Possible Effects of Sewage Farming on Ground Water Quality in MuhanaMandi, Jaipur

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ABSTRACT:- Due to increasing rate of population growth, generation of sewage is also increasing proportionately. So, sewage management becomes must to keep the human surroundings clean and hygienic. At the same time, water demand is also increasing with the increasing population. Sewage farming is a very appropriate option of reusing sewage which can prove to be an efficient step towards sewage management and can also solve the problem of water scarcity to some extent. This paper deals with the sewage farming being practiced in Muhana Mandi, Jaipur. Waste water samples were collected from Muhana Mandi site and were analysed in Environmental Engineering laboratory of Swami Keshvanad Institute of Technology Management & Gramothan, Jaipur. The waste water samples were tested for electrical conductivity, pH, total dissolved solids, suspended solid, dissolved oxygen, chemical oxygen demand and biological oxygen demand. The solid content of waste water samples were also varied by diluting it with potable water, while performing tests. The chemical components such as N, K, P, pH, were also found to be varying for both treated waste water and groundwater.

Key-words:-Sewage management, Sewage farming, Water scarcity, Ground water.

I. Introduction

Increasing demand of water and decreasing surface water resources has resulted in over exploitation of groundwater, specially for agriculture purposes. This situation demands discovering new sources of water. Using the treated sewage for agriculture can be a possible solution. Raising of vegetables and fodder crops around the sewage treatment sites using sewage water is a common practice at many places. Raw sewage needs proper treatment before its reuse because sewage characteristics vary with the type of discharging industry.

Hence, using sewage water for farming decreases pressure on fresh water sources, on the other hand it also allows saving of fertilizer expenses. At the same time there can be harmful effects of using sewage water for farming because few industries discard toxic elements in its waste, which may get absorbed by plants through soil.

In 2017, the FAO published the suggested guidelines for the "agricultural reuse of treated water and sand treatment requirements". In these guidelines, the type of agricultural reuse was classified on the basis of the type of irrigated crop [23] (Table 1).

S. No.	Type of Agricultural	Reuse Type of Treatment	Quality Criterion
01	Agricultural reuse in crops that are consumed and not processed commercially.	Secondary Filtration—Disinfection	pH = 6.5–8.4 BOD < 10 mg/L
02	Agricultural reuse in crops that are consumed and not processed commercially.	Secondary—Disinfection	pH = 6.5–8.4 BOD < 30 mg/L SS < 30 mg/L
03	Agricultural reuse in crops that are not consumed.	Secondary—Disinfection	pH = 6.5–8.4 BOD < 30 mg/L SS < 30 mg/L

Table: 1: FAO guidelines for the agricultural reuse of treated water

The present study was undertaken with the following objectives:

- Analysis of raw sewage being used for agriculture at Muhana Mandi, Jaipur.

Analysis the waste water after adding the fresh water in different percentage of dilution (Overcome the problem of untreated sewage by dilution process)

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1.1 Effect of waste water reuse on crop and soil health (as per former studies)

A number of studies have already been done to study the effects of sewage farming on soil and crops and few of them are discussed below in Table No.2.

Parameter	Associated Effects on the Soil and the Environment		
	Physicochemical Properties	Microbiological Properties	References
Organic matter	Organic matter, Soil structure stabilization, Formation of aggregates, Water retention, Improves nutrient content, Buffer Capacity, Cation exchange capacity, Enzymatic activity, Increase in TOC, Increases the availability of contaminants	Selection of specific populations and soil microhabitats	15,16, 21, 22, 23
	Nutrients Increase in organic soil matter, Water retention Leaching to groundwater Improves nutrient content Risk of eutrophication of aquatic environments	Perturbation of the metabolic activity of microbial soil communities	17, 18, 24, 25, 29, 30
Salinity Soil	Salinity Soil salinization or sodification, Decreased stability of aggregates, Changes in soil structure in the long term, Permeability of soil and water retention, Increased soil compaction, Variation in soil pH, Negative impact on soil fertility, Dynamics in organic and inorganic compounds	Changes in soil microhabitats and variation in the richness and diversity of the microbial community	20, 31, 32, 33
Contaminants	Contaminants Soil toxicity and leaching, Accumulation in soils, Negative impact on soil fertility, Potential contamination of the food chain, Mineralization of organic matter, Changes in enzyme activity, Decomposition of fallen leaves, Limiting soil fertility	Increased tolerance to microbial contaminants. Antimicrobial resistance. Reduction of microbial biomass	19, 26, 27, 28

Table 2 : The influence of agricultural reuse on soil's physicochemical and microbiological parameters (literature review)

II. STUDY AREA

The study area is Muhana mandi which is situated in Jaipur, Rajasthan. The latitude is 26.849684, and the longitude is 75.769188. Muhana mandi, Jaipur, Rajasthan, India is located at India country in the Districts place category with the gps coordinates of 26° 50' 58.8624" N and 75° 46' 9.0768" E. Site location of Muhana Mandi shown in figure 2.1.

