



Water Soluble Anions in Free Fall Dust in Sonapat NCR Region, Haryana, India

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Abstract

Three sets of free fall samples were collected at three sites in Sonapat NCR from March 2013 to April 2013. These samples were collected to monitor air in the Sonapat NCR. These samples were used for the analysis of anions, which are Fluoride, Chloride, Sulphate, phosphate, nitrate. A small quantity of the samples obtained was used to analyse anions present in air and the rest was used to analyse the concentration of heavy metals in air sample which are lead, copper, arsenic, zinc, chromium, iron, manganese etc. These anions which are water-soluble in nature are extracted by ultrasonic methods with water and all the anions were analysed using ion exchange chromatography. Of the analysed anions, fluoride, chloride and sulphates ions were high in concentration. Nitrates and phosphates ions were lower in concentration. Main motive was used to examine the temporal variations of the anions ions at the three sites. The results indicated that there was as such no major difference among the three sites. However, when we compare the average concentrations of chloride and sulphate ions, it could be easily concluded that traffic area near NH-1, Murthal had comparatively more influence than the other two sites.

Keywords: Aerosols, anions, free fall, Milli-Q, ion exchange chromatography (IC).

Introduction

Aerosols the ubiquitous component of atmosphere are suspension of particulate matter either solid or liquid droplet or both in gaseous medium. Aerosol, air and dust are considered synonyms and are frequently substituted for each other. The term aerosols strictly apply to both the gaseous and particulate phase in a system, but it is widely used to refer to the particulate phase alone¹. The physical attributes of airborne particulates include mass concentration and the size distribution¹⁰. Particle size distribution determines particles behaviour and the particle size and shape are clearly linked to the nature of their resources, history, process of their entrainment and transport and post formation process. The particles size is characterised by particle diameter. Particles below 100µm in size can stay in atmosphere for hours to a day, depending on wind condition. Highest residence time varying from hours to days is observed in 10µm sized particles. Particles below 10µm can be transported to several thousand kilometers in the atmosphere from the source region by wind². Biological contents of the aerosols include pollen grain, fungal, spores, mites, insects, plant fragments and animal biomass and such aerosols are called bio-aerosols. Chemically, aerosols are dominantly in homogeneous mixture of different chemical species. The elemental composition also strongly depends upon the particle formation and post formation process just as particle size. The fine particulates generally come from manmade activity such as vehicular exhaust, industries, biomass burning and are rich in toxic metals^{3,4}. Airborne particulate matter causes adverse effect on health

through the inhalation of particles below 10 µm in size which can be deposited in the tracheobronchial and alveolar regions of the lungs^{5,6}. It is now well established that the fine aerosols are carrier of pollens, bacteria, fungal spores and cause allergic disease^{7,8}. Dust is type of aerosols, related to, but distinct from smoke, mist, fumes and fogs. Free fall is a suspension of only solid particles in a solid gas phase, or deposits of such particles⁶. This includes particles greater than 20µm in size, which settle back to the surface quickly due to gravity sedimentation processes⁹.

Description of Study Area: Sonapat is a town and a municipal council and a district in the state of Haryana, (India). It is 20 kms north from Delhi and also known as an education city in the India. Sonapat is bounded by 28°47'15" to 29°17'10" north latitude and 76°27'40" to 77°12'44" east longitude and covers an area of 2261.53 sq.km. Sonapat comes under the National Capital Region (NCR).

In map i. is residential area in Sonapat, Sec-15, Sonapat, ii. is NH-1, Murthal, iii. is Kalpna chawla hostel.

The climate of Sonapat is intense hot in summers and cold in winters. Season from November to March is of winter; of summer prevails during May and June. Temperature in January reaches 7°C, while in May and June reaches 46°C. Monsoon between July to September month fetches about 75% of rainfall from south-west direction. Weather is mild during this period and annual average rainfall in the district is 502.2 mm. In April

and May humidity level goes below 20% and in monsoon period high humidity is experienced in the district. Likewise, winds are strong in the monsoon periods and light in winter and post-monsoon months. During the period from April to June, dust and thunder storm, frequently accompanied with squalls is experienced. In air, concentration of aerosols like TSPM and PM10 observed in Sonapat was above the standard limits. Aerosols concentration was found higher during winter seasons and thus people are more prone to respiratory diseases in winters.

