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PHYSICOCHEMICAL AND BACTERIOLOGICAL CHARACTERIZATION OF WATER FROM WELLS AND BOREWELLS NEARBY LANDFILL AREA OF WASTE DUMPING SITE OF AHMEDNAGAR CITY

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ABSTRACT: The present study includes physical, chemical and bacteriological analysis of water in the Vicinity of landfill area of Burudgaon dumping site, 15 km away from the Ahmednagar city. Ahmednagar is the largest district (total area of city is 85.14 sq.km) of Maharashtra in terms of area and population. A total of 6 different samples of water were collected from the distances (400-1400 meters) in sterile plastic containers from wells in the nearby area of dumping site. Total area of dumping site is 2000 sq. meters while total waste produced is 76 metric ton. According to the results the pH of the water samples were found to be in the range of (9.2-9.9) which was not within the permissible limit of WHO guidelines. Highest TDS is noticed in test sample 4 (100meters north well water 48ft). Amount of TDS in sample 4 is 4644.0 mg/l which is too high TSS (2-6 mg/l). The pH of the all samples was within the permissible limit of WHO guidelines. TSS of the 5 samples was above the permissible limits and turbidity of only 4 samples was within permissible limits. In bacteriological analysis, except one sample collected from the tube well, most samples were coliform positive. Total 5 isolates were isolated from the water sample collected. On the other hand, 6 samples of drinking water from distribution system were fecal coliform positive and 4 samples were E. coli positive. However in water samples from all the sites, bacterial count exceeded the recommended permissible level of WHO. The isolates from the water samples were IS1-Klebsiella pneumonia, IS2-Escherichia coli, IS3-Moraxella spp., IS4-Aeromonas veronaii and

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IS5Achormobacter dentrificans. Introduction of sewage into the drinking and bore well water was the main reason for the bacterial contamination. The boiling of water is therefore advisable before consumption. The physicochemical and bacterial characters of the sewage water were unworthy. The sewage water recycling was necessary to minimize the water borne diseases.

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1.INTRODUCTION

One of the most important environmental problems faced by the world is management of wastes. Industrial processes create a variety of wastewater pollutants; which are difficult and costly to treat. Apathy toward solid waste management is one of the prime concerns of ever increasing pollution and adverse effect on the human health. A total of 217 million out of 844 million people of India live in urban areas. This accounts for 25.72% of Indian population (1991 census). Rural India lacks proper water supply infrastructure and people do not have access to safe drinking water. The urban areas, on the other hand, are faced with the problem of inadequate supply and low quality of these services. India has about 20 percent of the world's population but only about 4 percent of the world's fresh water resources. The per capita water availability in the country is expected to drop to 1500 cubic meters in 2005 from 2384 cubic meters in 2000, which is lower than 1700 cubic meters - the benchmark for water scarce regions. Water contamination is so severe that about 70 percent of all diseases in India are water borne and about 73 million workdays are lost each year due to them (Sharma, 1998 and 2002). Presently, 6.2 billion liters of untreated industrial wastewater is generated every day that causes pollution and reduces available freshwater reserves. Thermal power and steel plants are the highest generators of industrial wastewater followed by textile and food processing industry (Sethi, 2012). People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching

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of soils, mining processing etc. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. It is necessary to know details about different physico-chemical parameters such as color, temperature, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD, alkalinity used for testing of water quality. Heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals (Patil. et al., 2012). Bacteria are among the most common microbial pathogens found in wastewater (Rosin, 2000). The practice of unintentional indirect reuse in developing countries is largely responsible for the approximately 4 billion cases of diarrhea daily that cause 2.2 million deaths a year, mainly in children under five years of age. The most known examples are salmonellosis caused by some Salmonella spp. Dysentery-like infections have also been found to be caused by some strains of enteropathogenic E.coli which can be currently classified into five major categories: enteroaggregative E.coli (EAEC), enteroinvasive E.coli (EIEC), enterohemorrhagic E.coli (EHEC), enteropathogenic E.coli (EPEC), and enterotoxigenic E.coli (ETEC) (Nataro and Kaper, 1998). There are several ways in which an individual can acquire disease from wastewater use: direct ingestion of the wastewater or aerosols created during spray irrigation may result in infection. In addition, infection may occur from ingestion of pathogens on contaminated vegetation, oysters or other surfaces. Another potential route of exposure is from the ingestion of ground water that has been contaminated by pathogens in irrigation

Water (Yates, 1997).

