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SURVEY OF SURFACE WATER BODIES' POLLUTION DUE TO WASTEWATER DISCHARGE FROM UNORGANIZED AUTOMOBILE SERVICE STATIONS LOCATED IN THE RESIDENTIAL SECTOR OF RAJAJINAGAR, BENGALURU, KARNATAKA, INDIA

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ABSTRACT

An increase in vehicle number in and around Rajajinagar has contributed indirectly to water pollution problems occurred in this area. The present study is aimed to prove this hypothesis correct by estimating the pollution potential of wastewaters from Automobile Service Stations at Rajajinagar. Automobile service stations are rapidly increasing in Rajajinagar with the increase in mobile population due to industrialization and IT resulting in urbanization by which means and methods of transportation are necessarily expanding with a population. On an average 20 to 30 vehicles are washed daily at every car wash facility and each vehicle takes an average of 161.4 to 227.4 liters of water depending on the size of vehicle. Wastewaters from such facilities contribute significantly to effluents and sewage from this area that is let into water bodies of Bengaluru. Adding to that most of the automobile service stations are located in developed areas and are inefficient in the treatment of effluents since it requires a sufficient land area distinctly. Wastewaters samples from different service stations of Rajajinagar, Basaveswaranagar were collected to analyze physico-chemical parameters such as BOD, COD, Oil & Grease, pH, Alkalinity, Sulphates, Phosphates, Chlorides, Suspended solids, Settable solids and Heavy metals like Iron, Chromium, Zinc, Lead. The result of laboratory analysis showed those BOD 5 times, COD 7 times, Oil & Grease 107 times, iron 2 times and settable solids 2 times greater than BIS (Bureau of Indian Standards) values for tolerance limit for effluents respectively. Significantly present Oil & Grease, along with other contaminant deposits on

the surface of water bodies cause DO depletion, impairment in photosynthesis, fatal to aquatic life, toxicity to water resources, and human life. The study was conducted to address the effluent conditions prevalent at the service stations of Rajajinagar, Basaveswaranagar for Bruhat Bengaluru Mahanagara Palike (BBMP) and Karnataka State Pollution Control Board (KSPCB) to point out the present practices adopted and the potential impacts of these haphazard practices on water bodies and life depending on them.

KEYWORDS: Pollution, Surface water bodies, Automobile service stations, Bengaluru.

