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SEASONAL VARIATIONS IN THE EFFICIENCY OF OXIDATION AND STABILIZATION PONDS FOR THE TREATMENT OF SEWAGE IN FAISALABAD CITY

Dr.Abdullah Yasar, Noreen Ashraf, Dr.A.B Tabinda, M. Naveed Anwar, Mujtaba Baqir, Ahmad Iqbal, Anam Waheed

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ABSTARCT

The present study is based on the seasonal efficiency of pollution parameters of waste stabilization ponds (WSP) in Chokera, Faisalabad. The plant consists of 16 ponds including 4 sludge ponds, 6 anaerobic, 2 facultative and 4 maturation ponds. The plant design supports 90,000 m^3/d of wastewater flow with 380mg/l biological oxygen demand. BOD elimination depends on hydraulic retention time of 16.5 days. Samples of influent and effluent water were collected from main inlet and exit drains respectively twice a year for the true representation of the seasonal variations. Physio-chemical and biological analysis of pollution parameters (Temperature, pH, COD, BOD, TSS, TN, EC and FC) were carried out in laboratory and values of BOD, COD and TSS and FC were found higher than NEQS. The percentage reduction efficiency of COD is 66.1 % and 59 %, BOD is 72 % and is 61 %, TSS is 63 % and 43%, TN is 58 % and 54 %, EC is 85 % and is 40% and FC is 82% and is 78% respectively. The overall efficiency of the treatment plant in reduction of the pollution level is satisfactory, asking for the improvement through cost effective alternative options like employing micro and macrophytes.

1.0 INTRODUCTION

According to an estimate, partially treated or untreated waste water is used over a land of 20 million hectares for agricultural purpose worldwide (Scott et al., 2004). This area is expected to grow further with rapid urbanization and increasing water scarcity. Public health and long term agricultural sustainability could be in danger by the use of untreated wastewater. However higher farm income can be related with untreated or partially treated wastewater as a result of increased water reliability, savings in chemical fertilizer cost and proximity to urban markets, which makes the cultivation of perishable and high valued products like vegetables possible. In Pakistan, almost 26 percent of domestic vegetables are irrigated with wastewater which might be alarming and increasing pressure on health and environmental regulatory agencies (Ensink et al., 2004).

The stimuli behind the use of wastewater for irrigation are availability, cost and its nutritional profile. Irrigation ground or canal water costs high and its availability discontinue at different intervals during the year. Water scarcity is another important reason for the substitution of canal water with wastewater especially for the former growing high-value crops (vegetables) which require more periodic and consistent supply of water. The last but not least reason why formers are shifting towards wastewater for irrigation is the nutritional and mineral content of untreated wastewater. Most of the researchers and formers claim that untreated wastewater is rich source

nutrients while conventional wastewater treatment methods remove nutrients along with pathogens, thereby making it less attractive for irrigation. (Weckenbrock et al., 2011).

Concurrently, long term agricultural production via wastewater may lead public health under serious risk. Hence, various studies have been undertaken to elaborate the volume of wastewater used for irrigation and their respective health and economic outcomes. According to a survey about 80% of all cities of Pakistan having a population more than 10,000 residents, use untreated wastewater for irrigation because wastewater treatment facilities are rarely available in these cities (Ensink et al., 2004). International Water Management Institute (IWMI) investigated the positive and negative effects in case of using untreated waste water for irrigational purpose in Faisalabad, Pakistan during the time spam of February 2000- May 2005. In spite of having accesses to treated water from the local waste stabilization pond system farmers prefer to use untreated wastewater for irrigation. Diversity of reasons has been put into paper to state why farmers were reluctant to use final effluents. (Sharma and Minhas, 2005).

To cope with water scarcity, environmental and wastewater related health issues various mitigation approaches have been practiced for household wastewater. These mitigation approaches can be divided inti two groups: non-conventional and conventional treatment. Conventional treatment includes trickling filters, activated sludge systems, biodisc rotators and aerated lagoons, has high-energy and economical requirements. On the other hand latter is solely dependent on natural purification processes which are also called eco-technologies including constructed wetlands and waste stabilization ponds (WSPs). Non-conventional treatment technologies are highly recommended for developing countries as they rely little on periodic maintenance and cost.(Al-Hashimi and Hussain, 2013) .

