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Study of Anionic Surfactants Concentration (MBASs) in Street Dust around Srinagar City, Kashmir Valley, Jammu & Kashmir

S. A. Shameem[1*], Jawaid Anwar Lone[2], Naseer Ahmad[3] and Abdul Hai[4]

[1]P. G. Department of Environmental Sciences, S.P. College, Srinagar. Current, Division of Environmental Sciences, SKUAST-K, Shalimar Campus, 190025

[2-4]P. G. Department of Environmental Sciences, S.P. College, Srinagar, 19001

*Corresponding Author E-mail: sa78@rediffmail.com

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ABSTRACT

Estimation of anionic surfactants concentration as Methylene Blue Active Substances (MBASs) in street dust were studied at three locations i.e. Exhibition crossing, Rambagh Crossing/ Bridge and S.P.College campus in Srinagar city from July to December. The results revealed highest concentration of MBAS at Rambagh bridge 0.880µ mol/g in August and September (range 0.668-0.880 µmol/g) followed by Exhibition crossing 0.670µmol/g in August (range 0.441-0.670µ mol/g). However, S. P. College campus as control site recorded lowest concentration of MBAS (0.130-0.170 µ mol/g). The study concluded that high amount of anionic surfactants recorded at Rambagh site is expected due to motor vehicles and other anthropogenic sources such as combustion, road dust and cleaning related activities. The study recommends that surfactants arise from vehicular traffic can be reduced by proper management of vehicular traffic, construction of fly over at high traffic areas, burying the garbage /litter instead of burning particularly during autumn season when the leaf fall is at peak in Kashmir valley.

Key words: *Surfactants, MBAS, Srinagar, Street dust.*

INTRODUCTION

Atmospheric aerosols have become a serious issue in environmental studies since they are believed to influence climate change and atmospheric systems[1-2]. These aerosols may also influence the global climate through scattering and absorption of solar radiation and act as cloud condensation nuclei (CCN)[3]. One of the organic species that can be determined from the atmospheric aerosols is surfactant. Surfactants or surface active agents are amphipathic molecules with both hydrophilic and hydrophobic (generally hydrocarbon) moieties that partition preferentially at the interface between fluid phases with different degrees of polarity[4]. The composition of surfactants can be categorized as anionic, cationic and non-ionic based on the characteristics of its polar (head) group[5-6]. Surfactants in the environment can be originated from natural and anthropogenic sources such as degradation of humic substances, biomass burning, sea surface micro layer and soots from combustion activities[7-8].

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Early studies of surfactants showed that their presence in the atmosphere potentially influences the global climate through their ability to reduce surface tension which in turn affects the physical properties of cloud droplets and eventually leads to an enhancement of cloud albedo[9-11]. Furthermore, surfactants can also increase the solubility of materials in aerosol particles[12-13]. In term of health, surfactants may destabilize mucus in the membrane which may lead to asthma and allergy[14-15] and are also able to reduce the surface tension of tear film, resulting in irritation and dry eye[11].

As the existence of surfactants in atmospheric aerosols could affect the environment, climate and health, it is therefore imperative that all possible sources of surfactants are investigated. Motor vehicles were expected to be the principal source of aerosols in the urban atmosphere due to urbanization, rapid economic growth and a resulting growth in population which in effect has resulted in an increase in the volume of traffic in developing countries[16]. As surfactants are widely used in lubricant s and diesel fuel, the atmospheric surfactants might be derived from the use of motor vehicles[17]. However, there were also significant contributions expected from other pollution sources, such as industrial, biomass burning, road dust and construction, which may increase the level of atmospheric surfactants[18-20]. The present study was conducted in Srinagar city of Kashmir at three different locations viz., Exhibition crossing, Rambagh crossing and S.P. College. The study was conducted to assess and estimate anionic surfactants (MBAS) concentration in street dust in Srinagar city at these locations.

