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Characterization of Wastewater in Rajouri Town, Jammu And Kashmir, India

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ABSTRACT
Water exaggerated physically, chemically as well as biologically is known as wastewater. Thrown away process of solid waste and its treatment has been the foremost environmental setback for most of the cities in India especially in rural area. To make people aware about the level of contaminants in wastewater and to suggest the ways of treatment of wastewater which will result in disposing off of domestic effluents without any danger to human health, a study on characteristics of wastewater in Rajouri town in Jammu and Kashmir was conducted. Concentrations of various physicochemical parameters like Total dissolved solids (TDS), pH, Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Alkalinity, Hardness Chloride Content, Nitrogen, Ammonium, Phosphorous, Iron and E-coli bacteria were determined. Study was done on five different sampling locations. All the parameters were found to be generally exceeding the limits set by W.H.O except for few sampling locations. The sampling site which was found to be the most polluted was Muradpur (SL 5) thus affecting the population there because of being on the downstream side and the least affected site was Kheora (SL2). In some sampling stations due to presence of vegetation at the disposal sites, the quality of sewage to some extent are acceptable may be because the vegetation absorb some of its undesirable constituents. To treat this wastewater and make it suitable for various purposes like irrigation, vegetation and other domestic purposes a treatment plant which will benefit population of 37,552 souls. Construction of wetlands will also lead to effective treatment and management of wastewater**.**
Keywords: Analysis, Environment, Parameters, Rajouri Treatment, Wastewater.

I. Introduction

Water is one of the most significant natural resource for survival on earth, almost all the works to be done depend on water. Water has severally been exaggerated physically, chemically as well as biologically known as wastewater. Wastewater generally signifies the liquid waste. It is released from familial areas like discharge from toilets, urinals, stables [1]. The manufacture of waste from human doings is unavoidable. A momentous fraction of this waste will end up as wastewater. The other sources of domestic wastewater includes outflow from gutter, gangrenous tank emancipation, grey water (water used for washing of clothes, cooking, floors etc) and rainwater assembled from roof top or balconies [2]Wastewater is also discharged from marketable chattels, factories [1]. Wastewater from industries and marketable chattels normally consists of heavy metals, huge amount of organic matter, nitrate, detergents, inorganic salt, oil etc[3].

Wastewater discharged from groundwater is in the form of leachate beginning from close by depositing place and due to careless handling of landfill sites it gets polluted [4]. It is also known as municipal wastewater which consists of huge amount of pollutants as a consequence of jumbling of wastewater from singular fonts like domestic, industrial and agricultural [5]. Municipal wastewater also consists of emancipation urban rainfall overflow from roads, roofs of car and pavements which consist of oils and animal faeces [2]. If there is a sewerage treatment plant in an area then there are also chances of water getting polluted because of overflow. Emulsions, agricultural drainage, diffuse also pollutes water and make it unfit for any use [6].

Population of the country which have increased at brisk pace have changed the way of living of people as a result of which municipal solid waste have also [7]. Total waste generated in India by metro cities is 9,275 Mld [8]. Among the total wastewater engendered, only 31% is taken care off before being disposed off, the rest 69% is never taken care off. About 70 % of the country is contaminated due to household and industrial waste [9]. Human doings have negatively crashed on excellence of water in the downstream fragments of the major rivers [10]. As far as rural areas are concerned 95% of population depends on ground water for household use [11]. About 80% of water pollution in India is done by domestic waste [12]. There is less or no facilities provided for gathering wastewater and to set out off after management or treatment. In India the waste whichever is disposed of is disposed off in

substandard way [13] which has lead to dangerous and unhygienic conditions in many parts of the country. Amount of pollution caused by wastewater has generally been difficult to judge. Thus Treatment and secure clearance of wastewater is compulsory. This will shield the environment and environmental management making it pollution free because the wastewater accumulated from cities and towns should finally revisit to accepting water or may be to the land. The treatment is of utmost importance especially in rural areas where people are less educated. Before the ways of treatment are suggested it is necessary to carry out the analysis of wastewater which is done by analyzing physical, chemical and biological characteristics. Few important are Total dissolved solids (TDS), pH, Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Alkalinity, Hardness Chloride Content, Nitrogen, Ammonium, Phosphorous, Iron and E-coli bacteria etc [1]. The treated water can be used for various valuable functions like growing plants, vegetables and other useful purposes [14]

The main objective of the paper is to study, characteristics of wastewater in Rajouri town in Jammu and Kashmir and then compare it with the standard set by WHO, so that general public could be made aware about the level of contaminants in wastewater and to suggest the ways of treatment of wastewater which will result in disposing off of domestic effluents without any danger to human health.

1.1 Study area

Rajouri district situated in the south western division of Jammu and Kashmir state is famously known as the land of kings covers an area roughly equal to 2630 sq km and lies between latitudes $33^0$00'00"& $33^0$35'20" North and longitudes $74^0$08'00" & $74^0$42'30" East as per survey of India. It lies at an altitude nearly equal to 915m above Mean Sea Level (MSL) enclosed by well-known Pir-Panjal hills. Rajouri town is the chief sector of the Rajouri district. Population of the town is 37,552 as per census of 2011. Out of this 57% are males and rests are females. Rajouri town is situated near the highway of district Poonch (85km away) and Jammu about 154 km away and is enclosed by Udhampur district, Poonch, Jammu district and Mirpur (Pakistan). The atmosphere in southern division (Nowshera, Sunderbani and Kalakote) of the constituency is half humid where as in northern division (Thannamandi and Koteranka, Darhal) it is pleasant. In Northern part of the district rainfall is heavy beside rainfall these areas also experiences snowfall. Rajouri town also experiences snow fall occasionally like in Dec 2012. Average variation in of temperature in area is 7°C to 40°C. The normal yearly rainfall is 76.9cm. River pouring throughout Rajouri town make way into the town from Darhal and Thanamandi. They congregate near Kheora then make its way through entire town via Madina Calony, Jawahar Nagar area, Chapriya and Muradpur finally meeting with another river at Nowshera, which ultimetly flows into Pakistan.

In Rajouri unacceptable running and no proper study of the wastes have caused lot of problems to uneducated people of the area In Rajouri.90-95% of the waste is plonked in an inappropriate way in open dumps, which ultimately pollutes the environment. The sewage of the area is very turbid as people in the area prefer to discharge faecal matter along with other wastes in adjoining drain. Fig 1 shows the Map of Rajouri district.