Wastewater Stabilization Ponds (WSPs) are one of the most appropriate biological approaches to treat the ever-increasing wastewater volume of rural, industrial and urban areas, especially those occupying tropical and subtropical regions. WSPs rely little on technology and periodic maintenance as these natural purification based ponds, which utilize microorganism to digest and oxidize the wastewater constituents (Amahmid et al., 2002; Kehl et al., 2009). Inoculated/self-grown bacteria digest and oxidize the organic parts in wastewater to reduce its hazardous materials. Subsequently, algal biomass converts carbon dioxide and other gases into oxygen and other useful nutrients via photosynthesis. This oxygen and hydrocarbons are used by bacteria during treatment process. In this way, most of the objectionable and problematic characteristics of the domestic wastewater disappear during detention period (Barras, 2006; Farzadkia et al., 2014).

Operational process and structure of WSPs vary from sight to sight depending upon the nature of sewage water and end use quality of treated water. In context to characteristic and quality treated water WSPs have been broadly classified into anaerobic or facultative and maturation ponds. Anaerobic and facultative ponds are mostly used for the removal of organic matter whereas maturation are meant to screen out pathogens. Peña and Mara (2004) used WSPs arrangement for preliminary treatment to mitigate grit, large and heavy solids. The design chosen during this study was similar to conventional electro mechanic wastewater treatment plant with additional added manually racked screens. In addition, constant velocity channels were introduced. The purpose of

preliminary WSPs was to remove organic matter expressed in terms of Biological Oxygen Demand (BOD). Similarly, Valero and Mara (2007) used simple WSPs for the fixation of nitrogen and other pathogens using algal biomass.

Faisalabad is located in the central Punjab. It is the third largest city in context of population of Pakistan and have an average population of more than 2 million, is located in central Punjab. The topography of the city is predominantly agricultural irrigated by River Chenab but for the last two decades city has become home to textile industry. At present, there are more than 250 smaller or larger textile units within the city which are producing almost 700,000 m^3 wastewater per day (Bhatti, 2009; Mahmood and Maqbool, 2006) Faisalabad is one among the cities which has waste treatment plants nonetheless it can treat approximately 30% of the daily produced wastewater. The rest of wastewater is drained to River Ravi from east part and Chenab from west part via series of canals, which in turn had polluted these two rivers. The Chenab is so extensively polluted that dissolved oxygen (DO) level of its water is depleted by more than 10%. Overall, River Ravi is receiving almost 47 % of industrial and municipal waste.

The whole scenario is quite alarming and demanding prompt and serious attention of Government, Environmental and Water Regulation Authorities. In order to combat wastewater and meet agricultural water scarcity, the water and sanitation authority (WASA) had implanted basic waste stabilization pond system (WSP) in surroundings of Faisalabad city. The WSPs planted in Faisalabad consist of six anaerobic, two facultative and four maturation ponds. It was designed for an inflow of 90,000 m3 per day and was constructed, with financial assistance from a foreign donor, at a site where untreated wastewater had been used for the past 50 years for the cultivation of vegetables, fodder, wheat and sugarcane.

The plant was constructed to provide irrigation water that is safe for use in agriculture. Final effluent was to be sold to farmers, which would contribute to the operation and maintenance cost of the WSP. The construction of the WSP was completed in 1998 but since it started operating, farmers have been reluctant to use final effluent from the WSP and have continued to use untreated wastewater. As a result final effluent is disposed of unused into a drain with untreated wastewater. The costs to operate the WSP are approximately US$ 185,000, or 2.5% of the annual budget of the WASA.

Present study is based on the determination of water quality of WSP in summer and winter. Samples were taken from the main drain entering into WSP and after the treatment (effluent) in June and December. Efficiency of the plant was determined by testing the samples in laboratory.