Methodology

Sample collection: three aerosols samples of free fall were collected by using phenomenon of gravity settling. Free fall samples were collected from 3 sampling sites i.e. i. Residence area Sec 15 Sonapat, DCRUST, ii. Area near NH-1, Murthal iii. Kalpna chawla hostel using plastic trays filled with two layers of glass marble balls kept at a height of 15 meters above ground level. The purpose of using a bilayer of marble balls in trays was to trap the freely falling dust particles in between the marbles ball and the trays so that the dust particles cannot escape easily. Dried sample was removed from trays with the help of a scraper and the tray as well as marble balls were washed with milli-Q to remove the sticky particles. The solution

was evaporated at 70°C in order to get the sample in dried form and then scrapped dried and water dried were mixed and were stored in plastic vials for analysis. Ion exchange chromatography was used for the estimation of anions present in free fall samples. In this study Metrohm 882 Compact IC plus 1 with all its attachments was used. 3.2m Mol Sodium Carbonate +1mMol Sodium Bi Carbonate solutions were prepared for mobile phase and flow rate was kept at 0.700 mL/min at a pressure of 7.94 MP a. Weight exactly 2mg of free fall samples, transfer it to 50ml plastic bottles and then add 20 ml of milli-Q (in a proportion of 1:10). Mix thoroughly by shaking plastic vials for at least half an hour and then filter the solution through 0.2 m filter and sample was ready to be inserted in ion exchange chromatography.

Results and Discussion

After running sample through IC, we got following results.

From figure 2 and table 1, we can easily conclude that phosphate and chloride ion concentration is high as compared to the others anions. In residential area concentration of fluoride, chloride, nitrate, phosphate and sulphate is 13.898 PPM, 196.439 PPM, 94.685 PPM, 3.284 PPM and 414.420 PPM respectively.



Figure-1
Map of Sonapat Area

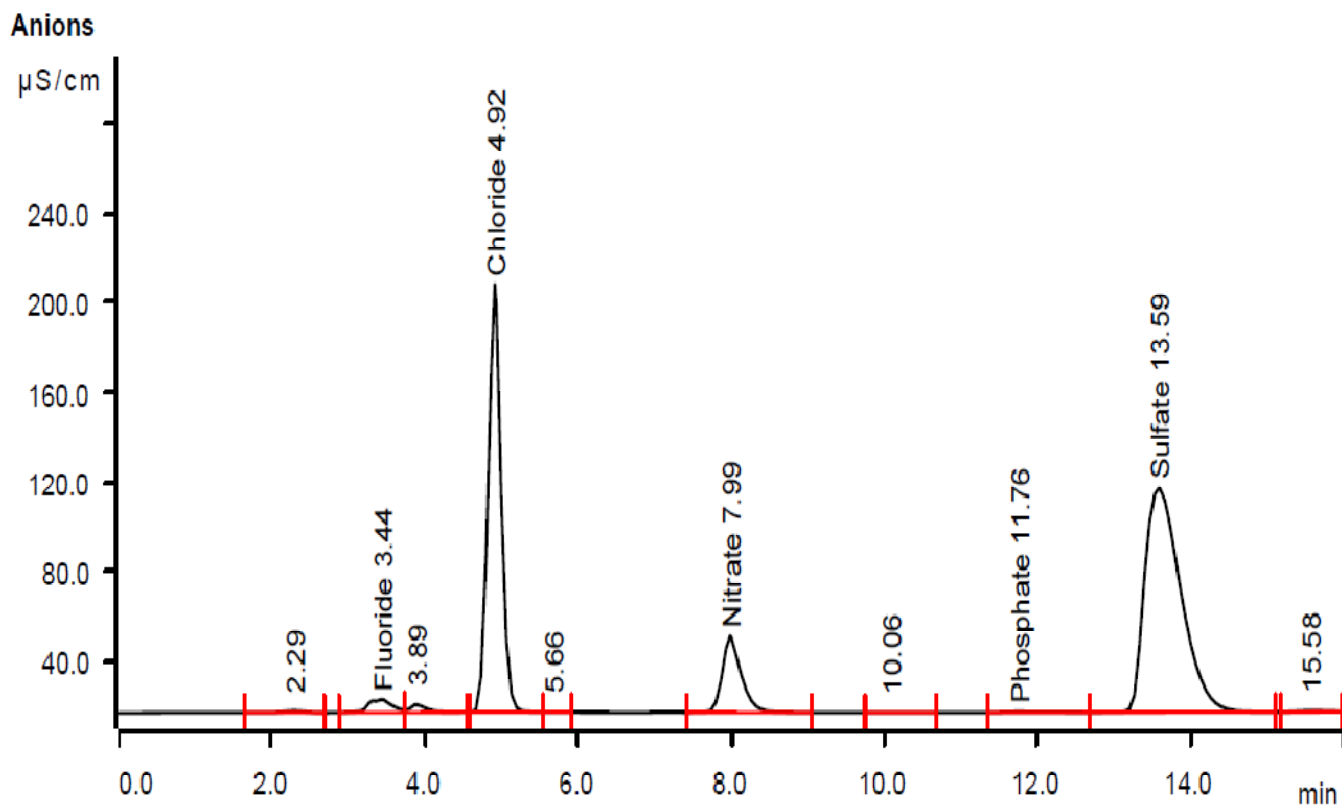


Figure-2
Anions concentration in sample 1 (residential area sec 15, Sonapat)