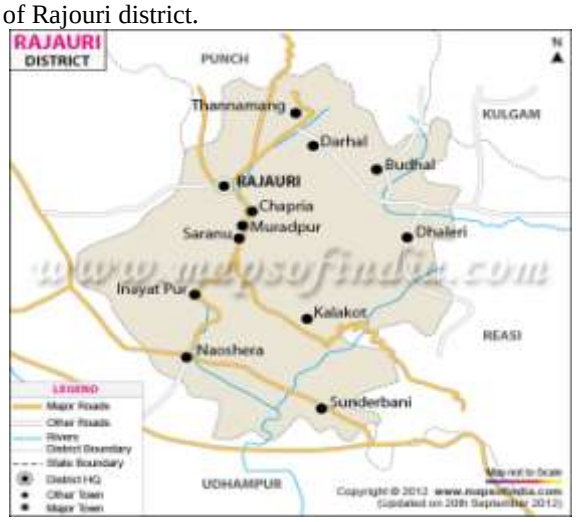

Figure 1: Map of Rajouri District, Jammu & Kashmir, India (Source: Maps of India)

II. Materials and Method

1.1. General

Wastewater is generally released from domestic residences, commercial properties and industries [1]. The study holds more importance in countries like India especially in rural areas.

1.2. Wastewater Collection and Sampling

All in all five sampling stations were chosen for characterization viz Jawahar Nagar (SS 1), Kheora (SS 2), Madina Colony (SS 3), D.C Colony (SS 4), Muradpur (SS 5). The Stations were chosen for analysis because they cover the entire town besides making their way into rivers while moving from these selected sampling stations. These stations were densely populated which ultimately helped in carrying out the research work in a better way and obtain good results. The samples were mainly of domestic quality as area lacks industries. The drain from which samples were collected as a rough discharge of 1 m^3/s. Samples were collected from these stations at different timings of the day. Sampling was done in such a way so that average values of various characteristics of sewage could be

ascertained. Two types of sampling were done i.e. Grab and Composite sampling. Samples were collected in 1000 ml clean plastic bottles.

The drain has varied discharges at different periods of day. Sampling was mostly carried out at 9 am in the morning at all the stations. The drain from which samples were collected was connecting a large area. The drain of Jawahar Nagar (SS 1), was having a length of about 600 m upto the point from where sewage was changing its course into an open area in the form of swamp, where as drain of Kheora (SS 2), was the longest about 800m long and that of Medina colony (SS 3), DC Colony (SS 4) and Muradpur (SS 5), being 400m, 450m and 700m long respectively. The sewage of all the stations finally finds its way into a nearby river called Rajouri River without any pretreatment, thus affecting a large population mainly on the downstream. The details of five selected sampling stations are shown in Table 1

Table 1: Details of five sampling stations

Station	Name of the Location	Length of drain (m)
SL 1	Jawahar Nagar	600
SL 2	Kheora	800
SL 3	Medina Colony	400
SL 4	DC Colony	450
SL 5	Muradpur	700

2.3 Data Analysis

After collection the samples were Stored at 4°C in Water Quality Analysis Lab. Tests were carried out for Total dissolved solids (TDS), pH, Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Alkalinity, Hardness Chloride Content, Nitrogen, Ammonium, Phosphorous, Iron and E-coli bacteria at the selected stations. Standard Methods for the assessment of Water and Wastewater by American Public Health Association [15] were used for carrying out tests. The results obtained were compared with standards set by World health organisation [16].

III. Results and Discussions

Details of the parameters of the wastewater samples compared with the emblematic values of Domestic wastewater set by W.H.O [16]. The range of the parameters and average of the parameters at different sampling locations are shown Table 2. This table shows that the wastewater is contaminated at the greater extent in some of the sampling stations. This is mainly due to poor or hardly any treatment of wastewater

3.1. Variations of wastewater Parameters

Total dissolved solids (TDS) are amalgamation of all dead and untreated materials in a wastewater in dissolved and suspended form. The TDS amalgamation at sampling station SL5, SL4, SL1, SL3 was high that is 2000 mg/ltr 1850 mg/ltr 1700 mg/ltr and 1550 mg/ltr respectively shown in figure 2. They all were exceeding the permissible limit at these stations. At station SL2 it was safe and value was 1250 mg/ltr. TDS have high values at some stations due to the fact that waste is disposed off in an in appropriate way at the site. Towering values of TDS reduces the succulence and may escort to gastro-intestinal aggravation in humans [12]**.** The pH is quantity of activity of ionized Hydrogen (H^+) ions in wastewater solution [17]. The pH value of all the five Sampling locations was found to be lying between 7.82 and 9.4. The maximum among all was found at SL5 and SL2 was having the least pH value followed by SL1 where it was 7.84 as indicated in fig 3. Wastewater was found to be safe for all the four stations viz SL1, SL2, Sl3 and SL4 but SL5 was exceeding the permissible limit. So on the whole wastewater for the town with respect to pH can be deemed as harmless. The effect of pH on hydrogen production from glucose from mixed culture was studied by [18] revealed that multiplicity of germs increases with increase in pH value. Turbidity is the measurement of quantity of particulates dangled in water [19]. It computes the amount of light dispersed when it is released on dangled solids. Turbidity at three locations i.e SL1, SL3 and SL5 was exceeding the limit set by W.H.O [16] where it was 32 NTU, 35 NTU, 42 NTU, where as sampling locations SL 2 and SL 4 27 NTU and 29 NTU and was safe as shown in fig 4. On the whole the mean turbidity on whole Rajouri town 33 NTU clearly exceeding the standard limit and wastewater in this regard was deemed as unfit. Turbidity when exceeds its permissible limit can cause health problems for example water borne diseases like protozoa [20]. Biochemical oxygen demand (BOD) is the extent of disbanded oxygen obligatory for aerobic heritable living things in water to shatter behind alive material there in a given water sample at unambiguous warmth in a distinct eon of time. BOD_5 at all the sampling locations was exceeding the permissible limit set by W.H.O [16] for discharged domestic wastewater. At different locations Maximum BOD_5 was 142mg/ltr at SL1 with minimum being 95 mg/ltr at SL2. At SL3, SL4, SL5 BOD_5 was 107 mg/ltr, 97 mg/ltr and 123 mg/ltr respectively as indicated in figure 5. Overall wastewater was unsafe with respect to BOD_5. COD is value of oxygen analogous to the crude matter of the water defenseless to rust due to husky compound oxidant and hence it is important to unrefined toxic waste [21]. The COD of all five selected samples were in between 15.8 mg/ltr to 57.5mg/ l, with sampling station SL5 having the limit intensity of COD i.e 57.8. These levels of COD show the subsistence of unrefined pollutants in water. Fig 6 shows the intensity of COD at all the sampling

locations. Attendance of COD can be exploited as unrefined indicators to review the wastewater toxic waste.