The research work was structured around following objectives;

i. To check the quality of water before and after treatment in WSP
ii. To check the seasonal variation in plant's efficiency
iii. To review the effect of untreated waste water on agricultural crops

2.0 METHODOLOGY

The WSP in Faisalabad is concealed with a total surface area of hectors 100s and operated with total or combined hydraulic retention time (HRT) of 16.5 days. Samples of

influent along with effluent sewage waste water were collected seasonally (Two times, one in summer i.e. June and other in winter i.e. December) before entrance into the drain and after the treatment to check the seasonal variations in the efficiency of WSP Faisalabad.

2.1 STUDY AREA

Faisalabad is located in Rachna Doab i.e. the area between the rivers Ravi and Chenab. The geographical area of the district is 5856km^2 with a total population of 3.54 million (Wikipedia, 2006). The plant was designed by financial assistant from a foreign donor, at the site where untreated waste water had been used for the past 50 years for the cultivation of vegetables.

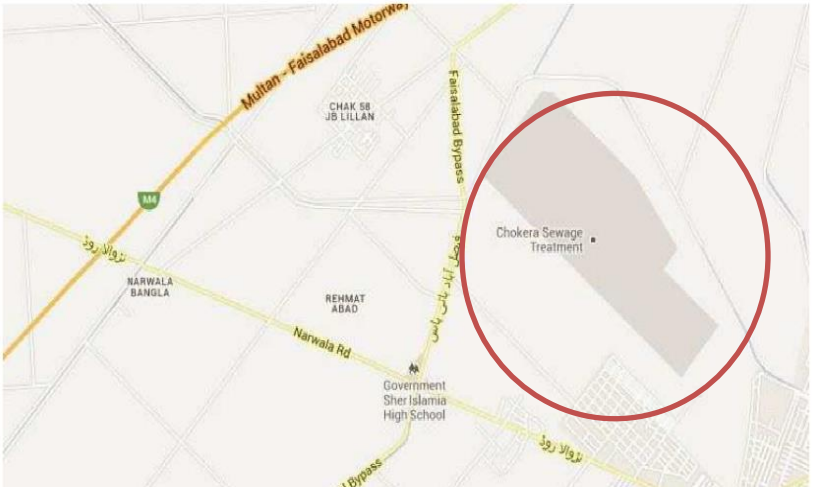


Fig 1: Map showing the Plant location in Faisalabad

2.2 WASTE STABILIZATION PONDS LAYOUT

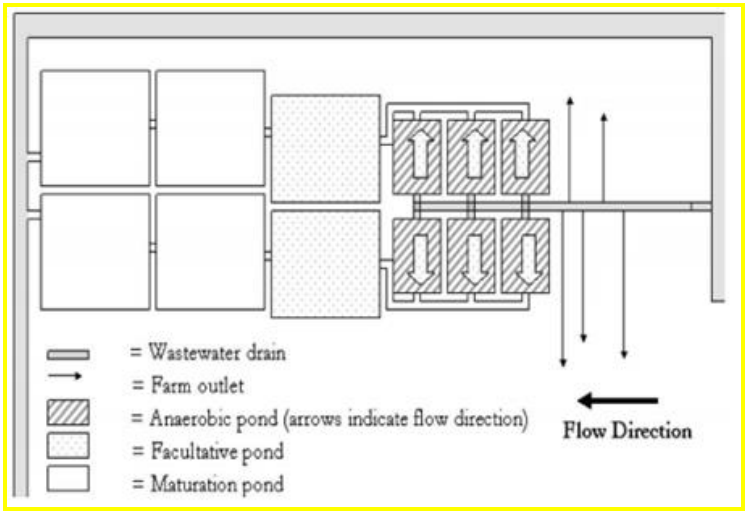


Fig 2: Plant layout

The plant consists of six parallel anaerobic ponds which open into two facultative ponds. Facultative ponds open into two series of maturation ponds. The plant design supports 90,000m^3/d of wastewater flow with 380mg/l biological oxygen demand. BOD elimination depends on total HRT for 16.5 days. According to a report of WASA in 1993, BOD removal efficiency in 16.5 days was 88%. But accordance with the national standards set by PEPA, BOD for five days should not exceed from 80mg/l for the discharge of any wastewater coming out from any source i.e. industrial or municipal wastewater (UNESCAP 2000). One of the most important and key limitation in the design is to removing or desludging the anaerobic ponds right after every three years. Considering the project design for the anaerobic ponds the mean rate of reaction in the winter season depend on the mean temperature that kept at 20 degree Celsius for total HRT of three days. That result in 115mg/l Biological Oxygen Demands from waste water quality for anaerobic pond, which was calculated from the design.