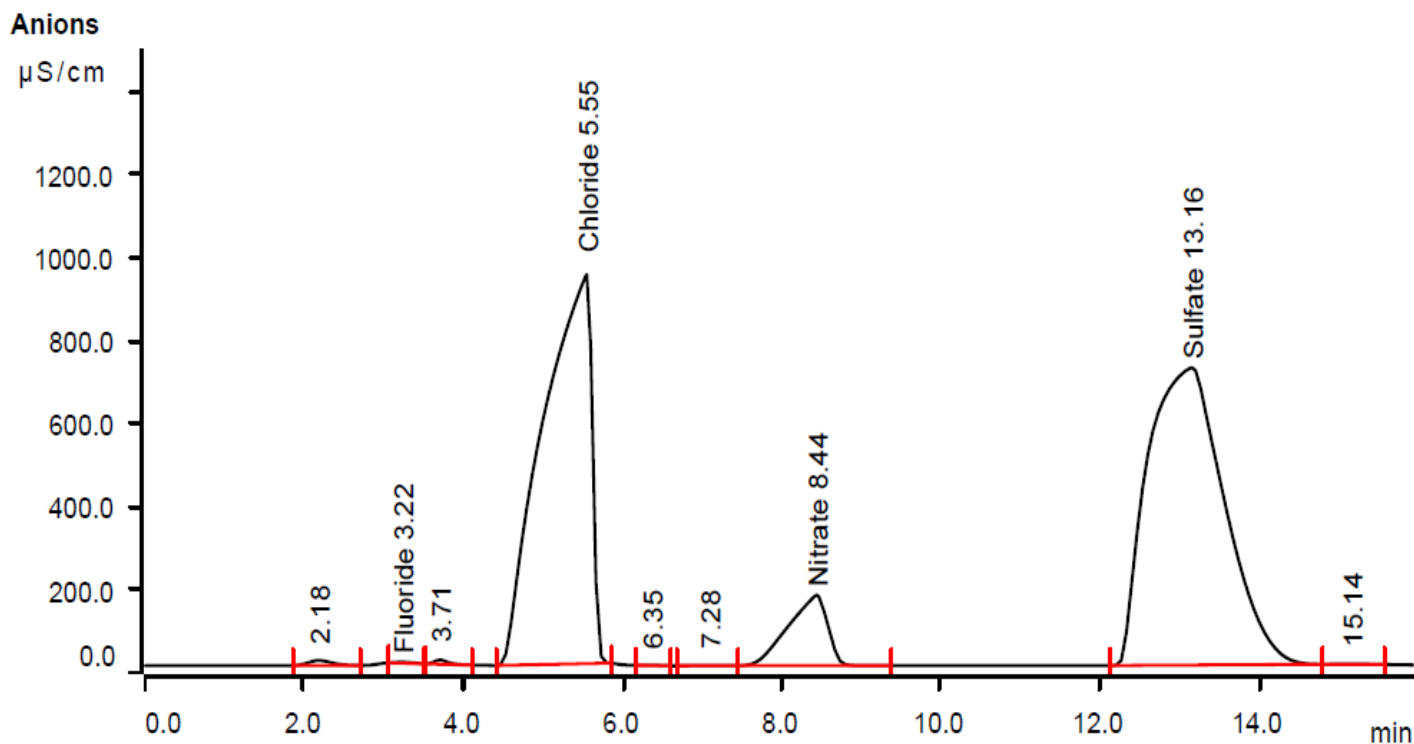


Figure-3
Anions concentration in sample 2 (NH-1, Murthal)

Clearly seen from figure 3 and table 2, NH-1 Murthal has 4.829 PPM, 3501.498 PPM, 948.580 PPM, 6070.284 PPM concentrations of fluoride, chloride, nitrate and sulphate respectively. As we see, the concentration of chloride, nitrate and sulphate is very high.