Study Area

The present study was conducted in Srinagar, the summer capital of Jammu & Kashmir state. It lies on the banks of the River Jhelum with geographical coordinates of $34^0$52"49'N-$75^0$01"26'E at an elevation of 1600m above sea level. Six study sites at three locations, Exhibition crossing, Rambagh bridge and S.P. College campus were selected in Srinagar city at a distance of about 1 km from each other to study the anionic surfactants such as MBAS concentration in street dust. The sites were designed as;

1. Site I and sub-site II, Exhibition crossing.
2. Site III and sub-site IV, Rambagh crossing/bridge.
3. Site V and sub-site VI, S.P.Collge campus.

MATERIAL AND METHODS

Surfactants Analysis

A petric dish methods was adopted and dishes were put 3m above ground level at different distances 5m onwards so as to avoid any interference. After 24 hrs, dishes were colleted and the samples were collected by slowly sweeping the substrates with a fine brush in a closed container. The dust samples were filtered with 0.63µm pore size filter. Then 10mg of the filtered sample was diluted to 20ml in volumetric flask with deionized water. The mixture was sonicated and filtered through a Whatman cellulose acetate filter (pore size 0.2 µm) under vacuum.

MBAS analysis

20ml of the sample solution was put into a 15ml glass vial (Vial A) with a screw cap and a Teflon liner. 0.5ml of alkaline buffer, 0.25ml methylene blue and 1.25ml of chloroform were added to vial A. The vial was then covered with the cap and shaken, using a vortex mixer for 2 minutes. After this sample was left for 3 minutes to allow the separation to occur. When two phases had separated, the chloroform was transferred, using a pasteur pipette, to vial B (a new vial), which contained 4.5ml of deionized water, 0.25ml of acidic methylene blue solution. Vial B was then shaken for 2 minutes using the vortex mixer and allow separating in 3 minutes. The chloroform layer was then transferred to a 10mm quartz cell and the light absorbance was measured using UV-Vis spectrophotometer at a wavelength of 650nm[21]. A calibration curve was established in the range of 0.05-2.00 µm for MBAS.

RESULTS AND DISCUSSION

Most surfactants are in anionic form are the majority of cleaning detergents used in Asian countries (Thailand, Malaysia, Taiwan, Korea and Japan) containing 18-35% of anionic surfactants[22]. In addition, anionic surfactants are also used widely in care products, textiles, paint, polymer, pesticide formulation, pharmaceuticals, mining and pulp and paper industries[23]. Anionic surfactants concentration as MBAS in street dust recorded in Srinagar city is depicted in **figure 1 to 3**. The results of the study revealed that concentration of anionic surfactants (MBAS) recorded at Exhibition crossing (site I & site II) was maximum in August (0.670 µmol/g) and September (0.665 µmol/g) respectively. Lowset concentration of MBAS at this site was recorded in December (0.411 µmol/g). Comparatively to the site I, the trend in concentration of MBAS at sub-site II was again high in August and September (0.390 µmol/g and 0.385 µmol/g) and lowest recorded in December (201 µmol/g). Surfactant concentration (MBAS) at site III showed high trend in August and September with similar value (0.880 µmol/g) and lowest in December (0.668 µmol/g). Moreover, these values were higher than obtained at site I and sub-site II. However, MBAS concentration recorded at sub-site IV were highest in August and September (0.820 and 0.815 µmol/g) and lowest in December (0.589 µmol/g). Comparing the over all results of anionic surfactants of site I to site IV with the control site V & VI, a marked difference (0.710 µmol/g) in MBAS concentration was observed at both sites. Surfactant concentration at site V & VI was recorded high in August and September (0.175 µmol/g, 0.170 µmol/g) and site VI (0.135 µmol/g, 0.132 µmol/g) and lowest in December at both sites (0.130, site V and 0.101 µmol/g, site VI). The overall results revealed highest concentration of MBAS at site III (Rambagh bridge 0.880 µ mol/g) in August and September (range 0.668-0.880 µmol/g) followed by site II (Exhibition crossing 0.670 µmol/g) in August (range 0.441-0.670 µ mol/g). However, S. P. College campus as control site recorded lowest concentration of MBAS (0.130-0.170 µ mol/g).