Ponds	No. of ponds	Depth (m)	Area (m)	HRT (days)
Anaerobic ponds	6	3+1 (slugged)	100X150	3
Facultative ponds	2	1.5	450X300	4.5
Maturation ponds	4	1.5	450X300	4.5

Table 1: Design & Layout characteristics of Waste stabilization ponds in Faisalabad

2.3 SAMPLING AND STORAGE

2.3.1 Waste water sampling:

Seasonal sampling of wastewater was done in the month of June 2014 and December 2014. Collection of samples was taken before entering into drains. Whereas the collection of the samples for wastewater effluent was taken from the out let of maturation pond.

2.3.2 Sample collection and storage:

Samples were collected in plastic cans and plastic bottles from the Paharang drains prior to enter in the system and were closed tightly to avoid any leakage. For further analysis and experimentation, samples were brought in laboratory. then brought in laboratory for further analysis and experimentation. Physical tests were done immediately after collecting the samples. Chemical and biological tests were performed in laboratory.



Fig 3: Photograph of main drain entering into the WSP



Fig 4: Photograph of ponds of WSP



Fig 5: Photograph of ponds of WSP



Fig 6: Agriculture field that receive untreated water

2.4 WASTE WATER ANALYSIS

2.4.1 Physical analysis of waste water

Temperature and pH were analyzed instantly after collection of samples by standard method of APHA (2005). Total dissolved solids and electric conductivity (TDS& EC) were measured with help of portable meter, according to the APHA standard method of water and waste water analysis (2005). pH, EC and turbidity were measured through (pH 100, YSI company), (EC 300, YSI Company) and (HANNA HI 93703) meters respectively.

2.4.2 Chemical analysis of waste water

Chemical analysis was consist of Chemical/ Biological C/BOD. Same as chemical analysis for the TSS was also run. TSS were measured according to APHA standard method of water and waste water analysis. To find out the oxygen required for the chemical oxidation of organic matter by the assist of powerful chemical oxidant, COD analysis was done.. It was determined with the help of low and medium range vials and COD apparatus (Lovibond, ET108). BOD (Biological Oxygen Demand) value was calculated by APHA method (5210b-5days BOD test) and samples were kept in incubator (SANYO-Mir 153).

2.4.3 Biological analysis of waste water

Fecal coliforms in waste water were determined by standard method (9221-C) through multiple fermentation techniques and reported in term of Most Probable Numbers (MPN/100ml).

2.5. REMOVAL EFFECIENCY

After completing all the tests in summer and winter, removal efficiency was calculated for each pollutant with the help of following formula

Total Efficiency of Removal = Total Input – Total Output/ Total Input x 100

3.0 RESULTS AND DISCUSSIONS

3.1 General

This chapter deals with the wastewater Monitoring results at Chokera (wastewater) Treatment Plant (Faisalabad). The monitoring was carried out on 11-07-2014 by on 11

am (for determination of trends of biochemical parameters in wastewater) when flow of different sites from Faisalabad has entered in the ponds. Second monitoring was carried out on 17-12-2014 for determination of biochemical trends in waste water. In the samples, concentration of parameters was checked according to National Environmental Quality Standards (NEQS).

The Environmental Monitoring comprises of the following section:

3.1 SEASONAL VARIATION IN WSP WATER QUALITY

Sampling was done in the month of June and December. The concentration of parameters in summers and winter is as follows:

3.1.1. Biochemical Trends in Waste water In Summer

The concentration of the parameters of Temp, pH, COD, BOD, TSS, TN, EC, and FC is shown in table 2.