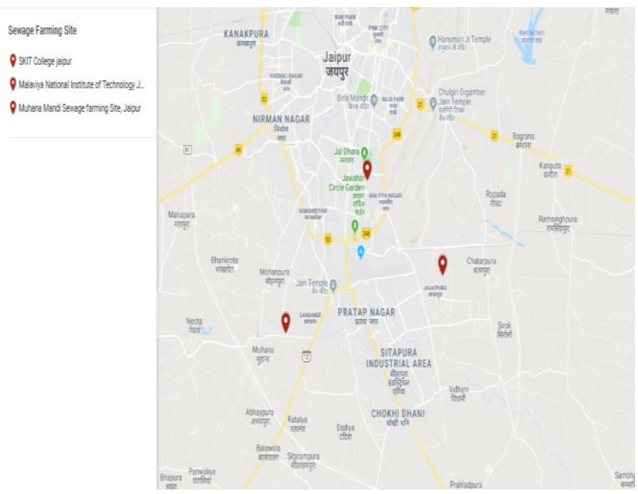

Fig.2.1 Google map of Muhana Mandi Site

III. SAMPLE COLLECTION AND METHOD ANALYSIS

Sample collection has been done from Muhana Mandi, Jaipur.

3.1 Waste Water Sample Collection

Sewage samples were collected from Muhani Mandi on five different dates during the months of October 2018 to January 2019.

3.2 Methods and Analysis

The collected waste water samples were tested in laboratory for electrical conductivity, pH, total solids, suspended solid, dissolved solids, dissolved oxygen, chemical oxygen demand, biological oxygen demand, Sulphate, phosphate, chloride, calcium, magnesium, potassium, sodium, carbonates and bicarbonates.

In the second step, the sewage was diluted with fresh water and then again tested. Dilution with fresh water has been suggested as a possible remedy.

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IV. Result and Discussion

Sewage samples were collected from the study area on five different dates as mentioned in table no. 2. Different tests (as mentioned in table no. 3) were performed, which have been used to predict the sewage characteristics.

The results of the tests have been compared to the standards prescribed by "Central Pollution Control Board (CPCB) report -2015" and the following conclusions have been drawn:

- The pH value lies between the range of 7.04 to 7.36, which shows that sewage is basic in nature and is acceptable as per CPCB recommendations.
- Value of suspended solids is above the permissible limits as prescribed by CPCB, this suggests that this sewage is untreated and needs proper treatment such as dilution with water with total solids under permissible limits
- Value of dissolved solids is under the permissible limits as prescribed by CPCB
- Value of Sulphate is under the permissible limits as prescribed by CPCB
- Value of Phosphate is under the permissible limits as prescribed by CPCB
- Value of Chloride is under the permissible limits as prescribed by CPCB
- Dissolved Oxygen value is low as compare to prescribed limit of CPCB, minimum DO should be maintained at 4ppm.
- BOD value is higher than the permissible limit, which shows that oxygen is required for decomposition of organic compounds present in waste water.
- Other properties do not produce negative effect on soil.

S.NO.	QUALITY	Test Result on 10-10-2018	Test Result on 05-11-2018	Test Result on 18-12-2018	Test Result on 28-12-2018	Test Result on 4-01-2019	Test Result on 10-01-2019
1	pH	7.21	7.14	7.4	7.07	7.36	7.10
2	TOTAL SOLID (mg/l)	2160	2410	2360	2240	2350	2270
3	SUSPENDED SOLID (mg/l)	226	240	270	185	190	230
4	TOTAL DISSOLVED SOLID (mg/l)	1750	1890	1980	1860	1840	1855
6	SO_4 (mg/l)	177	161	157	149	139	161
7	PO_4 (mg/l)	0.61	0.65	0.64	.71	0.57	.69
8	Cl (mg/l)	93	97	99	96	95	91
9	DO (mg/l)	1	.5	1.2	.7	1.1	.4
10	BOD (mg/l)	48	49	56	65	41	60

Table: 3: Test Result of Muhana Mandi sewage

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Table no. 4 shows the results of tests performed on diluted samples of wastewater with fresh water, with varying percentage of dilution. Test performed on sewage sample is

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tested in SKIT College and MNIT College in environment lab. Dilution in sewage sample is varying in the proportion of 20%, 30%, 40% and 50%. Standard sample is also prepared by diluting the distilled water in sewage sample.

