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# Comparative Study of Physico- Chemical Characteristics of Water and soil of Treated and Untreated Waste Water

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## Abstract

Safe discharge of untreated waste water and scarcity of water is still a burning problem in front of mankind. Discharge of untreated waste water, without any treatment affects the physico – chemical properties of water and soil which enters into food chain and affects agriculture products, animal and human health. This paper reveals that use of treated waste water instead of untreated waste water improves the physico – chemical properties of water i.e. pH, EC, TDS, Chloride, Hardness, DO, BOD, COD, Nitrate, Phosphate and Sulphate changes from 8.49 to 7.20, 1.71 to 3.-82mmhos/cm, 2253 to 734 mg/l, 776.70 to 564.33 mg/l, 1100 to 330 mg/l, 0.5 to 6.9mg/l, 300 to 60mg/l, 800 to 144 mg/l, 13 to 17mg/l, 6.89 to 9.12 mg/l and 28 to 37 mg/l respectively. In soil physico – chemical properties i.e. pH, EC, Chloride, Organic Matter %, Organic Carbon %, Nitrogen % and Phosphorus % changes from 9.4 to 7.5, 1.25 to 1.10 mmhos/cm, 16.7 to 19.3 mg/l, 0.65 to 2.55%, 0.37 to 1.47% and 0.018 to 0.022 % and 0.016 to 0.013%. Heavy metal contents i.e. Zn, Cu, Cr, Cd, Ni ,Pb and Fe in water samples change from 3.568 to 3.494 mg/l, 2.814 to 2.616 mg/l, 1.623 to 1.235 mg/l, 1.930 to 1.562 mg/l, 0.051 to 0.028 mg/l, 1.084 to 1.047 mg/l and 1.449 to 1.362 mg/l respectively. In soil samples, heavy metal contents i.e. Zn, Cu, Cr, Cd, Ni, Pb and Fe changes from 1.690 to 1.245 mg/kg, 1.100 to 1.080 mg/kg, 0.138 to 0.590 mg/kg, 0.243 to 0.144 mg/kg, 0.041 to 0.025 mg/kg, 0.311 to 0.282 mg/kg and 1.831 to 0.818 mg/kg respectively After using treated waste water physico – chemical properties of water and soil improve but there is a minor change in heavy metal content. So, treated waste water (after secondary treatment) can be used as a best source of irrigation water which fulfill the nutrient requirements of crops. But, it is advisable that we should move towards tertiary waste water treatment techniques so that we can also reduce the heavy metal content up to a greater extent, combat the problem of waste water pollution, reduce the stress on limited fresh water available today and can use waste water for various domestic purposes.

**Keywords**: Treated waste water, untreated waste water, secondary treatment, heavy metal, nutritional value.

## Introduction

Now a day, development has become synonymous with deforestation and progress has become synonymous with pollution. Inability to cope with the increasing pressure on their infrastructure, largest cities are reaching to the saturation points due to deterioration of our environment day by day. Industrial effluents, sewage and farm wastes are the major pollutants, contaminating the environment[1]. Water is the fundamental need of life. It is not possible to survive any forms of life on earth. Anthropogenic activities have also introduced substantial amounts of pollutants into the environment by mobilization from their natural insoluble deposits[2]. The water required by the life must be pure that it is free from all the types of contaminants, but in the present time it is not possible due to industrialization. The major amount of water is used in various industrial purposes and after completion of the process it is discharged directly to ground or surface water and in turns contaminates the water and soil[3]. Among pollution causing industries, some industries achieve a major attention by environmentalists due to expenditure of large volume of water, utilization of chemicals during various processes of manufacturing. These effluents contain carcinogenic aromatic amines, organic and inorganic materials[4]**.** Discharging the contaminated water without pre treatment may directly cause environmental degradation and it indisputably declines the soil productivity and negatively affects the level of crop production in the surrounding agricultural areas[5]. Untreated effluent take account of high level of BOD, COD, colour, toxicity, surfactants, turbidity, and at the same time it contain high level of heavy metals. Heavy metals in the untreated wastewater are of most concern and they represent a significant ecological and public health concern as they are non-biodegradable, toxic, accumulated in the environment, biomagnified along the food chain and posing a significant danger to aquatic living organisms and human health also[6]. Microbial activity slows down and biological treatment system also fails due to the existence of heavy metals and other compounds. To avoid health hazards it is essential to remove these toxic heavy metals from waste water before its disposal.