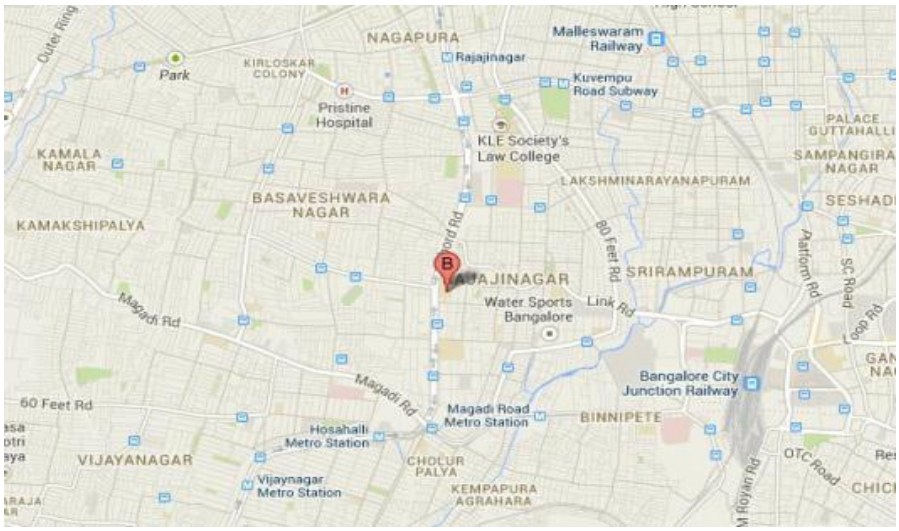
INTRODUCTION

Water as universal solvent has the ability to dissolve a large variety of chemical substances. It dissolves salts and other ionic compounds, as well as polar covalent compounds such as alcohols and organic acids because of which it is not totally pure. This is the primary cause of water pollution and freshwater crisis, which are the present global challenges. 1.8 billion people around the world don't have access to safe water and 2.4 billion lack access to adequate sanitation. In recent years, increasing industrialization, urbanization and development activities have resulted in water pollution and a crisis in Bengaluru. 90% of surface water bodies where sewage fed due to sustained flow of untreated sewage resulting in surface water pollution. Water quality analysis of these water bodies found that almost half of them were highly polluted because of industrial effluents, dumping of solid wastes and building debris. None of them had water that was fit for drinking, according to standards set by the Bureau of Indian Standards (BIS). Automobile service stations are an important component of services sector industry (Moorthi, et. al., 2008) because it is inevitable to keep increasing vehicles in good condition. Increase in number of Automobile Service Stations following haphazard practices and their wastewaters which is let into surface water bodies causing pollution. Wastewaters contain contaminants that contribute to oil and grease, heavy metals and physicochemical characteristics. The oil from these wastewaters cover the surface of water and cut off oxygen diffusion from air to water (Kadarwati & Herlina, 2008) and contribute to biological oxygen demand (BOD) and chemical oxygen demand (COD) in effluent water (Yasin, et. al., 2012). Worsening conditions of surface water bodies propelled us for the survey of pollution due to wastewater discharge from unorganized Automobile Service Stations at Rajajinagar, Bengaluru.

MATERIALS AND METHODS

The Study Area

The samples were collected from different automobile service stations of Rajajinagar with latitude ranging from - 13^0 00' 56.57"N to 12^0 59' 02.07"N and longitude from 77^0 31' 38.02" E to 77^0 39' 20.14" E 20.94" E one of the highly residential areas in Bangalore. The study area enclosed by Basaveshwaranagar, Mahalakshmi layout, Vijayanagar, Malleswaram and Rajajinagar industrial suburb.

