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Feasibility Study for Improving the Quality of Refined Sewage Due to the Advancement of Soil

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ABSTRACT

In this study, changes in the quality of wastewater due to movement on the soil surface during irrigation were studied. For this purpose, 20 irrigation operations were carried out in four furrows, and then the quality of wastewater and runoff was tested. Investigations showed that the total suspended matter (TSS) and electrical conductivity (EC) of the wastewater after the advance on the soil have increased significantly. The increase in EC during the irrigation season with relative stabilization of the bed is more significant. On the other hand, changes in the biological parameters of the wastewater (COD and number of coliforms) after moving in the furrow, except for the increase in the first irrigation, had a decreasing trend. Increasing these indexes in the first irrigation with regard to high air temperature can be attributed to erosion, increased suspended load and soil contamination. The faster flow of wastewater and the possibility of combining air oxygen, absorbing some of the coliforms by the soil and, possibly removing them from sunlight, can affect the reduction of contamination in subsequent irrigation. The results showed that the higher the SAR, TSS and COD of the input wastewater and the EC, the lower the contamination reduction due to the progression. The present study is one of the first studies to investigate the effect of soil movement on the quality of sewage

Keywords: *Sewage Treatment, Soil Advancement, Jute Irrigation, Biological Indices*

INTRODUCTION

Studies show that many of the sewage contaminations such as fecal coliforms (microbial contamination index and sewage disease), and biomarkers and chemical oxygenation are significantly reduced after passing through the soil layer, while soil "good self-healing" As time passes, the amount of contamination accumulated is decreasing (Behrooz, 2005). Also, the stimulation of indigenous microorganisms (Doosky et al., 2013) and temperature rise, especially higher than 13 degrees (Yuan et al., 2013) can also increase the process of reducing pollutants. It is important to note that in the long term the soil retains its refining properties in the removal of elements from the sewage (eg, PHosPHorus) (Eveborn et al., 2012. The use of soil as a filter for urban wastewater treatment increases the oxygen content of the solution and decreases the oxygen content of the wastewater and also reduces the amount of turbidity, suspended solids, total coliforms and fecal coliforms. The unique features of this process in sewage treatment include the lack of need for aero chemicals, mechanical energy, and low PHysical space (Kadam et al., 2009). Also, due to the possibility of reducing organic matter by soil, soil can be used as an on-site treatment process for the treatment of domestic wastewater (Teerlink et al., 2012).

Environmental factors such as sunlight can affect the quality of sewage. For example, the treatment of sewage with sunlight makes the products such as lettuce, which are irrigated with this wastewater, are not contaminated with E-coli bacteria (Bichai et al., 2012). Also, sunlight and air temperature increase can be the most important factor in the mortality of coliforms (Yukselen et al., 2002). It should be noted that the growth and survival of microorganisms (such as coliform and E-coli) are very sensitive to the conditions of food shortages and high temperatures (especially those above 37 ° C) and can leave the water environment to survive and solidify (Sakyi, 2012 and Asare; Ghasemi, 1367).

Disinfection efficiency (reduced microbial load, like coliform) is increased by increasing sunlight and increasing the intensity of radiation and contact time, while at the same time it has an inverse relationship with the degree of turbidity (Dosti et al., 2011). High turbidity, as a biological agent, can lead to the growth and multiplication of pathogenic microorganisms and pathogens, and reduce the water disinfection efficiency (Dobordaran et al., 2006; Dezuane, 1997).

Dilution and movement are other factors in changing the quality of sewage. For example, by entering the sewage into the river and moving in its direction, the water pollution will vary in different places and times (Ji, 2008).

Considering the necessity of using sewage and reuse of runoff in agriculture (water crisis debate), the problem of pollutants in these unconventional waters is of particular importance (Hasan Akhli, 2006).On the other hand, runoff from irrigation influences the quality of surface water that is discharged, and it can increase the toxicity and microbial contamination, the growth of algae and aquatic weeds (and consequently the reduction of DO in these waters) while depositing erosion soil. (Fred Lee et al., 2007).Therefore, the study of the quality of runoff, especially when using wastewater in irrigation, is important and leads to practical solutions for decommissioning or reuse of it. In this study, the possibility of increasing the quality of sewage with its movement on the soil in the presence of environmental factors was investigated in jute irrigation.. According to the sources of Persian and Latin sources, "the effect of movement on the soil on the quality of sewage" has not been studied and studies have focused on "the effect of sewage penetration in the soil and its effect on wastewater treatment." Accordingly, the present study is one of the first studies to evaluate the effect of soil movement on the quality of sewage.