2. MATERIALS AND METHODS

Collection of Samples

Wastewater samples were collected, in plastic containers previously cleaned, from six different regions nearby waste dumping sites of Ahmednagar. During sampling, sample bottles were labeled as S1-S6 and transported to the laboratory. All the Physico-chemicals were carried out by following the standard protocols (APHA-1989). Bacteriological analysis was immediately carried out. Samples were stored in the refrigerator at about 4°C prior for further analysis. It is important to

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minimize the time between sampling and laboratory analysis to ensure sample integrity: 24 hours (h).

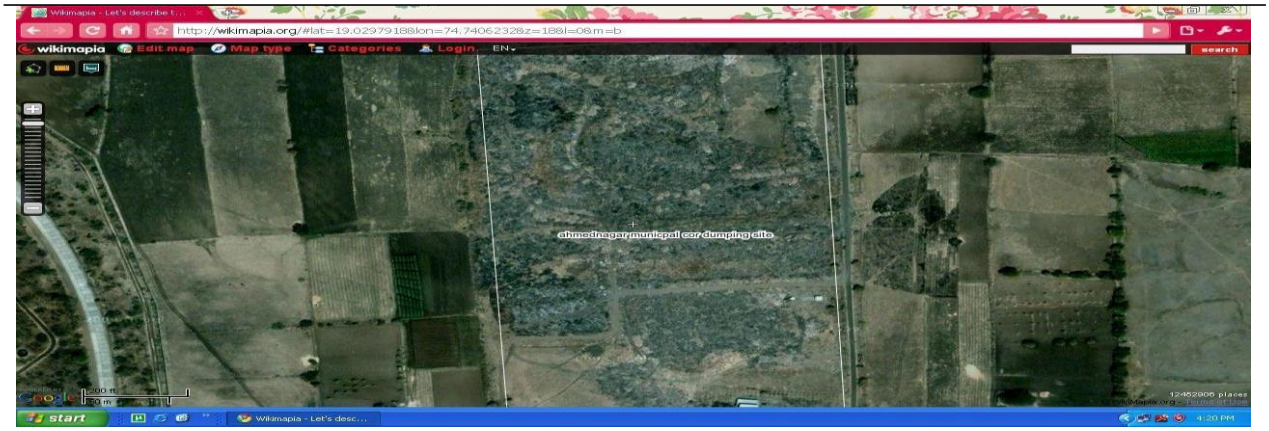

Fig. 1. Image showing the site of sampling from Ahmednagar Area Source: Google Maps

Determination of physico-chemicals

pH,Hardness,Turbidity,TDS,Alkalinity , Chloride, Calcium, Magnesium, Sulphates, Phosphates, Potassium, Biological oxygen demand (BOD) and Chemical oxygen demand (COD) (APHA- 1989).

Microbiological analysis

The wastewater samples were subjected to isolation using conventional spread plate technique on Nutrient Agar plates, Yeast Extract (3g), Peptone (10g), NaCl (5g)Agar (20g), pH (7+-2). After isolation bacteria were sub-cultured on Nutrient Agar slants for further use. All the six isolates were identified on the basis of standard cultural, morphological, biochemical and sugar fermentation tests according to Bergey's Manual of Determinative Bacteriology Table 2. (Ninth Edition).

Table 1. Physico-chemical and Biological Characterization of Samples (S1-S6).