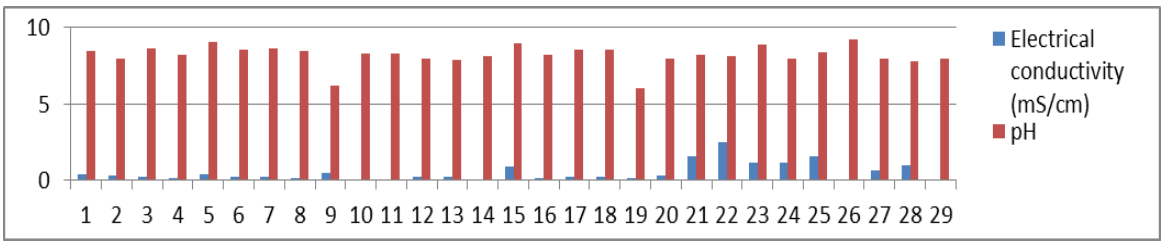


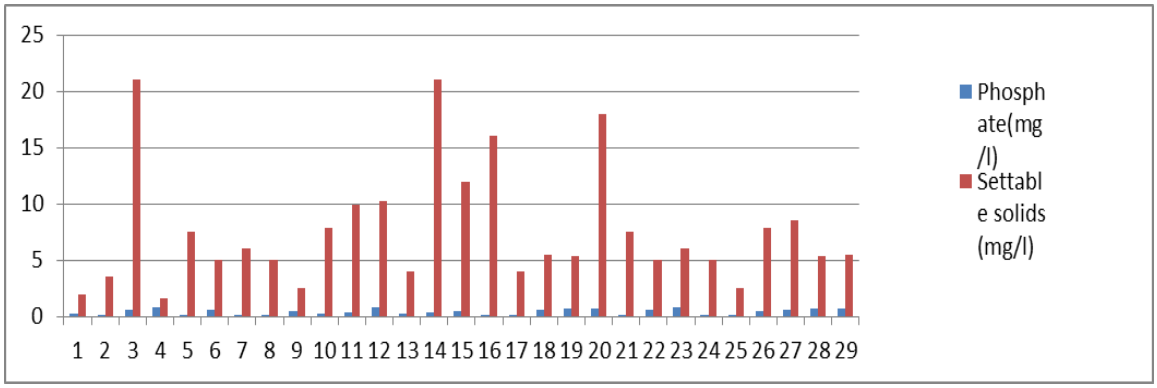
Collection of Water Samples

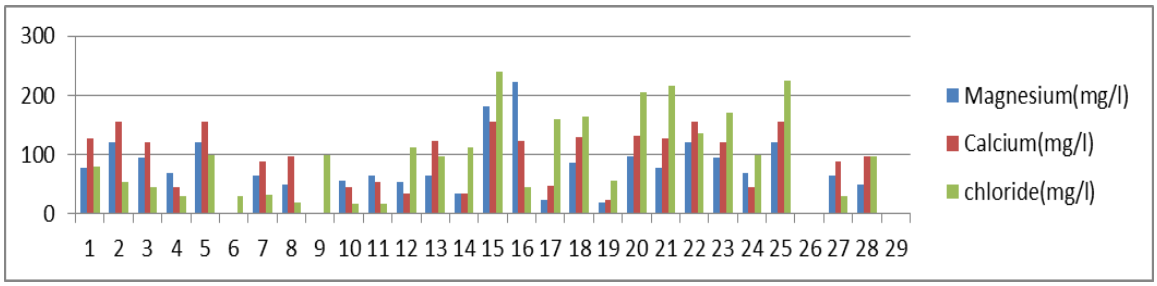
The water samples were collected in polyethylene bottles treated with hydrochloric acid directly after the wash of automobiles before contact with the ground from the point sources. The grab samples of service stations, water is collected at regular intervals for a period of 12 hours and mixed, then the composite samples were taken for examination. Temperature during sample collection and assessment was between 19^0C to 22^0C.

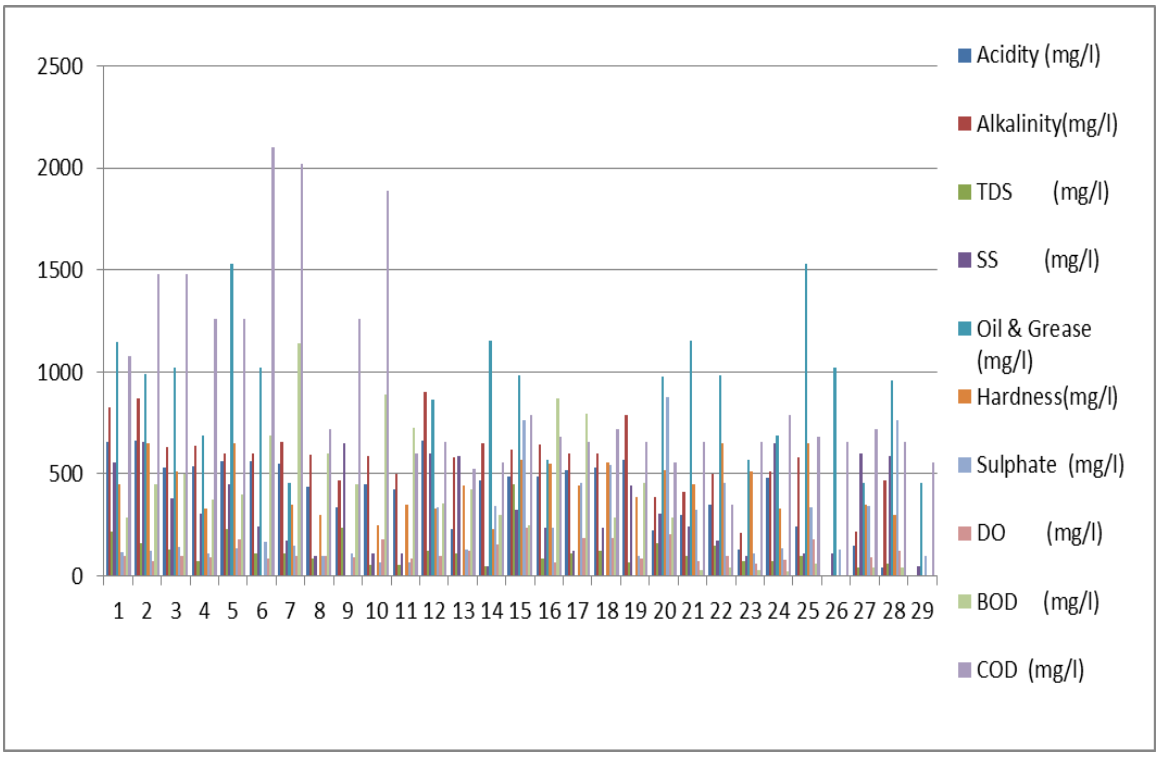
The samples were analysed for physico chemical parameters like pH, Electrical conductivity, TDS, Oil & Grease, Alkalinity, Acidity, DO, BOD, COD, Chloride, Sulphate and Phosphate Heavy metal analyses was conducted for chromium, iron, zinc and lead.