Appraise of ability of water to deactivate acids is known as alkalinity. If water is too alkaline obnoxious taste is there in water. The alkalinity at the sampling locations was varying between 11.5 mg/ltr and 15.5 mg/ltr with maximum at SL 3 and minimum at SL 2 shown in fig 7. Alkalinity at other locations SL 1, SL 4, SL 5 was 12 mg/ltr, 18 mg/ltr and 14 mg/ltr. There is no limit set for alkalinity for wastewater by W.H.O [16]. Alkaline water is still considered to be harmful for human health. Working out of the figure of divalent ions which mainly icludes calcium and magnesium in attendance there in water is known as Hardness [22]. Hardness of water at study area was varying in between 104 mg/ltr to 147 mg/ltr in phrase of $CaCO_3$ (fig 8) at SL 2 and SL 5 . At other stations the variation of hardness was 118 mg/ltr at SL1 to 125 mg/ltr at SL 3 and then 127 mg/ltr at SL 4. There is no limit for hardness for discharged domestic wastewater as it can be used for any purpose safely except for drinking because excessive calcium and magnesium cause's stones in kidney and laxative problems respectively but the shortage of these constituents may lead to utilitarian modifications. Chloride (Cl^-) is an element that crop up in nature and is established in plenty. Chloride content at the sampling locations was in the range of 382 mg/ltr to 697.62 mg/ltr with maximum at sampling location SL 2 and minimum at SL5 as shown in fig 9. At other locations SL 1, SL 3 and SL4, the chloride content was 469.21 mg/ltr, 586.86 mg/ltr, 593.23 mg/ltr respectively. Chloride absence is providentially less, if not looked after and treated well can cause death but if it is in excess it may lead to health risks to people going through heart related diseases and kidney sickness [12]. Nitrogen is in attendance in sewage in the shape of as unrefined compounds (proteins amines, amino acids and urea) and ammonium salts as in organic compound. Nitrogen at the sampling locations was varying between 25.9 mg/ltr to 51.3 mg/ltr with least at SL 1 and maximum at SL 5. At SL 2, SL3, SL 4, it was 27.8 mg/ltr, 37.4 mg/ltr, 44.5 mg/ltr respectively. It is important for both plants and animals but the excessive nitrogen is detrimental to the both [12]. Nitrogen was exceeding the permissible limit as SL 5 on all other locations it was within the permissible limit (fig 10). Ammonia is the multifaceted by hydrogen and nitrogen (NH_3) gas and is clutched to wastewater due rotting nitrogenous untreated matter. Amount of nitrogen determines the age of sewage [1]. Ammonia at the sampling locations was varying between 2.3 mg/ltr to 5.7 mg/ltr (fig 11) with least at SL 2 and maximum at SL 5. At SL 1, SL3, SL 4, it was 2.7 mg/ltr, 3.5 mg/ltr, 4.4 mg/ltr respectively. Lesser quantity ammonia is mordant; on the other hand if its value is increased it is dangerous to animals living in water and dialysis patients [12]. Ammonia at SL5 was exceeding the permissible limit. Food scums supplies phosphorous to domestic wastewater. Using enhanced amount of artificial detergents add significantly to percentage of phosphorous in sewage. Phosphorous at the sampling locations was varying between 5.5 mg/ltr to 9.6 mg/ltr (fig 12) with least at SL 3and maximum at SL 5. At SL 1, SL 2, SL 4, it was 7.85 mg/ltr, 6.4 mg/ltr, 8.8 mg/ltr respectively. Phosphorous at all the locations was exceeding the limit prescribed by W.H.O [16].

Iron is normally found in water as ferrous or ferric structure. It is not dangerous to wellbeing yet it is considered for the visual intentions. Existence of iron alters the color of water [23]. Iron at the sampling locations was varying between 1.4 mg/ltr to 4.4 mg/ltr (fig 13) with least at SL 2 and maximum at SL 1. At SL 3, SL 4, SL 5, it was 3.6 mg/ltr, 3.2 mg/ltr, 3.7 mg/ltr respectively. Except for SL2 all the locations were exceeding the permissible limit. Since this wastewater is having excess iron content it won't be suitable to use it for irrigation purposes. E-coli are the dowel figured aerobic bacteria originates in the intestinal territory of man, they are not destructive to man and are constructive in demolishing untreated material in biological treatment process. E-coli was ranging in between 2.5 -3.7 MPN/100 ml (fig 14). However due to presence of vegetation at the disposal sites, the quality of sewage at some stations to some extent are acceptable as the vegetation absorb some of its undesirable constituents.