MATERIALS AND METHODS

In order to achieve the objectives of the project, 12 twelve wings with a length of 42 m, a width of 60 cm, a longitudinal slope of about 0.1%, and the same soil texture were selected at a field in Isfahan University of Technology, and open-ended jet irrigation was performed. Irrigation without irrigation was carried out for four days. 20 jute irrigation in four main flocks with 5 replications. Experimental farm soil characteristics are presented in Table 1:

Table1. *Distribution of particle size and soil texture in two layers of 0-15 and 15-40 cm and some soil characteristics of the field*

PHysical and chemical characteristics					Soil particles				
PH	**ECD s/m**	**Materials to percent %**	**Apparent density of soil g/cmm**	**Gravel %**	**soil pattern -**	**Clay %**	**Silt %**	**Sand %**	**Depth cm**
8/08	1/40	<1	1/68	36/2	Clay looney	27/4	20/3	52/3	0-15
8/14	1/43	<1	1/70	46/5	Clay looney	27/0	18/8	54/2	15-40

The sewage used was the effluent from the wastewater treatment basins located at Isfahan University of Technology. The plant is designed for a population of 9,000 people and is operated in aerated ponds, including an aerobic-anaerobic aerobic pond and a Seagate sub-basin. The duration of sewage in each basin is about 20 days (Fig. 1).

Figure1. *Exhaust from collecting and treatment pools of wastewater from Isfahan University of Technology*

In each experiment, the amount of input current was selected at 0.8L / s based on the maximum non-stress flow rate. In order to eliminate side effects, two lateral ventricles were considered for each of the main vetches. The duration of the upstream flow to the end of the furrow length was measured. Also, the intensity of the inlet and outlet flow was determined by a convoy type short-necked navy. From the barrel pipe) was used for simplicity and precision in flood dewatering management. The water pressure on the barrel tube was maintained by a 50-cm water tank at the end of the experiment. (figure 2). Irrigation operations continued until the extreme penetration was reached

A B C

Figure2. *Field views, including storage and water supply sources (A), Navigator (B) and Sewage Progression (C)*

Sampling of the wastewater and runoff of this effluent after the length of the furrow, based on the sampling standards (Research and Improvement Productivity Center of the country's water and wastewater industry, 1374 and the American Public Health Association, 1998), was carried out so that the sample The quality of the wastewater was input and outflow runoff. The samples were transferred to the laboratory in a short time and at low temperatures (along with ice bags).Sample containers were even dark brown and of a resilient plastic material of about 0.2 to 1 liter. It should be noted that the use of containers is non-standard material (due to surface adhesion that interferes with the identification of microorganisms).

The purpose of the sampling was to perform Physical, chemical and biological tests. The measured quality indices included electrical conductivity (EC), acid-play (PH), total suspended matter, chemical oxygenation, total coliform and wastewater temperature, which was measured for operational effluent and furrow runoff. Regarding the effect of temperature and intensity of sunlight on the growth of coliforms, the general condition of air was recorded in the meteorological station located on the same farm.

Contaminated indices including TSS, COD and Coliform were determined by methods of filter paper, closed reflective spectroscopy and multicellular methods, respectively. The results of the tests for determining the total number of coliforms were expressed as the most probable possible number in 100 ml (Research and Improvement Productivity of the Water and Wastewater Industry of the country, 1374 and the American Public Health Association, 1998).

Pollution indices were conducted in the first three stages, the middle and the end of the irrigation period. Also, the amount of positive and negative ions of input wastewater at the first and the end of the irrigation period was obtained by flame metering and volumetric measurements.

FINDINGS AND DISCUSSION

By following the design and based on the measurements mentioned, the following results were obtained:

A. Characteristics related to the impact of environmental conditions and soil characteristics on the waste water quality, as presented in Table 2. As observed, in all irrigation, air is smooth and sunny, and the temperature of the wastewater has changed in proportion to the temperature of the air. Hydraulic characteristics, depending on the irrigation rotation, have different forward speeds during the experiments, which was lower in the first irrigation due to the specific conditions of the bed, and the percentage of runoff was also reduced accordingly.