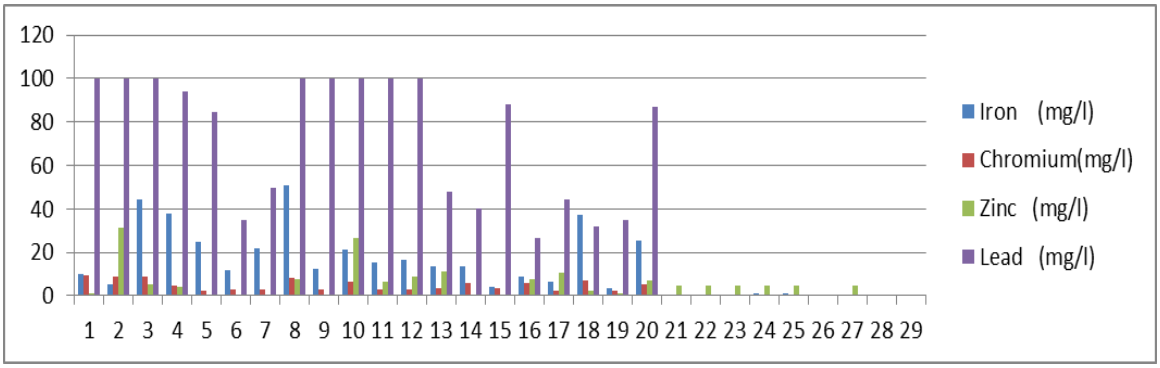
RESULT AND DISCUSSION




25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Phosphate(mg/l)
Settable solids (mg/l)


300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Magnesium(mg/l)
Calcium(mg/l)
chloride(mg/l)


2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Acidity (mg/l)
Alkalinity(mg/l)
TDS (mg/l)
SS (mg/l)
Oil & Grease (mg/l)
Hardness(mg/l)
Sulphate (mg/l)
DO (mg/l)
BOD (mg/l)
COD (mg/l)


120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Iron (mg/l)
Chromium(mg/l)
Zinc (mg/l)
Lead (mg/l)

Parameters	pH	E C (mS/cm)	PO_4^{3-} (mg/l)	Se S (mg/l)	Mg (mg/l)	Ca (mg/l)	Cl^- (mg/l)	DO (mg/l)	TDS (mg/l)	SO_4^{2-} (mg/l)
Standard	5.5 - 9.0	_	5	_	5	20	25	_	500	25
Minimum	6.02	0.1	0.084	1.6	18.9	22.9	16	60	42	25
Maximum	9.22	2.5	5	21	223.1	156.3	240	233	450	879.9
Average	8.19	0.56	0.4	7.61	83.99	99.23	99.33	119.29	122.4	268
S.deviatn.	0.68	0.59	0.24	5.29	51.74	54.84	71.43	56.25	86.93	226.53