Table 2: Physico-chemical parameter's estimation of Waste water at Rajouri Town

Parameter	**Range**	**Mean Value**	**Typical Value of Untreated Domestic wastewater**		
			Weak	**Medium**	**Strong**
Total Dissloved Solids (mg/l)	1250-2000	1670	250	500	850
pH	7.82-9.4	8.37	5-9		
Turbidity (NTU)	32-42	33	-	-	-
BOD_5 (mg/l)	95-142	112.8	110	220	400
COD (mg/l)	15.8-57.5	36.92	250	500	100
Alkalinity as $Caco_3$ (mg/l)	11.5-15.5	14.2	50	100	200
Chloride (mg/l)	382-697.6	545.81	30	50	100
Hardness (mg/l)	104-147	124.2	-	-	-

Nitrogen (mg/l)	25.9-51.3	37.38	20	40	85
Ammonia (mg/l)	2.3-5.7	3.72	12	25	50
Phosporous (mg/l)	5.5-9.6	7.63	4	8	15
Iron (mg/l)	1.4-4.4	3.26	-	-	-
E-Coli (Nos/100mg)	2.5-3.7	3.17	-	-	-

Typical values of untreated wastewater (source: Metcalf and eddy, Inc, 5-36)

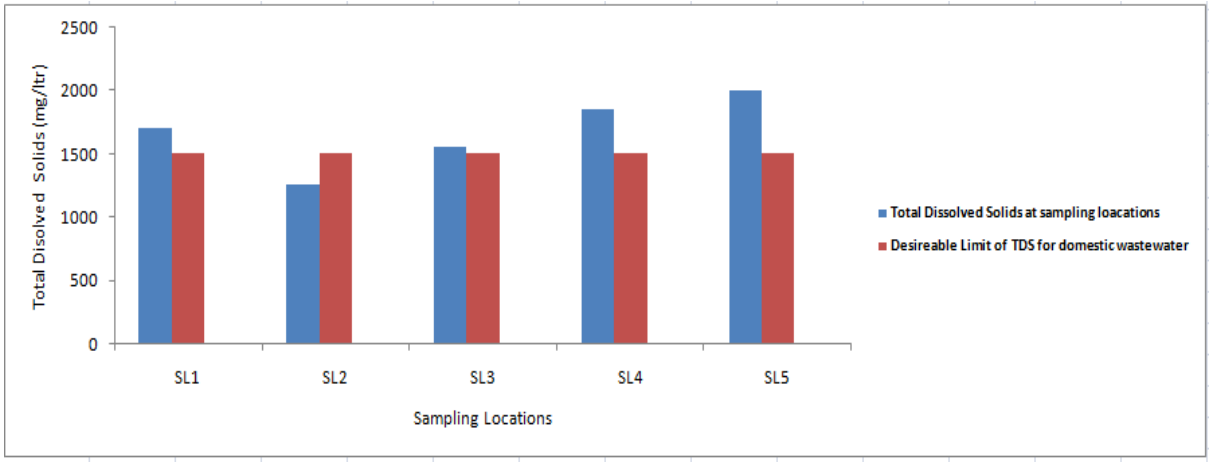

Fig. 2: showing values of Total Dissolved Solids at different sampling locations

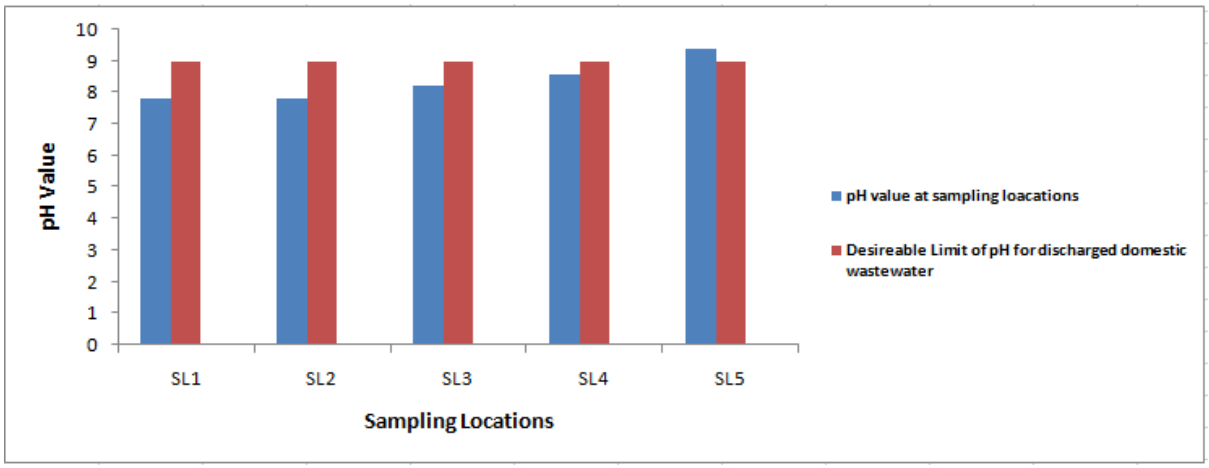

Fig. 3: showing values of pH at different sampling locations

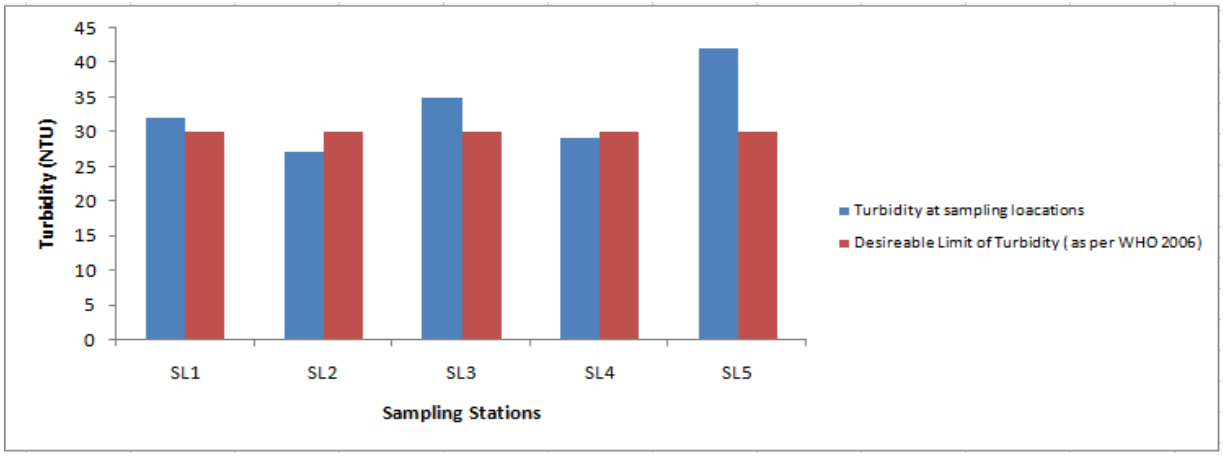

Fig. 4: showing values of Turbidity at different sampling locations

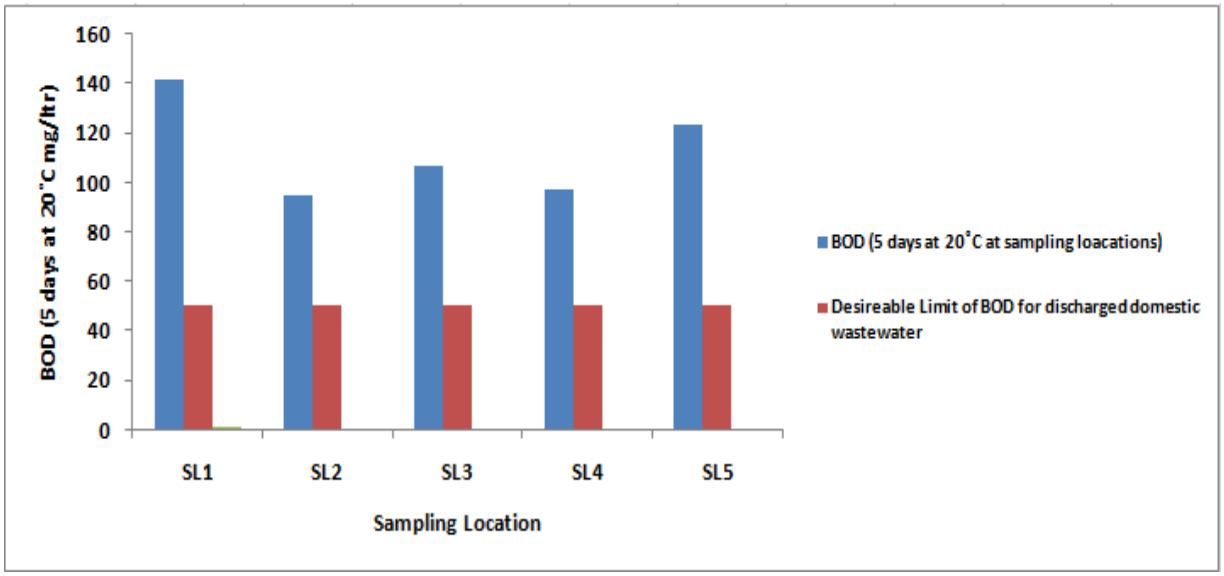

Fig. 5: showing values of BOD_5 at different sampling locations

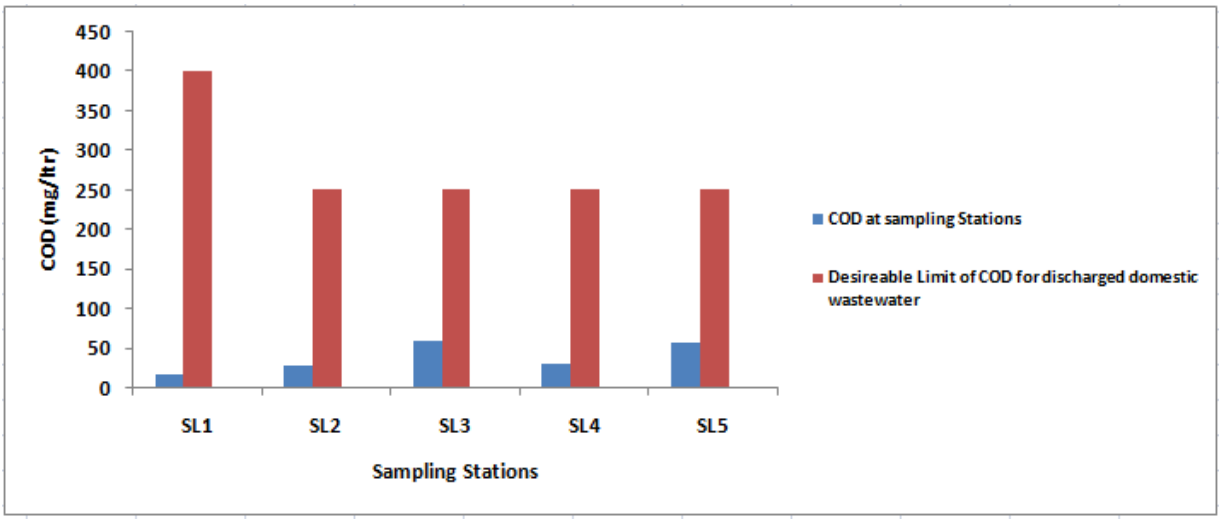

Fig. 6: showing values of COD at different sampling locations

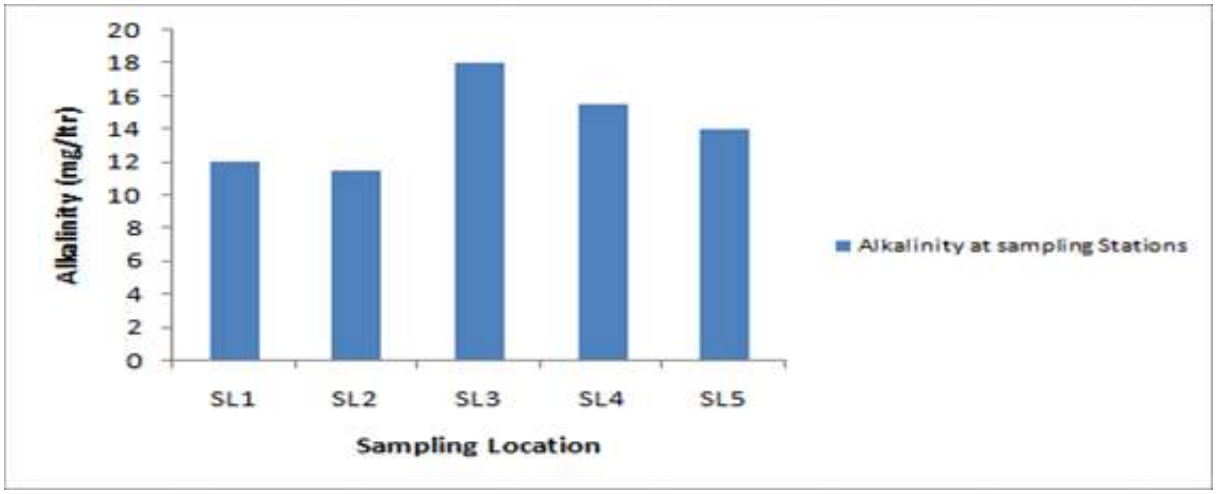