Table 2: Results of waste water parameters before and after treatment in stabilization ponds in summers

Sr #	Parameters	Unit	Concentration of influent	Concentration of effluent	NEQS
1	Temperature	^{O}C	32	34	40
2	pH value	--	6.91	7.14	6-9
3	COD	mg/l	1288	436	150.0
4	BOD	mg/l	394	110	80
5	TSS	mg/l	248	91	200.0
6	TN	mg/l	42	18	
7	EC	dm/s	3.7	2	
8	FC	--	>16000	288	0/100ml

3.1.1.1. Temperature

Temperature is a parameter which was measured immediately when sampling was carried out. The temperature of influent was 32˚C as this was probably the temperature of that day at 1:30 pm. The temperature of the sample that was collected after the treatment process was 34°C. The temperature was within the limits set by National Environment quality Standards which is 40˚C. The sample of wastewater was collected immediately when wastewater entered to pond for stabilization so, there were not probably chemical activities as compared to static wastewater in ponds.

3.1.1.2 pH

Power of Hydrogen is the parameter which changes quietly as temperature of wastewater changes. This parameter was measured immediately after collection of

samples by pH meter. The value of pH of influent was 6.91 and of effluent are 7.14 which are within the limit set by NEQS i.e. 6-9. This parameter changes as biochemical activities occurs in wastewater. Therefore this parameter measured as sampling bottle was about to seal.

3.1.1.3 Chemical Oxygen Demand (COD)

The COD analysis calculated through chemical oxidation by potassium dichromate the greater part of the organic matter present in the wastewater. COD measurements are required in the accumulation balance in waste water treatment. Chemical oxygen demands remains whenever there is not complete degradation of waste in wastewater. The sample was collected immediately and sealed the bottle so that chemical activities halt till test. The concentration of collected sample of influent was measured as 1288 mg/l and of effluent is 436 mg/l which is too high than the limit set by NEQS which is 150 mg/l. This parameter has value which is greater than NEQS and chemical oxygen demand may change with the variation of surrounding conditions. This is not as much reducing as in NEQS even after the treatment. According to a small scale study, the COD removal efficiency was 42 % with retention time of 3 days.

3.1.1.4 Biological Oxygen Demand (BOD)

BOD_5 is quantify of how much dissolved oxygen is utilized by aerobic bacteria at 20°C in 5 days. It is the broad quantification for power of organic matter in wastewater (Abdella and Hammam, 2014).The concentration of BOD_5 is measured in influent is 394 mg/l and in effluent is 110 mg/l. Although it reduced after the treatment but the values are still higher than the permissible limits of NEQS. BOD removal was 48 % in a study conducted by Shah and Hashmi (2012) with 3 days retention time under the same environmental conditions in Taxila.

3.1.1.5 Total Suspended Solids (TSS)

Total Suspended Solids concentration in wastewater of influent was measures as 248.0 mg/l and of effluent is 91 mg/l which is a representation that this value is higher before the treatment but after treatment it is within the limit set by NEQS which is 200.0 mg/l. TSS concentration decreases in wastewater as much wastewater stabilize in pond. Within 19 hours which is enough retention time for wastewater, TSS settles down at bottom and enhances the water quality.

3.1.1.6 Total Nitrogen (TN)

Nitrates are not constant because of immediately adsorption capacity of microorganisms and plants. And becomes the part of their protein. By the process of denitrification it converted into nitrogen gas and nitric oxide. Under the plain conditions the mobility of nitrates depend on the buildup that might not happen (Leeper and Uren, 1993).The amount of total nitrogen in waste water before the treatment is measured as 42 mg/l and after the treatment are 18 mg/l that shows the values of effluent are within the limit of NEQS i.e. 20 mg/l but influent values are higher than standards.

3.1.1.7 Electrical Conductivity (EC)

Electrical conductivity is extensively use to point out the sum off ionized water component. By the determination of chemically association close correlation on the

addition of cation & anions with the presence of total concentration of salts. The EC was taken immediately after sampling by EC meter. The amount of EC measured before the treatment is 3.7 dm/s and after the treatment it is 2 dm/s. these values are within the permissible limits of NEQS.