Parameters	SS (mg/l)	BOD (mg/l)	HR (mg/l)	$[H^+]$ (mg/l)	$[OH^+]$ (mg/l)	O G (mg/l)	COD (mg/l)	Fe (mg/l)	Cr (mg/l)	Zn (mg/l)	Pb (mg/l)
Standard	600	350	200	_	200	20	250	3	2	15	1
Minimum	45	20	0	40	210	20	352	0	0	0	0
Maximum	655	1140	650	664	900	1530	2100	51	9.6	31.3	100
Average	318.9	399.33	352.88	428.81	579.59	915.52	920.06	13.39	3.46	5.62	44.74
S.deviatn.	211.7	311.21	212.99	197.78	216.54	493.51	473.14	14.41	3.06	7.27	42.22

Physico Chemical Characteristics

Colour is caused by metallic substances like iron and manganese compounds, humus, peat, tannins, algae, weeds, protozoa and industrial effluents. The colours of the samples from service stations were all oily black due to oil, grease, mudwaste, lubricants & cleansing agents which also contributed for disagreeable odour. The majority of aquatic creatures prefers a pH range of 6.5-9.0, though some can live in water with pH levels outside this range. As pH levels move away from this range (up or down) it can stress animal systems and reduce hatching and survival rates. Even minor pH changes can have long-term effects. A slight change in the pH of water can increase the solubility of phosphorus and other nutrients – making them more accessible for plant growth. 1.33% of the samples were above the standard permissible limit 9.00. Alkalinity is the quantitative capacity of aqueous media to react with hydrogen ions. Alkaline supplied from outside the body, like drinking alkaline water results in a net gain of alkalinity in our body and may cause gastro intestinal problems, metabolic alkalosis etc. The alkalinity of the samples was 189.7% higher than the acceptable limit which affect the fauna in water bodies. Electrical conductivity is the measure of the ionic activity of a solution based on the concentration of dissolved ions in terms of its capacity to transmit current which ranged from 0.1mS/cm to 2.5mS/cm. Total dissolved solids are the organic and inorganic substances in molecular form that survive through 6 micrometer filter but the samples shown less amount of TDS but contained suspended solids above the standard by 47%. Acids don't dissolve oil and the two forms separate layers when mixed, oil and grease of the samples were severely high, independent of acidity with an average of 916mg/l by the lubricants, oils present in automobiles. High amounts of phosphates are mainly due to the cleansing agents used in washing which indicates eutrophication. Addition of these wastewaters to surface water may lead to imbalance in the

nutrient and material cycling process due to overproduction (Ricklefs, 1993).[14] The result also showed high levels of sulphate and chloride indicating difficulty in cleaning clothes when let into water. Sulphate minerals can also cause scale buildup in water pipes and have laxative effect on humans and young livestock.[14] High levels of chloride also results in damaging plants and hence this water cannot be used for irrigation and also contribute to corrosion when chloride reacts with sodium and forms sodium chloride.[15] High levels calcium and magnesium indicated elevated level of total hardness of samples by 122% that forms scales and reduce the life of equipment, raise the costs of heating the water, lower the efficiency of electric water heaters and clog pipes totally making water unfit for any industrial use.[16] Dissolved oxygen is the oxygen that is dissolved by diffusion from the surrounding air, aeration of water that has tumbled over falls and rapids; as a waste product of photosynthesis[17] and the average oxygen dissolved in samples was found to be 119 mg/l. The elevated levels of BOD and COD than DO indicates the effect of discharged wastewater on the water bodies that demand for oxygen by biota and organic synthesis is more than the dissolved oxygen present inside the water.

Heavy Metal Analysis

Heavy metals were analyzed using Atomic Absorption Spectrophotometry and the result showed that many of the samples were highly toxic and the values were above the permissible limit. Toxicity of iron leads to heart related problems, chromium leads to kidney failure; zinc causes Ataxia to name a few. Lead being the most dangerous affects the nervous system, irrespective of age and dosage.[18]

CONCLUSION

From this study it shows that the service stations in the study area from which our samples were collected found to be highly contaminated and contributing pollutants to the water bodies especially surface water and their sediments in Bengaluru. From this it is clear that the food grains, which are cultivated and procured from here are also polluted to some extent because the water used for these water bodies like small tanks and lakes for agriculture in these catchment areas. Further study is needed to identify the concentration of heavy metals in the products of the farmland of this area.

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