Progressive speed Exhaust flow Final soil penetration			Public air Condition Average air Average input water Temperature temperatures Average flow waste water				Irrigation period
1/27	14/6	71/8	Smooth and sunny	32	29/2	30/0	First
3/22	47/5	45/1	Smooth and sunny	31	28/8	29/6	Center
3/12	49/4	45/8	Smooth and sunny	28	23/5	25/7	End

B. The chemical quality of the wastewater used in terms of the amount of salts contained in it in Table 3. As can be seen, although the total amount of soluble particles in the waste water at the beginning and the end of the period was not appreciably changed, the risk of degradation of sodium (using The sodium absorption ratio (SAR) at the beginning of the period is severe and at the very end it is evaluated for the least harmful effect. The amount of chlorine has always been noticeable.

SAR $(meq/lit)^{1/2}$	مجموع بارهاي مثبت يا منفي	SO_4^{--}	Cl^-	HCO_3^-	CO_3^{--}	Mg^{++}	Ca^{++}	K^+	Na^+	دورةآبياري
		meq/lit				*meq/lit*				
5/4	16/6	1/6	10/6	4/4	0/0	1/7	4/5	0/9	9/5	اوّل دوره
2/0	16/3	0/3	10/6	4/9	0/5	5/0	6/2	0/3	4/8	آخر دوره

C. Summary of the results of the Physical, chemical and biological tests of wastewater along with the relative changes in the quality indicators of the effluent compared to the input to the wells are presented in Table (4):

Table4. Quality of wastewater entering the furrow and its output in three periods of the irrigation season.

Changes	Coliform 1000MPN/ 100cc	% Changes	COD mg/lit	% Changes	TSS mg/lit	Change s %	EC dS/m	% Changes	PH	Check location	Irrigatio n period
108%	233	16%	92	1465%	60	17%	0/99	1%	8/26	Entrance	First
	485		107		939		1/16		8/34	Output	
	0/04		0/01		0/01		0/09		0/62		P-value
-13%	69		110	1126%	68	23%	1/10	11%	7/26	Entrance	Center
	60	-13%	96		834		1/35		8/06	Output	
	0/63		0/01		0/01		0/07		0/22		P-value
-77%	176	-20%	84	1136%	53	30%	1/10	3%	8/01	Entrance	End
	40		67		655		1/43		8/25	Output	
	0/02		0/04		0/01		0/19		0/53		P-value
-	1	-	200	-	100	-	-	-	6/0-8/5	Agriculture	Standard Border
-	1	-	60	-	40	-	-	-	6/0-8/5	Discharge	

**Report of the Environment Organization of Iran (Mohammadi, 138*

According to the results table, in terms of PH, TSS and COD, the waste water quality is at the acceptable level for irrigation, but in terms of total coliforms it is not standard. The amount of suspended matter after the move in the flock is past the limit.

Based on the results obtained in this study, by creating the appropriate conditions, it is possible to improve the quality of the wastewater and its treatment through the passage of soil. These conditions include contaminated soils that increase sewage pollution and proper soil texture that prevents sewage into the soil and contaminates groundwater resources. Soil conditions should be in such a way that there is a possibility of aeration to the sewage along its pathway on the soil. It should be noted that the drainage bed on the soil should have conditions that prevent the increase of TSS. In this case, the stresses and the effect of fluid movement on soil particles should be used. Soil salinity level should be eliminated by leaching before the start of treatment operations, so as not to be observed in this study, increase salinity of the effluent. The PH of the soil should also be appropriate for the purification conditions. Also, the climatic and temperature conditions of the area during treatment operations are such that favorable conditions for growth of microorganisms and as a result of increased pollution of the effluent cannot be provided.

According to the results of Table 4, there was no significant difference between the PH and the EC inlet and outlet. There was a significant difference between the input and output TSSs, so that the TSS output was higher than the input. Output COD in the first period of irrigation was higher than the input COD in the first irrigation. If the input COD in the middle and last irrigation was higher than the outlet. The coliform output was higher in the first irrigation than the input. In the last coliform watering, the entrance was greater than the output.