3.1.1.8 Fecal Coliform (FC)

Bacterial indicators or gauge of fecal pollution and enteric viruses are there in large concentrations in raw wastewater and direct and indirect contact of populations to sewage is of primary concern (George et al., 2002).The amount is determined by MPN number method. Concentration of FC in influent is >1600/100ml and in effluent is 288/100ml. The amount in before and after treatment is higher than permissible limit of NEQS. It shows the large bacterial contamination in sewage water.

3.1.2. Biochemical Trends in Waste water In Winter

The concentration of the parameters of Temp, pH, COD, BOD, TSS, TN, EC, and FC is shown in table 3.

Table 3: Results of waste water parameters before and after treatment in stabilization ponds in winter

Sr #	Parameters	Unit	Concentration of influent	Concentration of effluent	NEQS
1	Temperature	^{O}C	28	30	40
2	pH value	--	6.62	7.10	6-9
3	COD	mg/l	1053.0	352	150.0
4	BOD	mg/l	277	107	
5	TSS	mg/l	180.0	102	200.0
6	TN	mg/l	48	22	
7	EC	dm/s	3.5	2.1	
8	FC	--	16000	352	0/100ml

3.1.2.1. Temperature

Temperature is a parameter which was measured immediately when sampling was carried out. The temperature of wastewater coming from different sites from Faisalabad was 28°C of influent 30°C of effluent as this was probably the temperature of that day at 1:30 pm in December. The temperatures were within the limits set by National Environment quality Standards which is 40°C. The sample of wastewater was collected immediately when wastewater entered to pond for stabilization and there were not probably chemical activities as compared to static wastewater in ponds.

3.1.2.2. pH

Power of Hydrogen is the parameter which changes quietly as temperature of wastewater changes. This parameter was measured immediately after collection of samples by pH meter. The value of pH of influent was 6.62 and of effluent was 7.10 which are within the limit set by NEQS which is 6-9. This parameter changes as biochemical activities occurs in wastewater. Therefore this parameter measured as sampling bottle was about to seal.

3.1.2.3 Chemical Oxygen Demand (COD)

Chemical oxygen demands remains whenever there is not complete degradation of waste in wastewater. The sample was collected immediately and sealed the bottle so that chemical activities halt till test. The concentration of collected sample of influent was measured as 917 mg/l which is too high than the limit set by NEQS which is 150 mg/l. the concentration of effluent was 352 mg/l that is also higher than the permissible limits. This parameter has value which is greater than NEQS and chemical oxygen demand may change with the variation of surrounding conditions.

3.1.2.4 Biological Oxygen Demand (BOD)

In the waste water treatment, organic matter is changed into inert mineralized products under the control conditions and at high rates (M. von, 2007).The concentration of BOD5 is measured in influent is 277 mg/l and in effluent is 107 mg/l. Although it reduced after the treatment but the values are still higher than the permissible limits of NEQS. higher values of BOD shows the more pollution caused by sewage waste.

3.1.2.5 Total Suspended Solids (TSS)

TSS concentration in wastewater influent was measures as 180 mg/l and of effluent 102 mg/l, which is representation that this value is within the limit set by NEQS which is 200.0 mg/l. TSS concentration decreases in wastewater as much wastewater stabilize in pond. Within 19 hours which is enough retention time for wastewater, TSS settles down at bottom and enhances the water quality.

3.1.2.6 Total Nitrogen (TN)

In any nutrient stability for land application of wastewater and treated wastewater (effluent), the deliberations of avoiding nitrogen from pollution groundwater are often given main concern over the latent impact of other wastewater contaminants such as sodium. The amount of total nitrogen in waste water before the treatment is measured as 48 mg/l and after the treatment are 22 mg/l that shows the values of effluent are within the limit of NEQS i.e. 20mg/l but influent values are higher than standards.