S.no	Tests Conducted	Original sample + 20% Tap water	Original sample + 30% Distilled water	Original sample + 30% Tap water	Original sample + 40% Tap water	Original sample + 50% Tap water
1.)	pH	8.06	8.16	7.94	7.83	8.15
2.)	Total Solids	1780 ppm	1600 ppm	2300 ppm	2400 ppm	2140 ppm
3.)	Total dissolved solids	1900 ppm	1860 ppm	500 ppm	1100 ppm	2260 ppm
4.)	Dissolved Oxygen	7.6 ppm	13.6 ppm	8 ppm	9.067 ppm	9.6 ppm
5.)	Turbidity	17 NTU	16 NTU	27 NTU	25 NTU	14 NTU
6.)	Colour	Grey	Pale yellow	Grey	Slight Grey	Slight Grey
7.)	Odour	Pungent	Nil	Pungent	Pungent	Nil
8.)	Conductivity	2.54	1.823	2.41	2.47	2.47
9.)	Settle able solids	3 ml	-	0.4	0.2	.1
10.)	BOD (mg/l)	40	29	36	30	25

Table: 4: Test Result of Muhana Mandi sewage diluted sample

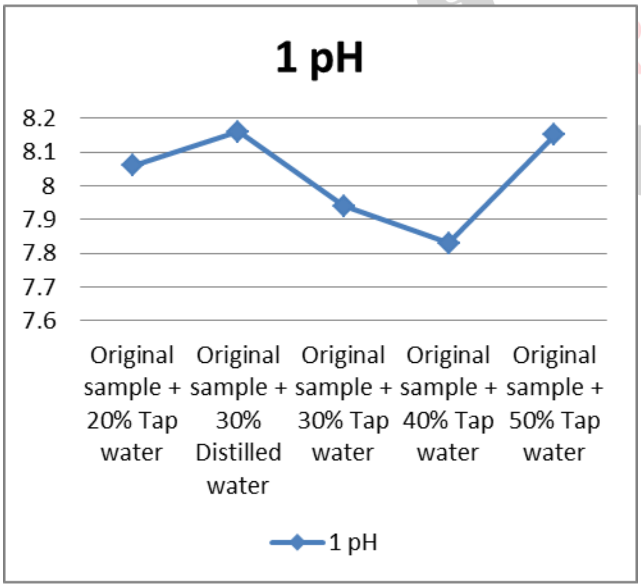


Fig. 1 pH test results of Muhana Mandi

- Highest value of pH obtained from sample diluted with distilled water.
- By increasing the dilution of tap water (in percentage), pH value increase (basic nature) due to increase the concentration of OH^- ions in mixed water which is shown in fig 1.

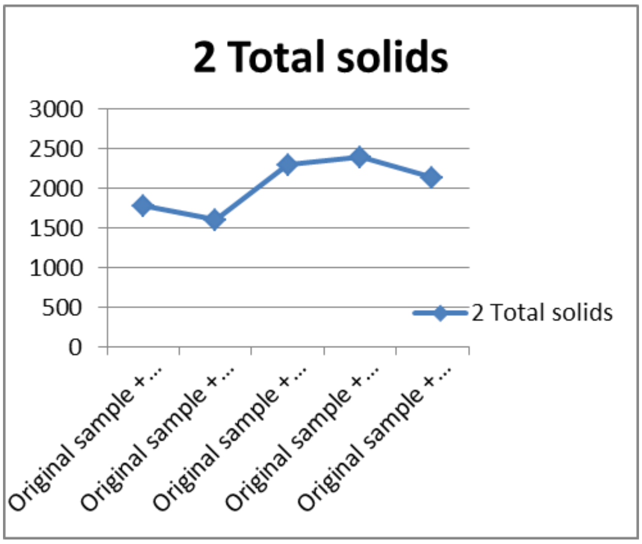
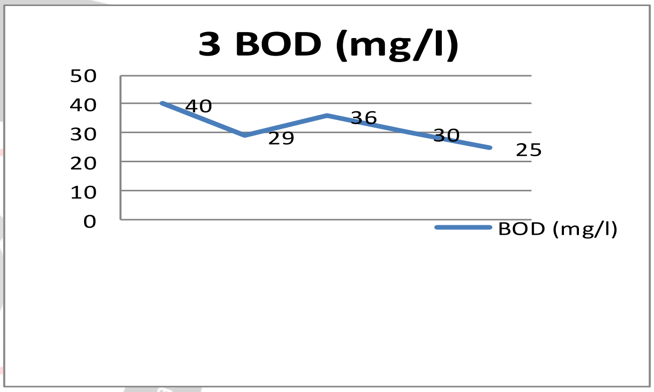


