Studying of BOD_5 and COD variations in domestic wastewater after treated by agronomical soil

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ABSTRACT
The objective in this study was the studying of BOD_5 and COD variations in domestic wastewater after treated by agronomical soil. In this experiment, we had 15 lysimeters that 1 to 5 lysimeters were irrigated by domestic wastewater and primary drainage water was accumulated from these lysimeters and 6 to 9 lysimeters were irrigated by primary drainage water and secondary drainage water was accumulated and 10, 11 and 12 lysimeters were irrigated by secondary drainage water. In order to compare soil properties, 13, 14 and 15 lysimeters were irrigated by agronomical water and finally, soil and water properties were analyzed in each stage. The results showed that soil could filter the domestic wastewater and reduced BOD_5 and COD of domestic wastewater. Also, irrigation with domestic wastewater increased nutritive elements in soil that can be source of nutrition for plants. The findings may give applicable advice to commercial farmers and agricultural researchers for management and proper use of water.

Key words: BOD_5, COD, domestic wastewater, agronomical soil.

INTRODUCTION
Irrigation is an excellent use for sewage effluent because it is mostly water with nutrients. For small flows, the effluent can be used on special, well-supervised “sewage farms,” where forage, fiber, or seed crops are grown that can be irrigated with standard primary or secondary effluent. However, agronomic aspects related to crops and soils must also be taken into account (Bouwer and Idelovitch, 1987). Irrigation may be defined as the application of water to soil for the purpose of supplying the moisture essential for plant growth. Irrigation plays a vital role in increasing crop yields and stabilizing production. In arid and semi-arid regions, irrigation is essential for economically viable agriculture, while in semi-humid and humid areas, it is often required on a supplementary basis (Oron et al., 1986). In a field experiment was carried out on a sandy soil in Agadir region, two types of water were used: the rainfall supplemented with treated wastewater irrigation of which five treatments were tested. Leaf, root content of nitrogen, phosphorus, potassium, calcium and magnesium was increased proportionally to the irrigation doses. The electrical conductivity of the soil increased from the start to the end of the experiment. The evaluation of soil nutrients for the three soil layers indicated their accumulation with increasing irrigation dose (Mosab, 2000). The objective of Mancino and Pepper (1992) was to determine the influence of secondarily treated municipal wastewater irrigation on the chemical quality of bermudagrass (*Cynodon dactylon* L.) turf soil (Sonoita gravelly sandy loam: coarse-loamy, mixed, thermic Typic Haplargid) when compared to similarly irrigated potable water plots. Research plots were irrigated using a 20% leaching fraction. After 3.2 yr of use, effluent water

increased soil electrical conductivity by 0.2 ds m^{-1}, Na by 155 mg kg^{-1}, P by 26 mg kg^{-1}, and K by 50 mg kg^{-1} in comparison to potable irrigated plots. Soil pH was not significantly affected by effluent irrigation. The concentrations of Fe, Mn, Cu, and Zn were found to be within the range considered normal for agricultural soil. Effluent irrigation increased soil total organic carbon and nitrogen during the first 1.3 yr of irrigation only. Total aerobic bacteria populations were similar in all irrigated plots indicating these microbes were not promoted or inhibited by the use of this wastewater. In summary, the irrigation of this turf soil for 3.3 yr with the secondarily treated wastewater used in this study had no serious detrimental effects on soil quality. Therefore, the objective of this experiment was to determine the BOD_5 and COD variations in domestic wastewater after treated by agronomical soil.

MATERIAL AND METHODS

This study was conducted on experimental lysimeters of Islamic Azad University, Shahr-e-Qods Branch at Iran with clay loam soil (Table 1). The volume of each lysimeter was 150 lit filled by soil and in order to prevent water influx from field to lysimeters, those placed on metal legs. After filling lysimeters by clay loam soil, plants seeds were planted and were irrigated with agronomical water. In this experiment, we had 15 lysimeters that 1 to 5 lysimeters were irrigated by domestic wastewater and primary drainage water was accumulated from these lysimeters and 6 to 9 lysimeters were irrigated by primary drainage water and secondary drainage water was accumulated and 10, 11 and 12 lysimeters were irrigated by secondary drainage water. In order to compare soil properties, 13, 14 and 15 lysimeters were irrigated by agronomical water. At the each stage, soil and water properties were analyzed and compared with agronomical water properties. The analysis of lysimeter soil texture, % of sand, silt, clay, amount of K,P, Na, Fc, PWP, pH, SAR, Ca, Mg, EC and analysis of different parameters of water, TSS, SAR, pH, EC, BOD_5 and COD were determined by using standard procedures.

RESULTS AND DISCUSSION

The first of this study, we analyzed lysimeters soil (Table 1) and domestic wastewater (Table 2) and then 1 to 5 lysimeters were irrigated by domestic wastewater and was accumulated primary drainage water (Table 3).