Test	Unit	S1	S2	S3	S4	S5	S6
pH		9.4	9.3	9.9	9.8	9.3	9.2
E.C	Mmhos/cm	1.58	1.82	3.69	5.16	1.80	1.6
Calcium	Mg/l	9.40	3.40	4.60	12.40	22.40	5.70
Magnesium	Mg/l	6.40	4.20	3.80	4.60	24.12	5.15
Chlorides	Mg/l	8.13	4.80	9.20	13.20	11.36	9.20
Sulphates	Mg/l	11.10	0.92	3.81	19.20	9.19	1.92
Phosphates	Mg/l	0.19	0.23	0.18	0.16	0.21	0.20
Nitrates	Mg/l	11.23	9.21	27.81	21.19	13.3	7.21

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Total Hardness	Mg/l	940	450	460	1870	590	1340
Turbidity	NTU	0.40	0.93	0.84	2.12	3.80	0.09
TDS	Mg/l	2445	691	638	4644	1032	2940
Alkalinity		250	310	300	380	480	370
Potassium	Mg/l	0.10	0.11	0.09	0.18	0.13	0.09
COD	Mg/l	98	96	102	105	94	109
BOD	Mg/l	25	24	32	33	35	23
MPN	All test samples showed bacterial counts above 16						

3. RESULTS AND DISCUSSION

The study of physico-chemical and bacteriological analysis of the six well and bore well water were done. All the test samples pH range is from 9.2 to 9.7, which was not desirable for drinking purpose. All test water samples result is alkaline in nature (Fig. 2). The third test sample, which is nearest from the dumping site and depth of well is 54ft, showed highest pH value that is 9.9 which is more alkaline which also exceeds maximum permissible limit of and Ministry of Work and Housing. According to W.H.O (world health organization) and Ministry of work and Housing (1975), highest desirable range of pH is from 7.0 to 8.5. The salt content in water is estimated by electrical conductance. Amount of total soluble salts presents in water is generally express in terms of electrical conductivity. As per work done by (Kirlna Jagloo, 2002) typical range of conductance range from 2,000-4,000mhos/cm. Sample four contains highest that is 5.16mmhos/cm. Presence of calcium in water imparts hardness to water. Nearest site which is 500meters in north-west direction and depth of bore well this was 250ft. The presence of calcium is below the highest desirable limits. Sample 5 shows high level of calcium content (Fig. 3.). Minimum level of calcium is present in second and third sample. Magnesium along with calcium imparts hardness to water. Magnesium desirable limits are 30 and all the test samples results are below 30. So the presence of magnesium ions is within desirable limit. (Fig. 4). Maximum level of magnesium is noted in sample fifth, which is 24.12 mg/l. The nearest sample (well water) which was 100meters away from landfill site contains comparatively high level of chlorides that is 13.20 mg/l. (Fig. 5). The maximum desirable limit for chlorides is 200 mg/l. Chloride content is below desirable limits into the test water sample. The chlorides content within desirable limit. Maximum level of chloride content is found in fourth sample that is 13.2 mg/l (Fig. 7). Sulphates are widely distributed in nature and natural