Agricultural activity is a key of food security in the world as well as an economic activity supporting country development and livelihood of many families. Unreliable rainfalls cause the agricultural activities to depend on irrigation instead of rain-fed[7]**.** Decreasing water level, shortage of water and pollution of

water is being a major problem worldwide. For agriculture purpose this problem gives rise to the use of alternative sources of water. However, fresh water scarcity arises from increasing demand of water resources, pollution of water sources, overexploitation of groundwater and periodic droughts which in turns affects the irrigation practices and threatens the development and sustainability of agriculture. Thus, treated wastewater has been identified as a practical solution for overcoming water scarcity, improving the physico–chemical properties of water and soil and supporting the agricultural production 8. Treated wastewater is a reliable and valuable water source in urban agriculture. Apart from providing moisture content, it also contains essential nutrients and organic matter for plant growth leading into increased crop yield[9].

The objectives of this paper are: To do the comparative study between treated and untreated waste water. To assess the applicability of treated waste water and adverse effects of untreated waste water on water and soil quality. To evaluate the effects of heavy metals on soil and water quality after continuous use of treated and untreated waste water. To analyze the physico – chemical parameters of water and soil samples.

## Material and Methods

For the Present study, water and soil samples were collected from 2 sampling sites in Post Monsoon season (winter). Sampling sites are: Treated sampling site (Waste water Treatment plant) which is located at Jaipur, Raj. Untreated Sampling Site (Amanishah Nallah) which is located at Jaipur, Raj.

Water samples were collected in cleaned and washed glass bottles and soil samples were collected in clean polythene bags. Collected water samples were analyzed for various parameters i.e. pH, EC, TDS (total dissolved solids) chloride, DO, BOD, COD, total hardness, calcium hardness, magnesium hardness, nitrate, phosphate and sulphate. Collected soil samples were analyzed for pH, EC, chloride, organic matter, nitrogen. Amount of heavy metals were also analyzed in water and soil samples by atomic absorption spectrophotometer (AAS). Experiments were carried out in the research Laboratory of Indira Gandhi centre for Human Ecology, environment and Population Studies, University of Rajasthan, Jaipur.

## Results and Discussion

Results show that use of treated waste water instead of untreated waste water improves the physico – chemical properties of water i.e. pH, EC, TDS, chloride, hardness, DO, BOD, COD, Nitrate, Phosphate and Sulphate changes from 8.49 to 7.20, 1.71 to 3.82 mmhos/cm, 2253 to 734 mg/l, 564.33 to 776.70 mg/l,1100 to 330 mg/l, 0.5 to 6.9mg/l, 300 to 60mg/l, 800 to 144 mg/l, 13 to 17mg/l, 6.89 to 9.12 mg/l and 28 to 37 mg/l respectively (table-1). In soil physico–chemical properties i.e. pH, EC, chloride, organic matter%, organic carbon %, nitrogen% and phosphorus% change from 9.4 to 7.5, 1.25 to 1.10 mmhos/cm, 16.7 to 19.3 mg/l, 0.65 to 2.55%, 0.37 to 1.47% and 0.018 to 0.022 % and 0.016 to 0.013% (table-2). After using treated waste water physico–chemical properties of water and soil improve but there is a minor change in heavy metal content. Heavy metal contents i.e. Zn, Cu, Cr, Cd, Ni, Pb and Fe in water samples change from 3.568 to 3.494 mg/l, 2.814 to 2.616 mg/l, 1.623 to 1.235 mg/l, 1.930 to 1.562 mg/l, 0.051 to 0.028 mg/l, 1.084 to 1.047 mg/l and 1.449 to 1.362 mg/l respectively. In soil samples, heavy metal contents i.e. Zn, Cu, Cr, Cd, Ni, Pb and Fe changes from 1.690 to 1.245 mg/kg, 1.100 to 1.080 mg/kg, 0.138 to 0.590 mg/kg, 0.243 to 0.144 mg/kg, 0.041 to 0.025 mg/kg, 0.311 to 0.282 mg/kg and 1.831 to 0.818 mg/kg respectively. Bio Concentration Factor (BCF factor in %) of treated water and soil in Zn, Cu, Cr, Cd, Ni, Pb and Fe is 47.36, 39.09, 70.11, 12.59, 80.39, 28.69 and 57.34 respectively. Bio Concentration Factor (BCF factor in %) of untreated water and soil in Zn, Cu, Cr, Cd, Ni, Pb and Fe is 35.63, 41.28, 47.77, 73.23, 89.28, 26.93 and 60.05 respectively (table–3).