Table 1- The analysis of lysimeters soil before planting

Soil texture	Sand (%)	Silt (%)	Clay (%)	K (mg/lit)	P (mg/ lit)	Na (mg/ lit)	FC (%)	PWP (%)	pH	SAR	Ca (mg/ lit)	Mg (mg/ lit)	EC (Ds/m)
Loam	42	28	30	201.41	5.12	30.21	13.7	6.14	7.2	8.72	12.01	14.12	5.68

Table 2- The analysis of domestic wastewater

TSS (mg/ lit)	SAR	pH	EC (Ds/m)	BOD_5 (ppm)	COD (ppm)
208.81	5.81	7.2	4.8	150	232

Table 3- The analysis of primary drainage water

TSS (mg/ lit)	SAR	pH	EC (Ds/m)	BOD_5 (ppm)	COD (ppm)
190.17	4.82	6.98	3.81	15	30

In the next stage, the 6 to 9 lysimeters were irrigated by primary drainage water and was accumulated secondary drainage water and were analyzed soil after irrigation by primary drainage water (Table 4) and secondary drainage water (Table 5).

Table 4- The analysis of lysimeters soil after irrigation by primary drainage water

K (mg/lit)	P (mg/ lit)	Na (mg/ lit)	pH	SAR	Ca (mg/ lit)	Mg (mg/ lit)	EC (Ds/m)
208.40	12.14	38.14	7.41	9.92	14.02	16.17	8.71

Table 5- The analysis of secondary drainage water

TSS (mg/ lit)	SAR	pH	EC (Ds/m)	BOD_5 (ppm)	COD (ppm)
188.14	4.63	6.94	3.42	5	8

Then, the 10, 11 and 12 lysimeters were irrigated by secondary drainage water and was analyzed soil after irrigation by secondary drainage water (Table 6).

Table 6- The analysis of lysimeters soil after irrigation by secondary drainage water

K (mg/lit)	P (mg/ lit)	Na (mg/ lit)	pH	SAR	Ca (mg/ lit)	Mg (mg/ lit)	EC (Ds/m)
219.12	18.38	45.17	7.48	11.17	18.52	19.22	8.82

The results showed that soil was a biofilter that could reduce a large part of domestic wastewater pollutions, for example BOD_5 and COD decreased, but this filtering increased EC, SAR, Na, Ca and Mg of soil. Also, the secondary drainage water was accumulated and analyzed, that our data indicated that primary drainage water pollutions reduced again, but EC, SAR, Na, Ca and Mg of soil increased under this condition. In the tables 7 and 8 we compared in each stage soil and water of lysimeters with soil before planting and agronomical water.

Table 7- Comparison of soil properties before planting with soil properties after irrigation by primary and secondary drainage water

	K (mg/lit)	P (mg/ lit)	Na (mg/ lit)	pH	SAR	EC (Ds/m)
Before planting	201.41	5.12	30.21	7.2	8.72	5.68
Irrigation by primary drainage water	208.40	12.14	38.14	7.41	9.92	8.71
Irrigation by secondary drainage water	219.12	18.38	45.17	7.48	11.17	8.82

Table 8- Comparison of domestic wastewater properties with primary and secondary drainage water properties

	TSS (mg/ lit)	SAR	pH	EC (Ds/m)	BOD_5 (ppm)	COD (ppm)
Domestic wastewater	208.81	5.81	7.2	4.8	150	232
Primary drainage water	190.17	4.82	6.98	3.81	15	30
Secondary	188.14	4.63	6.94	3.42	5	8

drainage water						

Salt leaching would become less effective when soil hydraulic conductivity and infiltration rate were reduced. These chemical changes may in part contribute to the stress symptoms and die off observed in some ornamental trees. As more landscape facilities and development areas plan to switch to recycled sewage water for irrigation, landscape managers must be prepared to face new challenges associated with the use of recycled sewage water. Persistent management practices, such as applications of soil amendments that provide Ca to replace Na; periodic leaching to reduce salt accumulation; frequent verifications to maintain infiltration, percolation, and drainage; regular soil and plant monitoring, and selection and use salt tolerant turf grass and landscape plants will be helpful in mitigating the negative impact and ensuring continued success in using sewage water for landscape irrigation. Many sewage water irrigators are not landowning farmers, but landless people that rent small plots to produce income-generating crops such as vegetables that thrive when watered with nutrient-rich sewage. Across Asia, Africa and Latin America these wastewater micro-economies support countless poor people. Stopping or over-regulating these practices could remove the only income many landless people have.

ACKNOWLEDGMENTS

The authors acknowledge the financial support of Agricultural Scientific Association, Islamic Azad University.

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