3.1.2.7 Electrical Conductivity (EC)

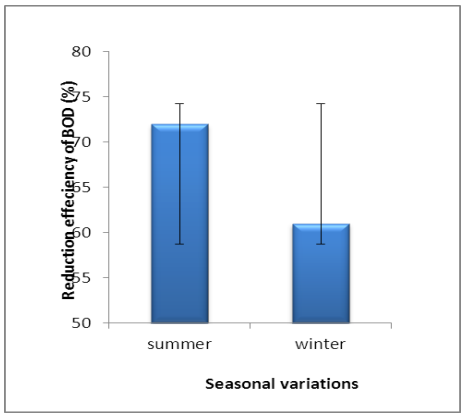
EC measurement, which is a speedy and accurate way to measure the values. For the determination of EC in a changing climate conditions and permitting the comparing of temperature with the standards one like 25°c shows the reasonable and accurate values. EC was taken immediately after sampling by EC meter. The amount of EC measured before the treatment is 3.5 dm/s and after the treatment it is 2.1 dm/s. these values are within the permissible limits of NEQS.

3.1.2.8 Fecal Coliform (FC)

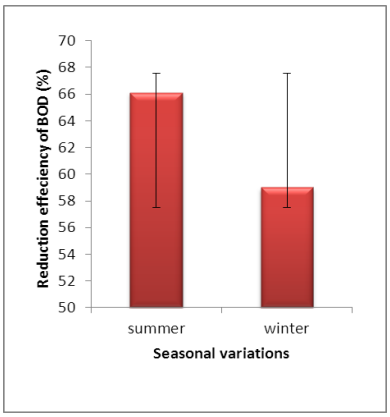
The amount is determined by MPN number method. Concentration of FC in influent is >1600/100ml and in effluent is 352/100ml. The amount in before and after treatment is higher than permissible limit of NEQS. It shows the large bacterial contamination in sewage water.

3.2 SEASONAL VARIATION IN WSP POLLUTANT REDUCTION EFFICIENCY

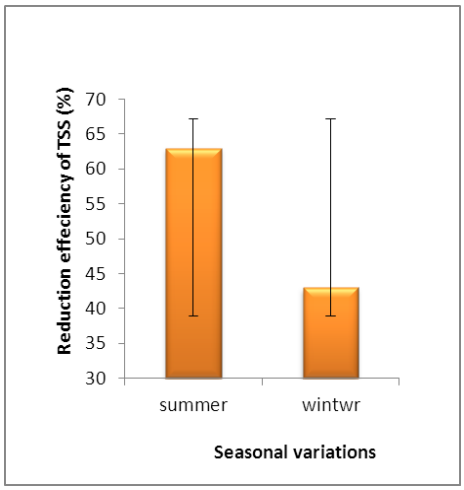
Percentage removal efficiencies of the pollutant in summer and winter are calculated. Two parameters i.e. Temperature and pH shows the negative values in percentage efficiencies. The negative signs show increase of that parameter after the treatment process in both summer and winter. Due to the bacterial activities and treatment process pH and temperatures increases. The removal efficiency of COD in summer is 66.1 % while in winter is 59 % (Fig 7 (a)). The results show that the more COD is removed in summer. If we look at the BOD removal efficiency it is 72 % in summers and 61 % in winter (Fig 7 (b)). Anaerobic treatment is extra suitable for waste water with higher sum of BOD. An appropriately designed anaerobic pond can accomplished around 60 % BOD elimination at 25°C at one day HRT is adequate for waste water with a BOD up to 300 mg/l and temperature i.e. higher than 20°C (Mara, 2003). The sludge set down at the bottom of the pond maintain anaerobic organism while the middle layer of anoxic expressing the zone of facultative area ranging from anaerobic close to the topmost and with bottom most anaerobic. Both of the topmost and bottom one layers may keep on for long time with the changing temperature and quality for the density of water (US EPA, 2002). The percentage removal efficiency of TSS is 63 % in summers and 43 % in winter (Fig 7 (c)). The more removal is achieved in summers. Same in reduction efficiency of TN in summers is 58 % and in winter is 54 % (Fig 7 (d)). Electrical conductivity removal percentage in summers is 85 % while in winter is 40 % (Fig 7 (e)). This shows the high level of salinity. More reduction is carried out in summers. Removal efficiency of Fecal coliform in summers is 82 % while in winters is 78 % (Fig 7 (f)). FC elimination efficiency is extremely dependent of the treatment. Activated sludge with more retention time and lagoons are the most capable biological treatments (George et al., 2002).The overall removal efficiency in summer is higher than in winter. In high temperature more treatment is carried out than in lower temperature. By designing the efficient working design of the WSP will help in the eliminating or lowering the FC. Design of the WSP for the removal efficiency of BOD was too low as were designed but in can be increased from the redesigned of the WSP, s that maximum efficiency should be achieved that should be more than 90% (Mara 1997). In WSP the removal efficiency were low for the pathogen and BOD removals, and were pretty surprising because of the design for the maximum or high HRT and inflow of decreasing water. The graphical representations of all the reduction efficiencies of pollutants in summer and winter are as follows