Fig. 2 Total solids test results of Muhana Mandi



- Total solids value increases instead of decreasing as proportion of bore water increases, this is due to total solids which are already present in ground water (Bore water of study area) as shown in fig 2.

Fig. 3 BOD test results of Muhana Mandi

- BOD value decreases as dilution increases due to increase in the amount of dissolved oxygen in waste water which is sufficient for decomposition of organic compounds, as a result of this there is reduction in the BOD of waste water as shown in fig 3.

- When using ground water (Bore water of study area) in dilution, value of total dissolved solids increases due to presence of more solids in tap water as shown in fig 4.

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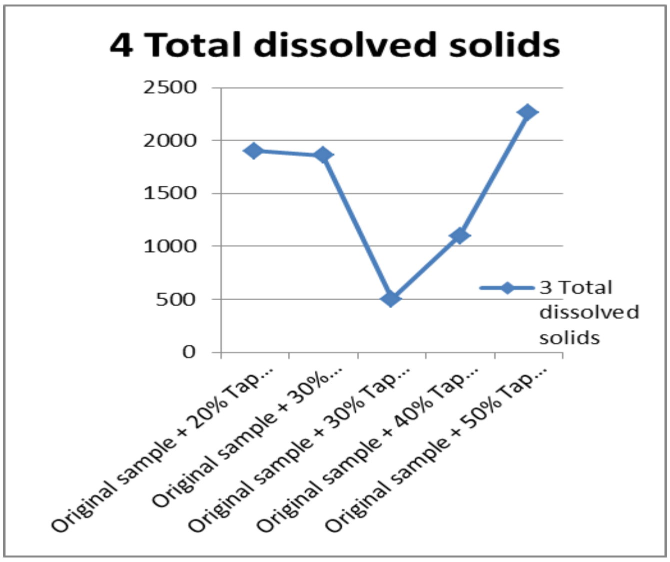