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water. Nearest site (100meters in north direction, well water sample) contains more amount of sulphates highest desirable limit as per WHO is 200mg/l. Presence of sulphates in test sample is within desirable limits. Maximum amount of sulphates is noticed in fourth sample (Fig. 9). Phosphates are widely distributed in nature. Amount of phosphorus is more in second sample, compared to all other samples. More amount of phosphate leads to algal growth. Nitrate range from 7 to 28 mg/l. Maximum desirable range of nitrate as per W.H.O is 45 mg/l. All the samples are within the desirable limit (Fig. 15).. Sample 3 contains more amounts of nitrates (Fig. 6). Presence of calcium and magnesium ions in water is total hardness of water. Maximum permissible limit for total hardness is 500mg/l and desirable limit is 100 mg/l. Hardness of water is maximum in nearest source that is 500 meters away from landfill site (Fig. 11). According to world health origination (WHO), turbidity should be 5.0 N.T.U. Sample four contains highest turbidity in all samples. It is minimum in sample number 1. All the samples reading are within the desirable limit. Maximum TDS is noticed in test sample 4 (100meters north well water 48ft). Amount of TDS in sample 4 is 4644.0 mg/l which is too high. Maximum permissible limit is 1500mg/l and desirable limit is 500mg/l. The excess presence of TDS was noted in few samples. The sample which is nearest contains high level of TDS Bore well sample also contains high level of TDS (Fig. 10). Organic matter was indicated by comparatively high BOD level. BOD range was too high, showing wide presence of organic matter, which is not potable. COD is indirectly used to measure the amount of organic compounds in water. COD is a measure of total quantity of oxygen required to oxidize all organic material in CO2 and water(Kirlna Jagloo,2002). The COD value was maximum for sample S6 (Fig. 14). COD values are always greater than BOD values of typical range varies from 100-51,000 and BOD was maximum for sample S4 (Kirlna Jagloo,2002). Various bacterial species were isolated from the water samples collected. The isolates from the water samples were IS1-Klebsiella pneumonia, IS2-Escherichia coli, IS3-Moraxella spp., IS4-Aeromonas veronaii and IS5Achormobacterdentrifican(Table2).

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Table 2: Identification of Bacteria isolated from soil by using Standard Morphological, Biochemical and Sugar Fermentation test

5	4	3	2	1	SN
IS5	**IS4**	**IS3**	**IS2**	**IS1**	**Isolates code**
Creamish	Yellowish	Shiny Whitish	Whitish	Yellowish	**Color**
Circular	Circular	Coccobacili	Circular	Circular	**Shape**
Flat	Flat	Flat	Flat	Flat	**Elevation**
Opaque	Opaque	Opaque	Opaque	Opaque	**opacity**
Irregular	Irregular	Entire	Entire	Entire	**Margin**
Negative rod	Positive rod	Negative rods	Negative rod	Negative rod	**Gm Staining**
+	+	+	+	+	**Catalase**
+	+	+	+	-	**Oxidase**
+	+	+	+	-	**Nitrate**
+	+	-	+	+	**Urease**
A	A	-	A	A	**Glucose**
-	+	-	-	-	**Starch**
-	+	-	-	+	**Gelatin**
-	-	-	A	A	**Lactose**
-	-	-	A	-	**Mannitol**
-	-	-	A	A	**Fructose**
-	-	-	A	+	**Sucrose**
-	-	-	+	+	**Indole**
-	-	-	+	-	**MR**
+	+	-	-	-	**VP**
+	+	-	-	+	**Citrate**
Achromobacter denitrificans	*Aeromonas veronaii*	*Moraxella* species	*Escherichia coli*	*Klebsiella pneumoniae*	**Probable Identified sp.**

