18 hopanes, 12 sterane, 2 methyl alkanes, 3 branched alkanes, 5 cycloalkanes and 1 alkene were identified and quantified from each category. The Carbon Preference Index for alkanes between C_{25} and C_{33} was greater than one and less than three, indicating anthropogenic sources like petroleum hydrocarbons. The H+S/EC ratio at C, K, R and I were 0.0022, 0.0011, 0.0083 and 0.0027 respectively, suggesting contribution from diesel exhaust emission. Levoglucosan at all the sites indicates presence of biomass burning as an important source to fine particles. In the present study, detailed chemical analysis of particulate matter samples provides data useful in pinpointing sources of pollution as also in predicting potential health effects.

Key words: *Fine aerosol, organic carbon, organic markers, sources, Mumbai*

Introduction

Fine particles are being emitted in the atmosphere globally from various sources. These sources are becoming more complex day by day as also composition of emissions. Many epidemiological studies have found an association with fine particle concentrations and increased human health effect [1-2]. The American Cancer Study, in particular, revealed that fine particles and sulfur oxides related pollution was associated with approximately 4, 6 and 8% increase of all cause, cardio pulmonary and lung cancer mortality, respectively, after controlling for individual lifestyle and socioeconomic status indicators [1]. With increasing concern about fine particulate pollution in India, Ministry of Environment and Forests, Govt. of India has introduced new National Ambient Air Quality Standards for $PM_{2.5}$ as 60 µg/m^3, also known as Central Pollution Control Board (CPCB) standards [3]. Ambient fine particles contain inorganic components like ions and elements as well as carbonaceous fraction which are made of hundreds of different individual organic structures [4]. Organic Carbon (OC) can be emitted from primary emission sources and generated from chemical reactions among primary gaseous organic carbon species in the atmosphere [5]. Primary organic carbons are emitted directly from combustion of fossil fuels, biomass burning, vegetative detritus and meat cooking. Secondary organic aerosols are formed from the oxidation products of volatile organic compound

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J Environ. Science & Engg. Vol. 55, No. 1, p. 35-41, January 2013

Site-wise Mercury Accumulation in Fish from Thane Creek and Ulhas River Estuary in the Vicinity of Mumbai: Influence of Environmental Factors

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The indigenous fishing folk inhabiting the villages along Thane creek and Ulhas river estuary in the vicinity of Mumbai, India rely on the local fish catch for their daily sustenance. But these water bodies are under considerable pollution stress due to the indiscriminate release of industrial effluents and domestic wastewater from their vicinity. A site-wise study on levels of mercury, a hazardous toxin, in commonly consumed fish among five villages along these water bodies was conducted. Stations located towards the riverine end of Ulhas river estuary, Wehele and Alimgarh, exhibited higher levels of fish Hg (0.2-1.6 µg/g) compared to the station at the seaward end, Diwe-Kewni (0.03-0.75 µg/g). Fish from stations, Vittawa and Airoli, located along Thane creek accumulated Hg relatively at moderate levels (0.15-0.96 µg/g). The influencing factors for bioaccumulation of mercury in fish were proximity to the sources of mercury, salinity, hardness, DO, BOD and pH of the water.

Key words: *Thane creek, Ulhas river, Mumbai, mercury, fish*

1. Introduction

The traditional fishing folk inhabiting the villages along Thane creek (73^{0}14' E, 19^{0}14'N to 72^0 54' E, 19^{0}17' N) and Ulhas river estuary (72^{0}55'E, 19^0 N to 73^{0}E, 19^{0}15'N), near Mumbai rely on the local fish catch for their daily sustenance. But these water bodies are under considerable pollution stress due to the indiscriminate release of industrial effluents and domestic wastewater from their vicinity. The analysis of water samples revealed very high pollution in these areas and the mercury levels in the waters along the selected villages are also high[1].

Pollution level at each site differs with volume, nature of effluents and sewage discharged in to them and is also influenced by the physico-chemical characteristics of water. Out of the five villages selected for the current study, two are located along the riverine end of Ulhas river estuary while one is located towards the seaward end. The remaining two sites are located along Thane creek. Hence variations in the physico-chemical parameters in these different sites may influence Hg accumulation in fish. A site-specific evaluation of Hg bioaccumulation in fish was therefore carried out in order to identify the sites with high fish Hg levels exceeding the safe limit of consumption and thus make the villagers aware about the probable health hazards due to mercury contamination.

2. Materials and methods

2.1. Sampling stations

Station 1 –Wehele : This station is located near Wehele village (19^{0}14'N and 73^{0}03' E) on the northern bank of Ulhas river estuary at a distance of 15 km downstream of Vadavli village where the estuarine zone of Ulhas river begins (Fig. 1). On the opposite bank of this site lies the heavily polluted,

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J Environ. Science & Engg. Vol. 55, No. 1, p. 42-50, January 2013

Distribution Pattern and Factors Affecting Heavy Metals in a Lake System

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Heavy metals are widespread pollutants of great environmental concern as they are non degradable, toxic and persistent with serious ecological ramifications on aquatic ecology. The objective of this study is to analyse the spatio-temporal variation of heavy metals in the sediments of a lake system (Akkulam-Veli lake, Kerala). Correlation analysis has been conducted to determine the factors that influence the accumulation of heavy metals. High cadmium content is observed during premonsoon (PRM) due to the reduction in salinity in the lake water and is absent during postmonsoon (POM) due to increase in salinity and dissolved oxygen. A hike in lead content can be observed during monsoon (MON). Heavy metal concentration is high during monsoon due to urban runoff. Heavy metals are accumulated in clay during PRM. During MON and POM, heavy metals found accumulated in silt fraction of sediment.

Key words: *Heavy metals, distribution pattern, correlation analysis, Akkulam-Veli Lake, Kerala*

Introduction

Heavy metals are significantly hazardous pollutants in aquatic environments, even at very low concentrations[1,2]. Information on the level of heavy metal pollution in the wetlands environment is important as they cause serious health hazards. These elements are magnified in the food chain and reach human beings causing deleterious effects[3]. Geochemical study of sediments helps to assess the ecotoxic potential of the lake sediment. There are a number of studies on the heavy metal distribution in lake sediments[4-9]. The objectives of the study are to analyse the spatio-temporal distribution of heavy metals in the lake system and to ascertain the factors that influence the distribution of heavy metals in the lake system. Correlation study is also conducted to find out the association of heavy metals with the other water and sediment characteristics.

Study area

The Akkulam-Veli lake (AV lake) is located at the north-western portion of Thiruvananthapuram along the SW coast of India (Fig.1). The AV lake has an area of about 0.76 km^2, and is situated between 8°31'14''and 8°31'52''north latitudes, and 76°53'12" and 76°54'6" east longitudes. It is a shore perpendicular linear lake with the seaward part abutting against the shoreline; and it is separated from the shore by a sandbar during non-rainy season. The lake is partially divided into two by the existence of a bund (Bypass) across its length. The western part towards the sea, forms the Veli lake and the eastern part starting from the bund, forms the Akkulam lake. The silting in the Akkulam lake affected the free flow of water from the lake to the Veli lake. For most part of the year, the AV lake remains separated from the sea by a sandbar. The streams that drain through the Akkulam-Veli lake

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