**Figure-1**
**Untreated Sampling Site (Amanishah Nallah)**

**Figure-2**
**Treated sampling site (Waste water Treatment plant)**

**Table–1**
**Physico – chemical analysis of Water samples in Post Monsoon season**

| **Parameters** | **Treated waste water** | **Untreated waste water** | **WHO Standards** |
|---|---|---|---|
| Temperature | $28^0$C | $25^0$C | - |
| Colour | Colourless | Greyish black | - |
| pH | 7.20 | 8.49 | 6.9- 9.2 |
| EC (mmhos/cm) | 3.082 | 1.71 | - |
| TDS(mg/l) | 734 | 2253 | 500 -1500 |
| Chloride(mg/l) | 564.33 | 776.70 | 250-1000 |
| Total Hardness(mg/l) | 330 | 1100 | 100-500 |
| $Ca^{+2}$ Hardness(mg/l) | 80 | 650 | 75-200 |
| $Mg^{+2}$ Hardness (mg/l) | 250 | 580 | 50-150 |
| DO(mg/l) | 6.9 | 0.5 | - |
| BOD (mg/l) | 60 | 300 | - |
| COD (mg/l) | 144 | 800 | - |
| Nitrate (mg/l) | 17 | 13 | 10 |
| Phosphate (mg/l) | 9.12 | 6.89 | - |
| Sulphate (mg/l) | 37 | 28 | 400 |

**Table-2**
**Physico – chemical analysis of soil samples in post – Monsoon season**

| **Parameters** | **Uncontaminated soil** | **Effluent irrigated soil** |
|---|---|---|
| pH | 7.5 | 9.4 |
| EC (mmhos/cm) | 1.10 | 1.25 |
| Chloride(mg/l) | 19.3 | 16.7 |
| Organic matter % | 0.65 | 2.55 |
| Organic Carbon % | 0.37 | 1.47 |
| Nitrogen % | 0.022 | 0.018 |
| Phosphorus % | 0.013 | 0.016 |

**Table-3**
**Heavy Metal analysis of water and soil samples in Post Monsoon season**

| **Heavy Metals** | **Untreated waste water (mg/l)** | **Treated waste water (mg/l)** | **WHO standards of water (in mg/l)** | **Contaminated Soil (mg/kg)** | **Uncontaminated soil (mg/kg)** | **BCF factor (contaminated water and soil sample)** | **BCF factor (uncontaminated water and soil sample** |
|---|---|---|---|---|---|---|---|
| Zn | 3.568 | 3.494 | 5 | 1.690 | 1.245 | 47.36 | 35.63 |
| Cu | 2.814 | 2.616 | 1.0 | 1.100 | 1.080 | 39.09 | 41.28 |
| Cr | 1.623 | 1.235 | 0.05 | 0.138 | 0.590 | 70.11 | 47.77 |
| Cd | 1.930 | 1.562 | 0.05 | 0.243 | 0.144 | 12.59 | 73.23 |
| Ni | 0.051 | 0.028 | - | 0.041 | 0.025 | 80.39 | 89.28 |
| Pb | 1.084 | 1.047 | 0.1 | 0.311 | 0.282 | 28.69 | 26.93 |
| Fe | 1.449 | 1.362 | 0.3 | 1.831 | 0.818 | 57.34 | 60.05 |

**Discussion:** Results show that after secondary treatment of untreated waste water, physico – chemical properties of waste water improved and continuous application of untreated waste water for irrigation purpose reduce the soil quality. Most of the physico – chemical parameters of untreated waste water are beyond permissible limits which makes the water and soil unsuitable for agricultural and other domestic purposes. In untreated effluent, high BOD may be due to fibre residues and suspended solids. Found the same observation[10].

Whereas most of the physico- chemical parameters of treated waste water are in permissible limits which improves the water and soil quality and also fulfill the nutritional requirement of agricultural crops. Findings of other researchers also results the same[11,12]. Amount of nutrients (Nitrate, Phosphate & Sulphate) increases to some extent and show the positive impacts on agriculture. So, this type of treated waste water can be considered as a source of nutrient and it reduces dependency on artificial fertilizers. Thus, use of treated waste water can be considered as a good source of water for irrigation purpose that can also solve the problem of untreated waste water along with the water scarcity.

## Conclusion

This research has provided fundamental information for the sustainable utilization of treated waste water for crop production. Sustained efforts are needed to further evaluate the safe use of treated wastewater in soil-plant system. It was found that BOD, COD, TDS, chloride, and hardness of the treated

effluent were reduced whereas DO, nitrate, phosphate and sulphate of the treated effluent were increases and high transparency of the treated effluent was obtained. After treatment of waste water some amount of heavy metals were also reduced. On the basis of the above findings we concluded that waste water should not be used as such for agricultural purpose. The treatment of the wastewater be made to render the waste water suitable for irrigation in agricultural lands.

**Recommendations:** On the basis of the findings of this research paper, it is advisable that the effluents should not be discharged directly into the adjoining pool and streams; there should be a waste water treatment plant so that waste water can be treated before it is used for irrigation. So, the need of the hour is to think about the Tertiary treatment level so that the amount of heavy metals can be removed up to a greater extent and it can be used for domestic purposes also. We can prevent our environment from these pollutants as we can promise to ourselves to adopt a sustainable way for using waste water. It will be a step towards saving our Environment.

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