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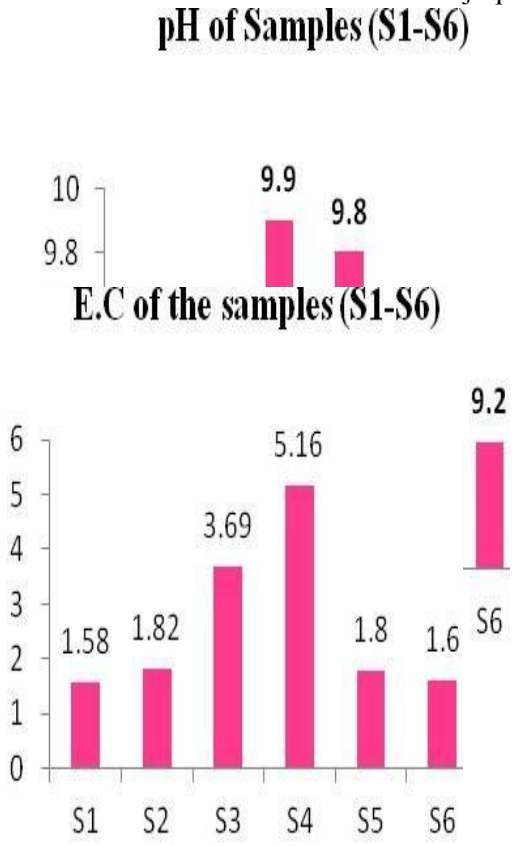
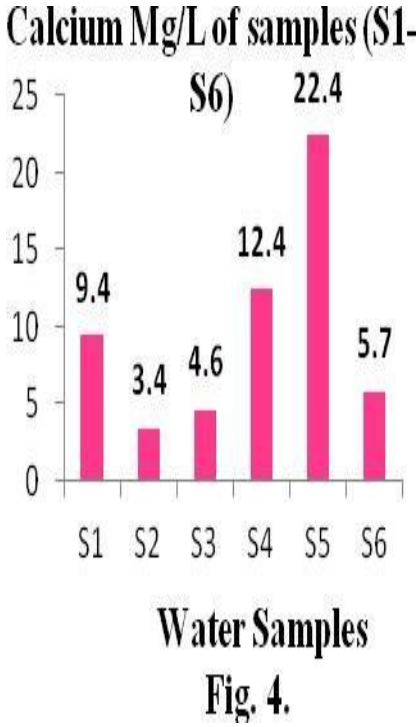


Fig. 3.



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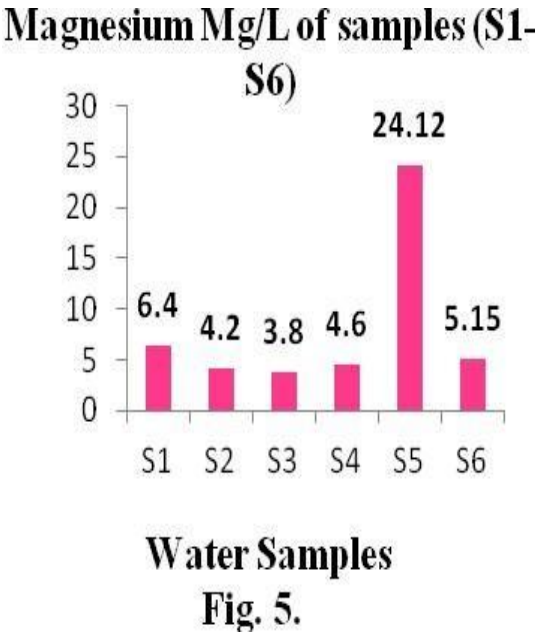

Fig. 5.

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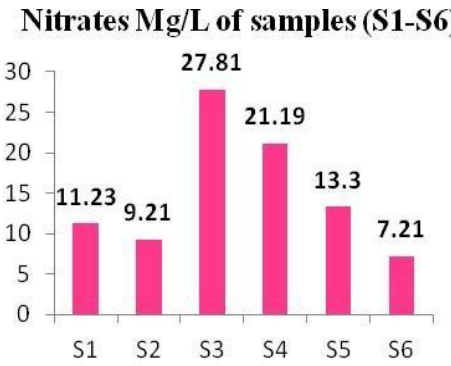

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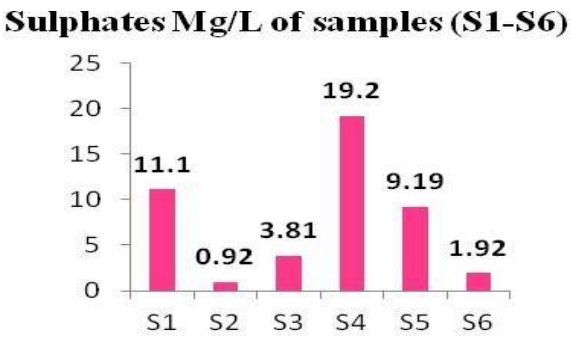