The high concentration of surfactants in the city centre Srinagar may well have occurred due to the background of the sampling sites as site III overall recorded maximum concentration in MBAS (0.880 µmol/g). Motor vehicles are expected to be the main contributor to the higher amount of surfactants recorded at this site. Additionally, anionic surfactants concentration such as MBAS recorded highest at site III (0.880 µmol/g) and site IV (0.760 µmol/g) might also be derived from various anthropogenic sources, such as food stalls, biomass burning, combustion, road dust and cleaning-related activities. Anionic surfactants (MBAS) in street dust came from the atmosphere which the surfactants adsorbed onto surface of soil or street as investigated in this study.

The present study revealed that major source of surfactants at site I to site IV were related to motor vehicles. A relevant study of assessment of MBAS concentration to this study in support have been reported by[10, 24]. Further high concentration of anionic surfactants was also due to the combustion process which might contribute to higher vehicles emission through gases and exhaust particulate matter, which resulted high amount of surfactants in Srinagar city particularly around a heavy traffic zone of site I to site IV. Jao *et al.*[17] and Sosnowski *et al.* [25], obtained similar results relevant to this study.

Moreover, high level of MBAS concentration at site I (0.670 µmol/g) and site III (0.880 µmol/g) was also contributed by unfinished burning by vehicles as the traffic load is quite high at site I to IV. Previous studies by Thomas *et al.*[26] and Venkataraman *et al.*[27]reported that diesel-exhaust particles or soot particles were the main causes of urban pollution. It is probable that the adsorption of anionic surfactant molecules essentially occurs

through dispersive interactions between the non-polar organic tail group of the adsorbing molecule and the hydrophobic part of the graphitized soot surface[28]. It is also expected that the dominance of surfactants in fine mode aerosols is largely derived from combustion processes, particularly from diesel vehicles[2,29,34], while coarse mode aerosol is commonly generated from dust, soil and other crustal material[7]. Biomass burning contribute to a high quantity of surfactants as a result of wind prevailing from the surrounding area or neighboring habitats[30-31]. Since high concentration of anionic surfactants (MBAS) at site III and IV has been due to surrounded human habitations which fuels biomass burning emissions in the atmosphere particularly during autumn season, (august and september), therefore, chances of health issues among the population living nearby will occur in future. Similar kind of study were surfactants in suspended particulate matter can affect human health have already been carried out by Cserhati *et al.*[14], Dye *et al.*[32] and Hohr *et al.*[33]. Problems like dry eye can possibly be caused by surfactants which may alter or reduce the surface tension of the tear film of the eye[11]. There are also reports on air particles which contaminated with surfactants can cause instability of mucus membrane in the respiratory system and thus lead to allergies and asthma[42]. Moshammer and Neuberger[34] proposed that surface active particles could be used as exposure index for short term decrease of lung function.

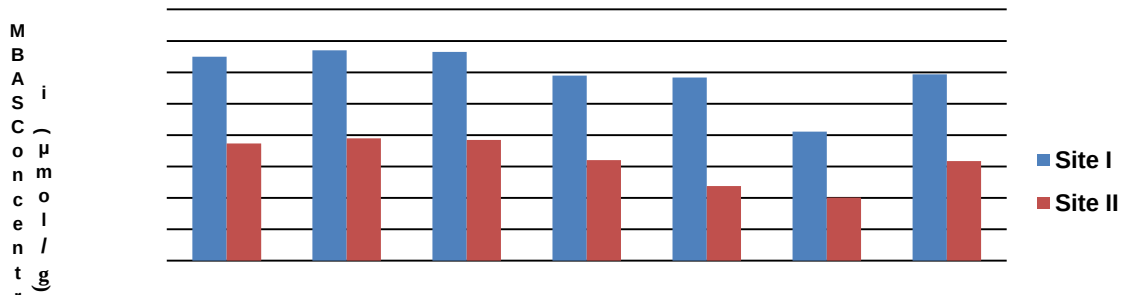

Fig. 1: Estimation of Surfactants (MBAS) in street dust recorded at Exhibition Crossing, Srinagar