According to the results table, in terms of acidity-play, in the wastewater quality, a slight upward trend is observed after its advance on the soil (up to 11% in the middle of the period). Given the resistance of this index to variability, this can indicate compounds that are soluble in the waste water along the pathway on the soil. Considering the changes in the electrical conductivity (EC) from 20 to 30% due to the progression of the flow during the furrow, it further confirms this.

Another quality indicator, TSS, also has a significant difference in the amount of input and output suspended matter. This difference can be seen from about 11 times the increase in non-irrigation irrigation (1100% change) to nearly 15-fold increase in first irrigation; more can be attributed to more credibility in the furrow bed. Compared to soluble, the accuracy of the results shows that during the course of the period, the greater the amount of irrigation, the soil is relatively tightened and therefore the erosion of the soil decreases; however, the salt composition is further increased with water and the amount of salinity changes in the path of soil Flow becomes more. More erosion in the first irrigation can also be attributed to SAR and EC wastewater, because high SAR and EC low water is one of the important factors in increasing soil erosion (Lentz et al., 1996; Li et al., 2010). This is important in terms of sewage treatment because of the greater the erosion, the burden of suspended matter is progressing further and, as a result, the effect of the sun's waves due to increased opacity, decreases and prevents the mortality of micro-organisms.

According to the results, changes in the COD index and the total number of coliforms have the same trend and, with the exception of the observed increase in the first irrigation, their values during the movement in the furrow have a decreasing trend in subsequent irrigation. Due to the high temperature of the air during the test, the increase in oxygenation of the wastewater after movement during the furrow in the first irrigation can be attributed to the erosion and increase of suspended load as well as soil contamination. Increasing coliform (and consequently reducing the dissolved oxygen) in this irrigation also reinforces this analysis. It should be noted that since coliforms are not significant in water and their presence in soil with uncultivated origin (such as soil and plant), or from faces in animals and plant remains, is possible (Hashemi-Karouei et al., 2013), increasing coliforms in First irrigation is justifiable. In subsequent irrigation, due to the faster movement (more advance velocity, Table 2) of the effluent and the possibility of combining oxygen with it, the amount of dissolved oxygen increased, and as a result, the oxygenation of the wastewater was reduced. Regarding the reduction of coliforms along the furrows, the absorption of coliforms by soil and, possibly, the removal of some of them by sunlight, can be considered effective in this regard. It should be noted that the comparison of the mean and final irrigation intervals, the lower TSS and COD of the input wastewater in the last irrigation, have significantly increased the reduction of coliforms due to the negative effect of opacity.

The final penetration rate of the soil can also affect the amount of wastewater treatment as a result of advancement on the soil and supplement the other factors of the treatment. The greater the penetration, the less soil erosion and the possibility of absorption of the coliform by the soil increases. The final infiltration rate also influences the speed of progression and thus the oxygenation of the wastewater of the outlet. This could be another factor justifying the increase in treatment in the last irrigation to the middle of the period. At the same time, in the first irrigation, despite the high level of penetration, contamination has increased due to the irrigation time, the quality of the input wastewater and the speed of the advance. It is worth noting that the closest and previous studies in this paper are about the effect of sewage in soil on the quality of drainage outflow from soil profile, which is wrong with the subject of this article due to the very different conditions.

CONCLUSION

Sewage treatment depends on the advancement of soils in jute irrigation, depending on the factors such as irrigation, intake effluent quality, effluent power in soil erosion, air velocity and air temperature, while the sensitivity of the treatment operation to the "quality of the wastewater and the turning point" Irrigation "is much higher than other factors. . Also, considering the ability of soil as a natural filter, it is suggested that the quality of drainage (drainage system outlet) and runoff from jet-water irrigation are compared. Also, the effect of different lengths of water movement on soils, plants, soils, and intensity of different streams and seasonal variations on the improvement or weakening of wastewater quality in surface irrigation can be investigated. Research on combining this topic and discussing the effects of irrigation with effluent on soil contamination and plant health can also be important given the current water crisis.

REFERENCES

[1] Laboratory Instructions for Water and Wastewater, Research and Improvement Center for the Water and Wastewater Industry of the country. 1374

[2] Hassan-e-Jalali, AS. R., 2006. Management of drainage systems and its reuse in agriculture, Iran National Irrigation and Drainage Commission, fourth technical drainage workshop, 39-58.