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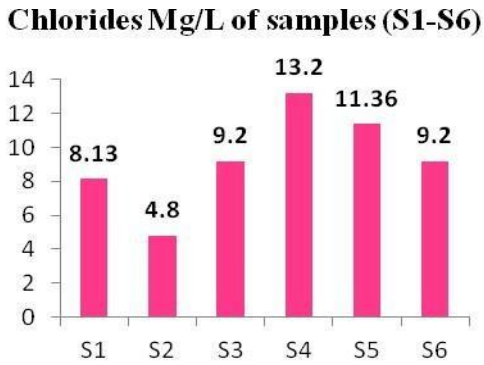

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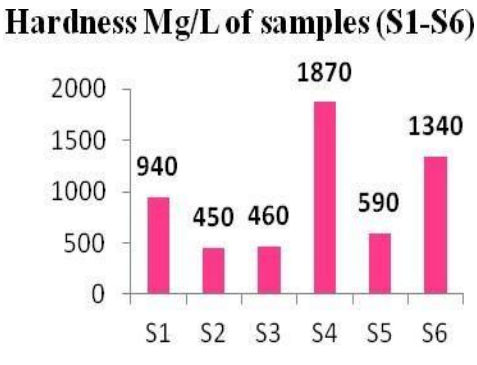

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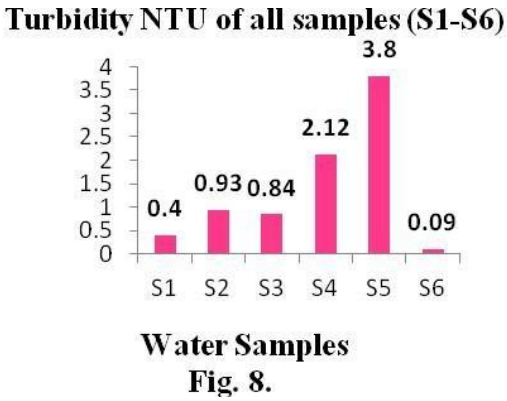

Fig. 8.

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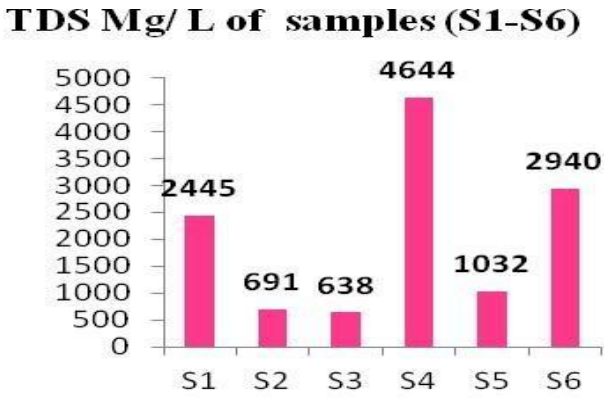
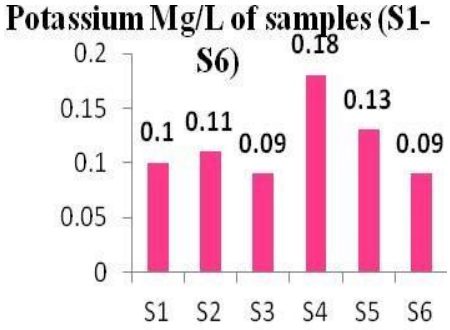
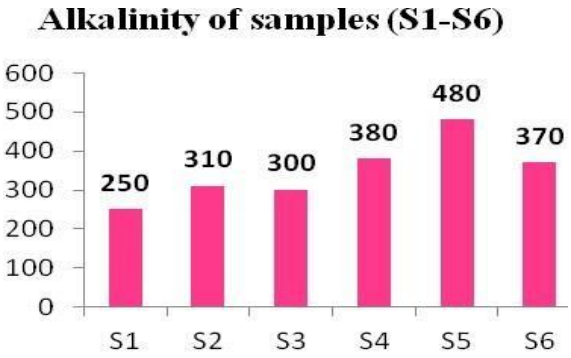