Fig. 4 Total dissolved solids test results of Muhana Mandi

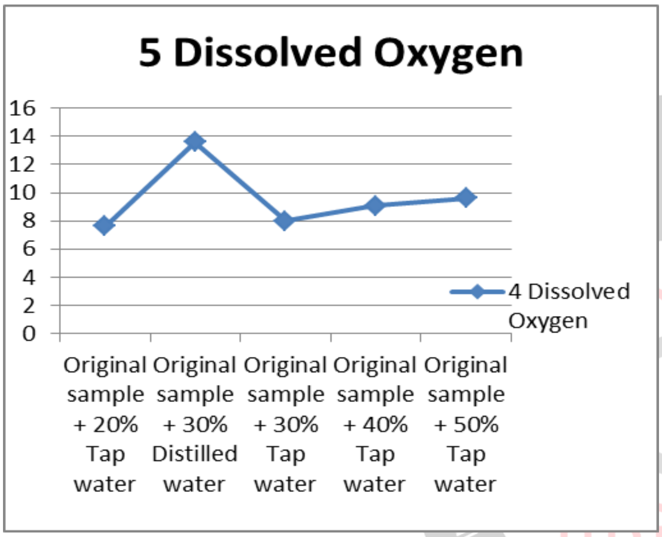

Fig. 5 Dissolved Oxygen test results of Muhana Mandi

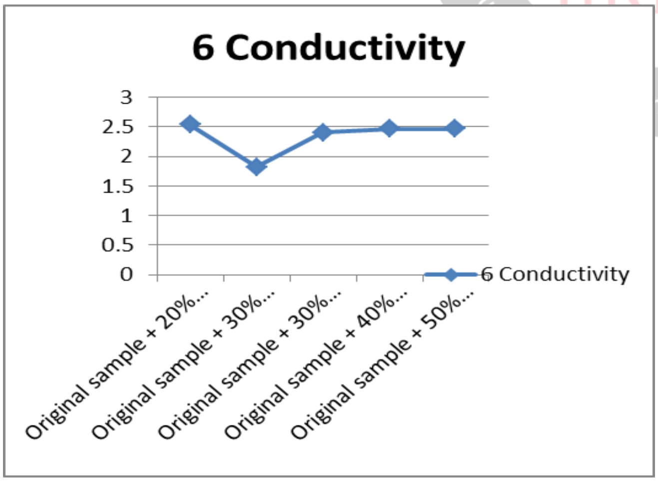

Fig. 6 Conductivity test results of Muhana Mandi

- Maximum value of dissolved oxygen is obtained when distilled water is used for dilution because high dissolved oxygen is present in distilled water as compared to tap water as shown in fig.5
- With increase of concentration of bore water, amount of dissolved oxygen in diluted sample also increases.
- Conductivity shows amount of ions present in sample. Minimum amount of conductivity is obtained when distilled water is used for dilution as shown in fig 6.
- Value of conductivity decreases with increase in concentration of bore water in diluted sample.

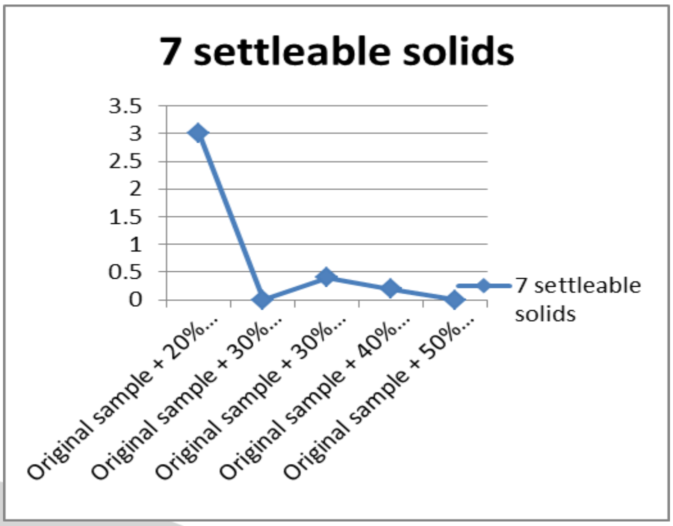

Fig. 7 Settle-able solids test results of Muhana Mandi

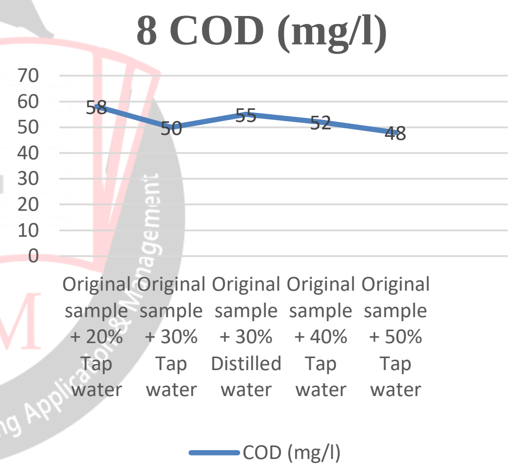

Fig. 8 COD test results of Muhana Mandi

- Fig. 7 shows that settleable solids are decreased as increasing the dilution in sewage water because organic matter is being decomposed in dilution due to increased dissolved oxygen, as shown in fig 7.
- COD value is decreased as dilution is increased due to increase in the amount of dissolved oxygen in waste water which is sufficient for decomposition of organic compounds, results of this is reduction in COD of waste water which shown in figure 8.

V. Conclusion

In sewage water, the value of pH, BOD, COD, DO exceeds the permissible limit of waste water used of irrigation purpose as compare to CPCB 2015 and FAO standards of sewage being used for irrigation purpose. After dilution

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with ground water (Bore water of study area) in different percentage in waste water, reduction in BOD, COD value and increment of DO value is observed, which can overcome the problem of sewage sickness and also improve ground water characteristics. Diluted waste water sample has significant value of TS, TDS, suspended solids etc. due to poor ground water quality which may be due to sewage farming.

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