Fig. 7: showing values of Alkalinity at different sampling locations

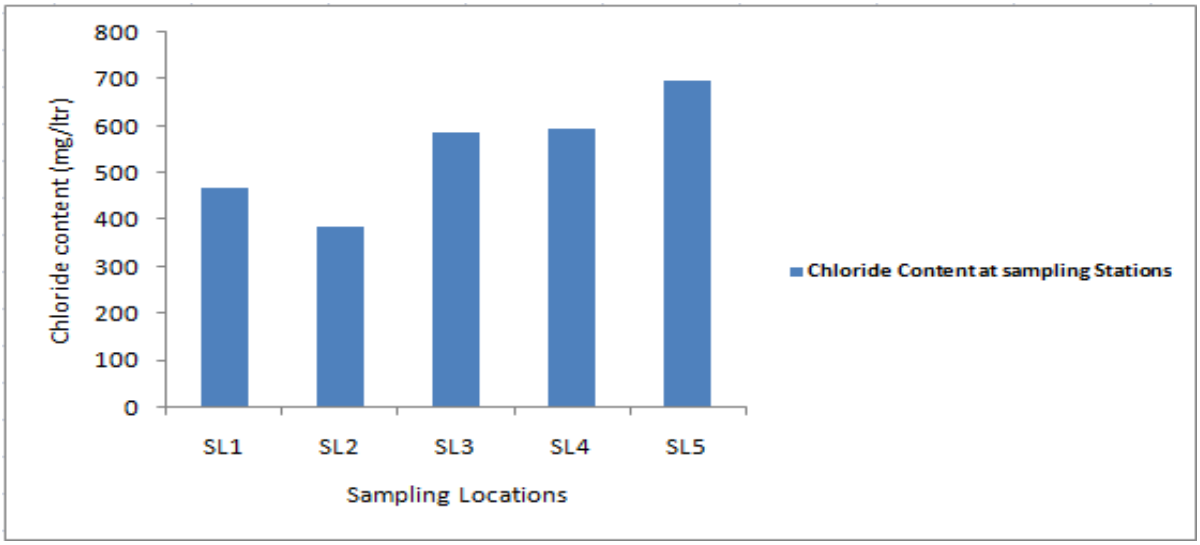

Fig. 8: showing values of Chloride Content at different sampling locations

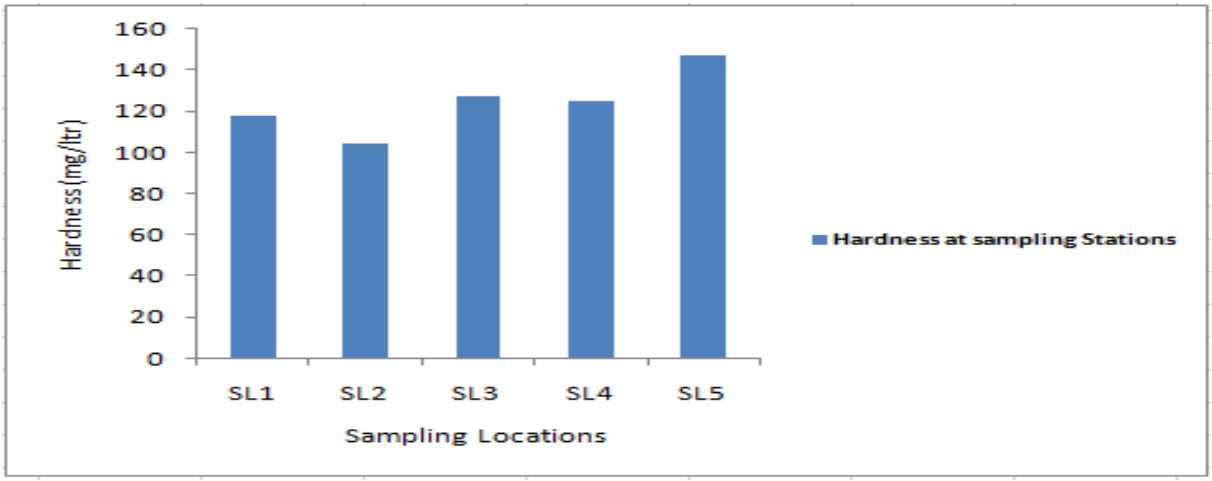

Fig.9: showing values of Hardness at different sampling locations

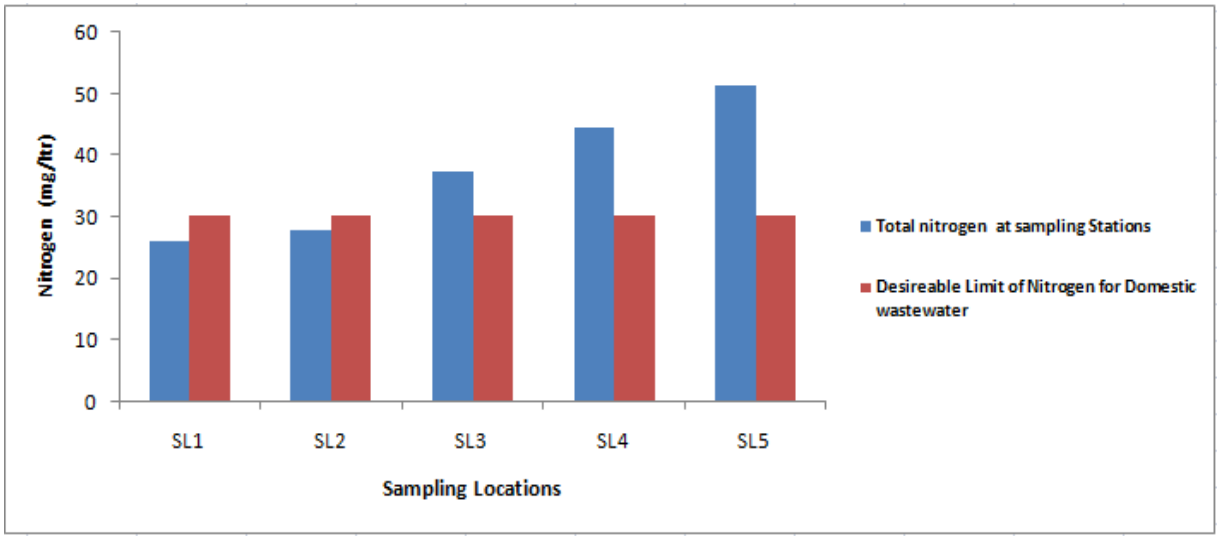

Fig.10: showing values of Nitrogen at different sampling locations

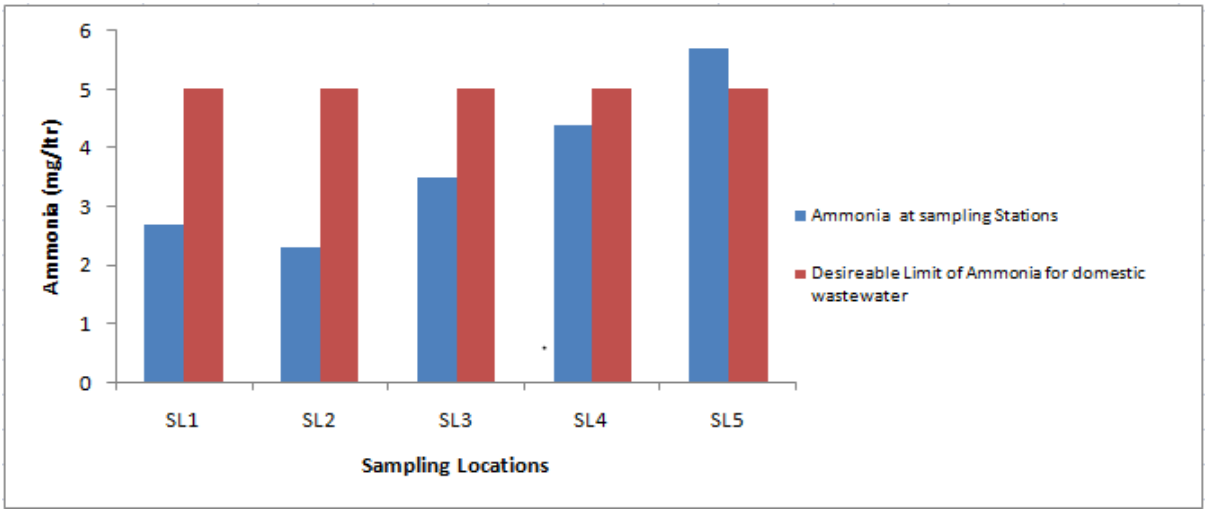

Fig.11: showing values of Ammonia at different sampling locations

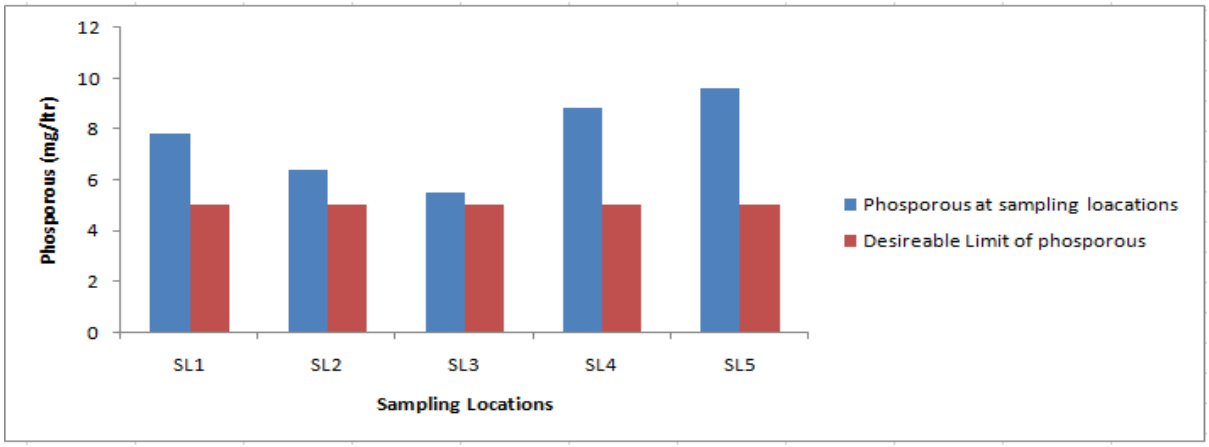

Figure 12: Showing values of Phosphorous at the sampling station

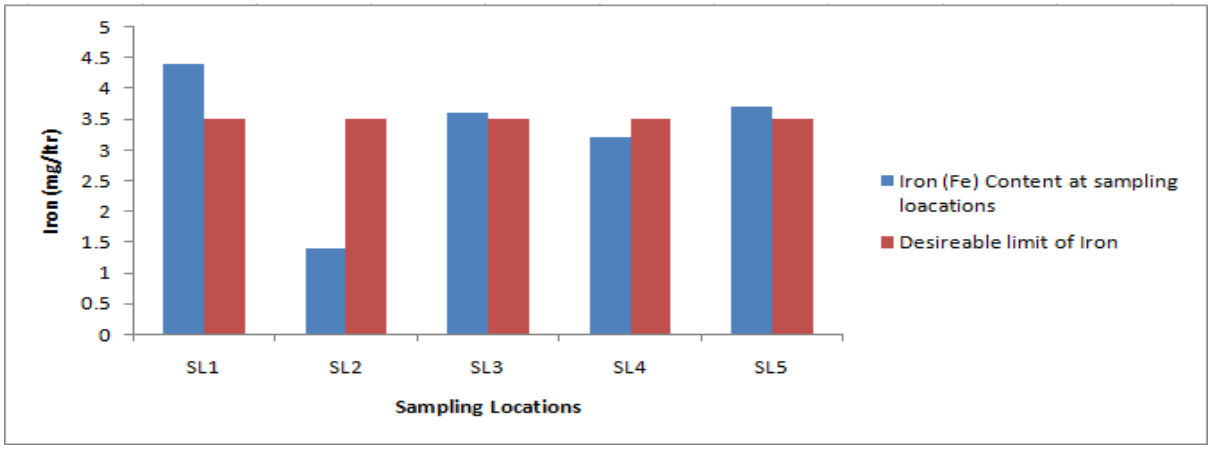

Fig.13: showing values of Iron Content (Fe) at different sampling locations

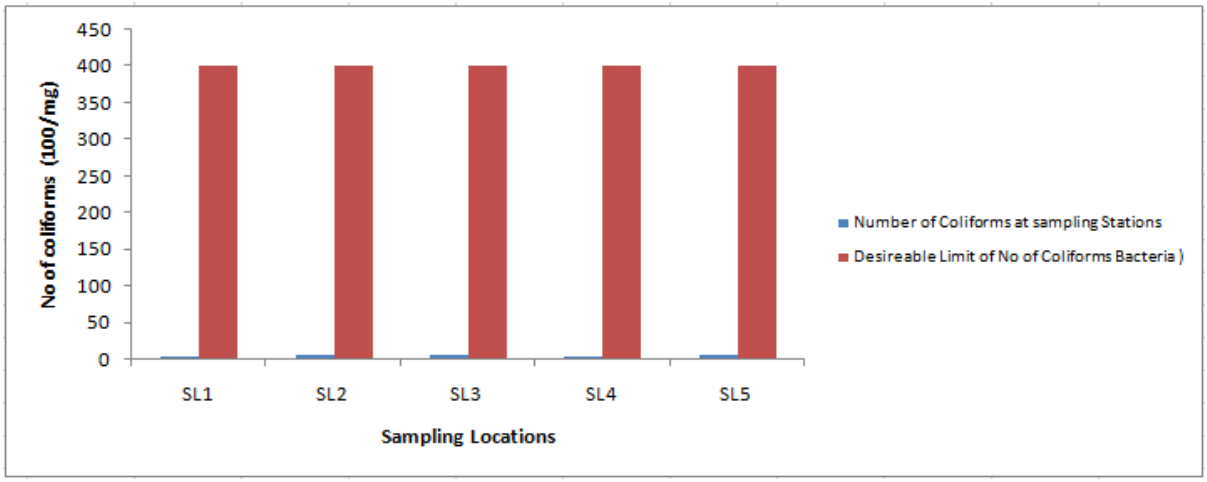

Fig.14: showing values of No. of Coliform bacteria's at different sampling locations

3.2. Suggested measures for treatment of Wastewater

The wastewater analyzed was found to be polluted in some of the sampling locations so in order to supply pure water to general public and use this wastewater for useful purposes like irrigation, agricultural and other domestic purposes which includes bathing, washing, cooking etc. The wastewater should be treated well before it is supplied. Here some of the parameters of wastewater were exceeding the limits set by W.H.O [16]. These parameters includes TDS, pH, Turbidity, BOD_5, Nitrogen, ammonia, phosphorous and Iron. Some of the suggested measures to reduce their concentrations and their treatment are discussed as under