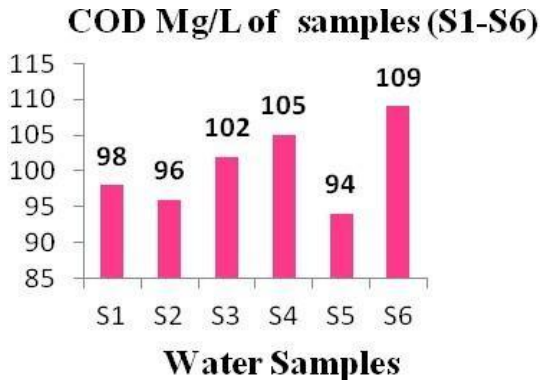
Water Samples
Fig. 10.

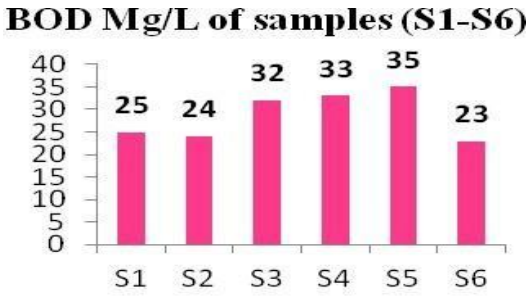


Water Samples.
Fig. 13.

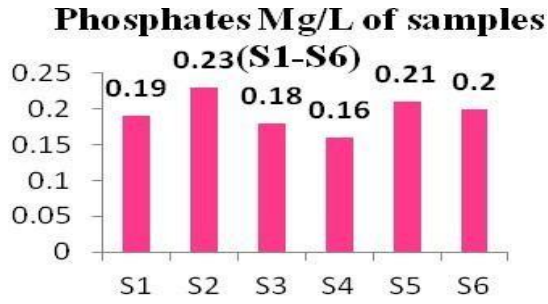


Water Samples
Fig. 12.





Water Samples
Fig. 14.



Water Sample
Fig. 15.

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Isolation and Identification of the isolates

Among the five sediment samples total eight strains were isolated using the Nutrient Agar Media. The isolates were identified on the basis of standard cultural, morphological and biochemical characteristics according to Bergye's Manual of Determinative Bacteriology as IS1-Klebsiella pneumonia, IS2-*Escherichia coli*, IS3-*Moraxella spp*., IS4-*Aeromonas veronaii* and IS5*Achormobacter dentrificans*.

4. CONCLUSION

Continuously increasing urbanization and pollution in the Ahmednagar district has decreased the quality of drinking and recreational water of the region. This necessitates that government should take initiatives and encourage large industries to set up their own treatment plants to reduce the wastewater by reusing the treated water for industrial purposes. The processes of wastewater treatments need to be explored to increase the efficiency. According to W.H.O (world health organization) and Ministry of work and Housing (1975), highest desirable range of pH is from 7.0 to 8.5. Chemical and Physical tests of water quality are inter-related and must be considered together e. g. higher water reduces solubility of dissolved oxygen. All the test samples from landfill site were exceeds the maximum limit of the W.H. O. for physical and chemical parameters. Results of samples show that water from landfill site periphery is highly polluted due to leachates. All the samples exceed desirable as well as permissible limit. Due to presence of large amount of Total Dissolved Solids (TDS), it generates undesirable taste to water. Water with high TDS is unpalatable and unhealthy. If conductivity of water increases suddenly, it indicates the source of dissolved ions. Presence of high amount of nitrates and phosphates has increased the eutrophication. Excessive bacteria also indicate, low level of D.O. rise in temperature, can also provide conditions for the growth of disease causing organisms.

5.ACKNOWLEDGEMENT

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