In figure 4 and table 3, we can see that the concentration of fluoride, chloride, nitrate, phosphate and sulphate is 10.668 PPM, 291.718 PPM, 340.490 PPM, 6.062 PPM and 608.247 PPM respectively. Concentration of sulphate, nitrate and chloride is comparatively high. Fluoride and phosphate are within limits.

Table-1
Anions concentration in sample 1 showing retention time (residential area sec 15, Sonapat)

Peak No	Retention time min	Area (µs/cm)* min	Height µs/cm	Concentration ppm	Component Name
1	3.438	1.9979	5.797	13.898	Fluoride
2	4.915	37.2285	191.363	196.439	Chloride
3	7.987	9.5454	34.049	94.685	Nitrate
4	11.760	.1170	.242	3.243	Phosphate
5	13.587	54.8671	100.144	414.420	sulphate

Table-2
Anions concentration in sample 2 shows retention time (NH-1, Murthal)

Peak No	Retention time min	Area (µs/cm)* min	Height µs/cm	Concentration ppm	Component Name
1	3.222	0.7491	2.966	4.829	Fluoride
2	5.552	663.2772	936.891	3501.498	Chloride
3	8.442	95.7442	169.882	948.580	Nitrate
4	13.155	802.4180	716.047	6070.284	sulphate

Table-3
Anions concentration in sample 3 showing retention time (Kalpna chawla hostel)

Peak No	Retention time min	Area (µs/cm)* min	Height µs/cm	Concentration ppm	Component Name
1	3.472	1.5532	9.489	10.668	Fluoride
2	4.953	55.2862	258.139	291.717	Chloride
3	8.158	34.3583	101.532	340.490	Nitrate
4	11.773	.1998	0.418	6.602	Phosphate
5	13.552	80.4849	136.300	608.247	sulphate

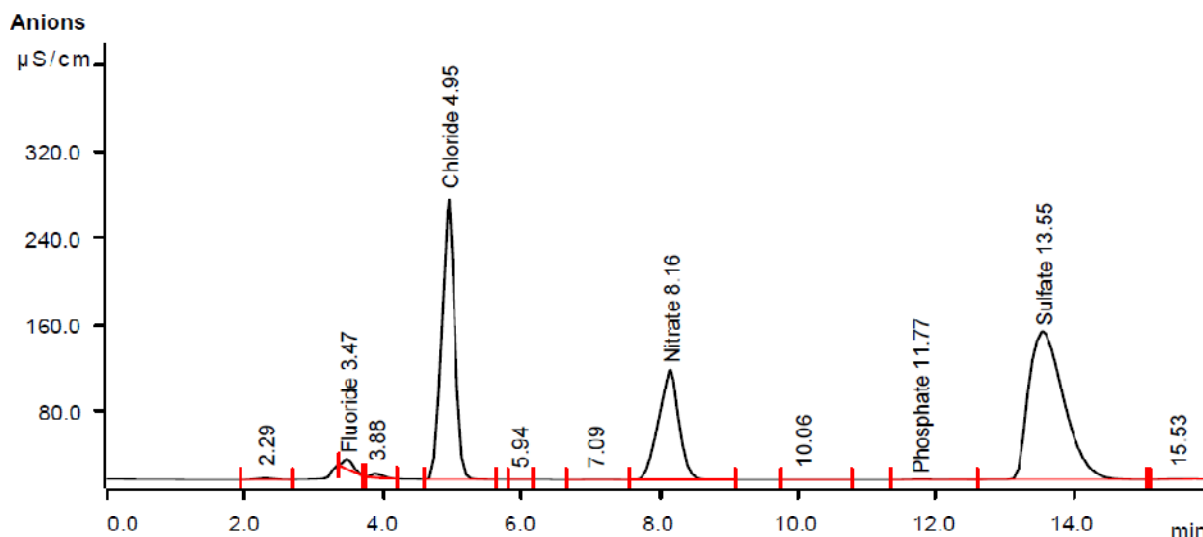


Figure-4
Anions concentration in sample 3 (Kalpna chawla hostel)

Conclusion

Air monitoring for Sonapat NCR was done so that levels of air pollution can be checked which put adverse effect on health of local people. Samples were collected over a period of one month from three sampling sites i.e. i. residential area ii. Kalpna chawla hostel iii. NH-1, Murthal. Concentrations of some ions are above limit as laid down by CPCB. Phosphate and chloride ion concentration is high as compared to the others anions in Residential area- Sec 15. The concentration of chloride, nitrate and sulphate is very high at NH-1 Murthal. In kalpna chawla hostel, Concentration of sulphate, nitrate and chloride is comparatively high. Fluoride and phosphate are within limits.

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