Total Dissolved Solids*:* Total dissolved solids cannot be removed by unadventurous treatment methods. Accumulation of chemicals enhances the intensity of TDS [24]. Zeolite process and softening may just lessen TDS to some extent [25]. To reduce the amount of TDS entirely processes like Reverse osmosis and electro dialysis may be used which will be cost-effective as well [26]

pH*:* Wastewater having soaring pH may be allowed to scamper in the course of a tank where citric or acetic acid may be added to lessen the pH. Filters, water softeners and tanks should be washed out and redeveloped occasionally. If the water is to be exercised for irrigation, crops or drinking, salinity should be checked using a hydrometer.

Turbidity: Its treatment may be done either by settling or filtration. Quantity of chemical reagents depends upon the application and they should be dosed into the wastewater stream to enhance the usefulness of the settling and filtration. Municipal wastewater plants frequently eliminate turbidity by amalgamation of sand filtration, settling tanks and clarifiers

BOD**:** It should be removed by constructing the treatment plant such as stabilizing pond which reduces the BOD in the wastewater released to rivers. Wastewater treatment plants are intended for utility as bacteria ranch, where bacteria are provided with oxygen and untreated waste. The surplus bacteria developed are eradicated as mud, and the solid waste is then arranged of on land

Nitrogen: It can be eliminated from drinking water by distillation, reverse osmosis, and ion exchange. Among this reverse osmosis is the best and cost effective. In this method force is pertained to water to move it in the course of a half-porous film. When this happens more than half of the impurities are wiped out. About 85 to 95 percent of the nitrogen can be confiscated with reverse osmosis.

Ammonia**:** High ammonia can be removed by chlorination and breakpoint chlorination [27].

Phosphorous*:* High Phosphorous content can be diminished by use of alum

Iron*:* Treatment of Iron may be done using sequestering, exchange of ions, oxidation filtration and settling. Amount of iron present in water will signify the method which will be best suited.

Beside the above discussed processes construction of wetlands will also lead to effective treatment and management of wastewater.

IV. Conclusion

After carrying out the analysis of wastewater the mean values of the parameters viz Total dissolved solids (TDS), pH, Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Alkalinity, Hardness, Chloride Content, Nitrogen, Ammonium, Phosphorous, Iron and E-coli were

found to be 1670 mg/ltr, 8.37, 33 NTU, 112.8, 36.92 mg/ltr, 14.2 mg/ltr, 545.81 mg/ltr, 124.2 mg/ltr, 37.38 mg/ltr,3.72 mg/ltr,7.63 mg/ltr,3.26 mg/ltr,3.17 MPN/100ml respectively. It was found that among these parameters TDS, Turbidity, BOD, Nitrogen, Phosphorous and Iron were increasing the limits set by WHO. Overall the Rajouri town with respect to these parameters was found to be unsafe. Among all the sampling locations that is SL 1 (Jawahar Nagar), SL 2 (Kheora) SL 3 (Medina Colony) SL 4 (DC Colony), SL 5 (Muradpur). Among these Locations the site which was found to be the most polluted was Muradpur (SL 5) thus affecting the population there because of being on the downstream side and the least affected site was Kheora (SL2). In some sampling stations due to presence of vegetation at the disposal sites, the quality of sewage to some extent are acceptable may be because the vegetation absorb some of its undesirable constituents. Hence a treatment plant is suggested to treat the wastewater and then used for various useful purposes like irrigation, washing, bathing etc which will benefit population of 37,552 souls. Construction of wetlands will also lead to effective treatment and management of wastewater.

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