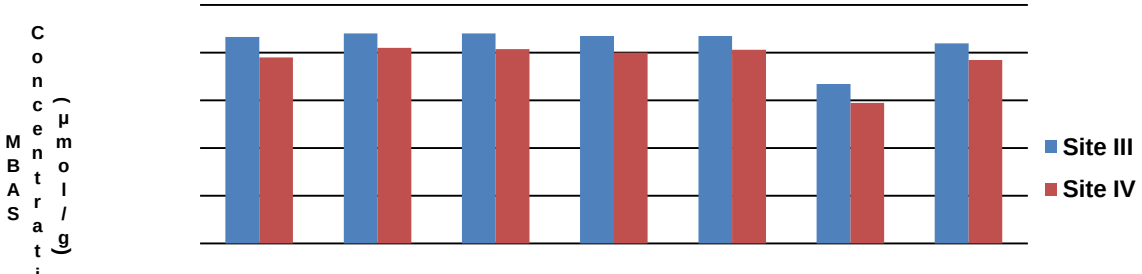

Fig. 2: Etimation of Surfactants (MBAS) in street dust recorded at Rambagh, Srinagar

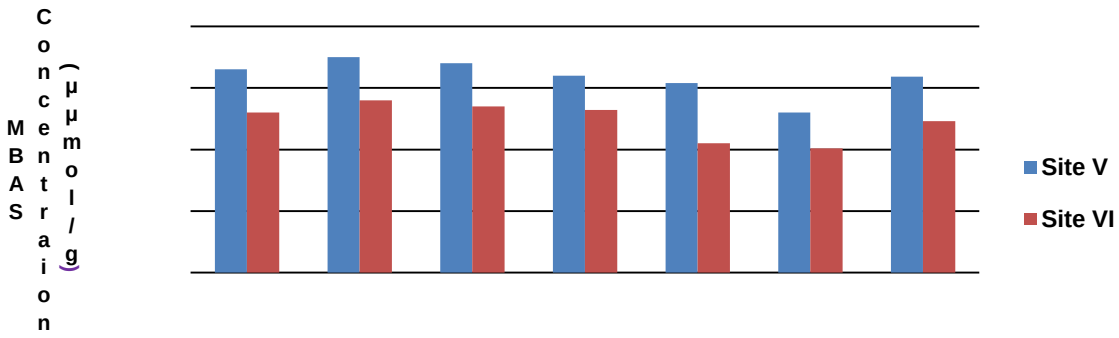

Fig. 3: Estimation of Surfactants (MBAS) in street dust recorded at S.P.College,Srinagar

CONCLUSION

Overall, the concentration of surfactants (MBAS) was high during the autumn season (august, september) due to soil/road dust, sea spray and biomass burning. This study suggests that anthropogenic sources such as motor vehicles contribute to the quantity of surfactants in the atmosphere. Moreover, due to the effects of surfactants, which can negatively influence human health; generate more clouds and thus have an impact on climate change, the chemistry of surfactants in atmospheric aerosols needs to be monitored regularly. The management and emissions of motor vehicles which can contribute to a high amount of surfactants in Srinagar city need to be reconsidered so as to develop a better urban environment in the future. Surfactants that come from human activities can be reduced for instance by burying the garbage instead of burning them and minimizing the use of mosquito coils, aerosol spray and detergent and also smoking activity. This is very crucial especially to human health as many studies have suggested that surfactants can promote various kinds of diseases. The study recommends that surfactants arise from vehicular traffic can be reduced by maintenance of roads, replacement of old vehicles, proper management of vehicular traffic, construction of fly over at high traffic areas, and burying the garbage /litter instead of burning particularly during autumn season when the leaf fall in Kashmir valley is at peak.

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