[3] The two brothers. B. Bina and B Nasr Esfahani, 2006. Effect of some Physical and chemical parameters on the growth of Aeromonads bacteria and heterotrophic bacteria (HPC) in Isfahan Drinking Water Distribution Network, Water and Sewage, 17 (1), 8-13.

[4] Boldy, M. Q Ebrahimi, S. AS R MovahediNaini and M. Ulami, 1392. Optimization of Biodegradation of Petroleum Hydrocarbons by Native and Non-Native Microorganisms, Water and Soil Conservation Studies, 20 (4): 165-181.

[5] Friendship, Z., M. Teimuri and h. AS Jamali, 2011. Disinfection of drinking water contaminated with coliforms using sunlight in presence and absence of Photo catalyst TIO2 in the summer and fall of 2011. Perception, Student Research Committee of the University of Qazvin, 8 (3): 24-28.

[6] Ghasemi, M., 1367. Wastewater treatment in tropical regions (translation), Isfahan Water and Wastewater Organization, 1[1] Behrouz, R., 2005. Use of soil profile for treatment of raw wastewater for agricultural purposes, second conference of research, technical and engineering experience exchange. 137-151.1-30.

[7] Mohammadi P., 2006. Review of Standards and Experience of Wastewater Use for Irrigation, National Iranian Irrigation and Drainage Committee Publication.

[8] HashemiKarouei, S. M., Islifar, M. And Zazawali, M. AS 1392. Determination of fecal coliform counting of water resources in some villages of Sari city by Multi-Band Fermentation Test (MPN). Journal of Mazandaran University of Medical Sciences. 23 (2): 95-8

[9] Anonymous. 1998. Standard methods for the examination of water and wastewater, 20th edition. United State.

[10] Bichai, F., M. I. Polo-Lopez and P. F. Ibanez. 2012. Solar disinfection of wastewater to reduce contamination of lettuce crops by Escherichia coli in reclaimed water irrigation. Water Research Journal. 46 (18): 6040-6050.

[11] Dezuane, J. 1997. Drinking water quality, 2nd Ed, International Thomson publishing Company, USA.

[12] Eveborn, D. D. Kong and J. P. Gustafson. 2012. Wastewater treatment by soil infiltration: Long-term Phosphorus removal. Contaminant Hydrology.24-33.

[13] Fred Lee, G. and A. Jones-Lee. 2007. Water quality issues of irrigated agricultural runoff/discharges San Joaquin River, central Valley, California. Agriculture and the Environment Conference. Central coast AGRI. water quality coalition, Monterey, CA.

[14] Ji, Z. G. 2008. Hydrodynamics and water quality: modeling rivers, lakes, and estuaries. Wiley interscience. PP 676.

[15] Kadam, A. M., P. D. Nemade, G. H. Oza, H. S. Shankar. 2009. Treatment of municipal wastewater using laterite-based constructed soil filter. Ecological Engineering. 35: 1051-1061.

[16] Lentz, R. D., R. E. Sojka and D. L. Carter. 1996. Furrow irrigation water-quality effects on soil loss and infiltration. Soil Science Society Journal. 60 (1): 238-245.

[17] Li, F. H. and L. J. Zhang. 2010. Combined effects of water quality and furrow gradient on runoff and soil erosion in North China. Pedosphere. 20 (1): 35-42.

[18] Sakyi., P. A and R. Asare. 2012. Impact of temperature on bacterial growth and survival in drinking-water pipes. Research Journal of Environmental and Earth Sciences. 4 (8): 807-817.

[19] Teerlink, J., V. Martinez-Hernandez, C. P. Higgins. J. E. Drewes. 2012. Removal of trace organic chemicals in onsite wastewater soil treatment units: A laboratory experiment. Water. Research Journal. 46 (16): 5174-5184.

[20] Yuan, H. J. Nie, N. Zhu, C. Miao and N. Lu. 2013. Effect of temperature on the wastewater treatment of a novel anti-clogging soil infiltration system. Ecological Engineering. 57 (1): 375-379.

[21] Yukselen, M. A., B. Calli, O. Gokyay and A. Saatci. 2002. Inactivation of coliform bacteria in Black Sea waters due to solar radiation. Environment International. 29 (1): 45-50.

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