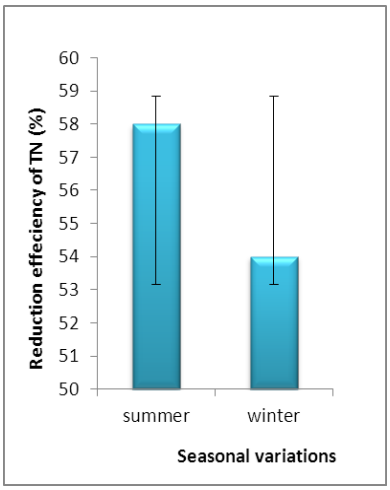
(a)



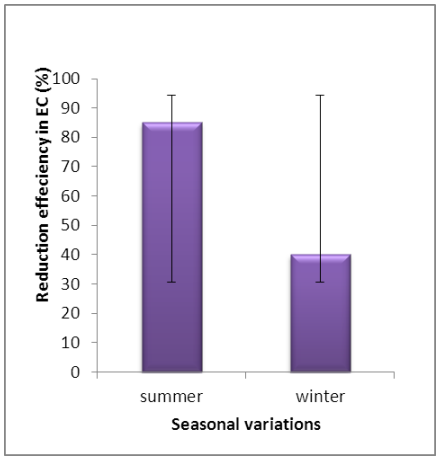
(b)



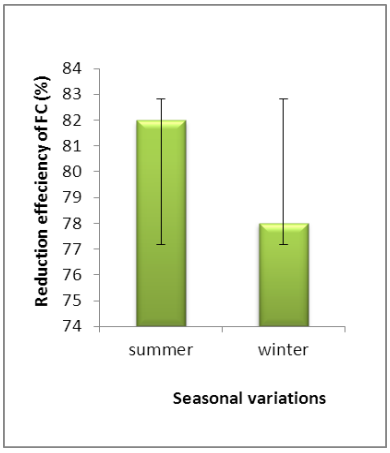
(c)



(d)



(e)



(f)

Fig 7: Graphical representation of pollution reduction efficiencies in different parameters (a) COD, (b) BOD, (c) TSS, (d) TN, (e) EC, (f) FC in summer and winter

3.3 PERFORMANCE OF WSP IN FAISALABAD

The results show the higher efficiency in summer as compare to in winter. Although it is not working properly due to lack of maintenance as it should be. Design of the WSP for the removal efficiency of BOD was too low as were designed but in can be increased from the redesigned of the WSP, s that maximum efficiency should be achieved that should be more than 90% (Mara 1997).) A same study was conducted in UET Taxila and their results showed that as the retention time is increased the efficiency of plant is also increased. Plant does not show much reduction in the pollutants with 3 days retention time. The experiment shows that small scale WSP express higher reduction efficiencies in summer as the bacterial and algal activities are enhanced in summer as compared to in winter. In a study it was revealed that if pond systems are managed and designed properly with proper number and arrangement of aerobic, anaerobic and facultative ponds, their effectiveness and pollution reduction efficiencies can be maximized. Such systems would also contribute in removal of organic waste present in waste water and would also help in minimizing the problems related to the treatment and disposal. According to a survey in United States about 90% of the ponds are working in small communities comprising the population less than 10,000 and are working very effectively.

3.4 WASTEWATER TRIBUTRIES TOWARDS WASTEWATER TREATMENT PLANT

The city Faisalabad is divided into two zone (Western and Eastern). The North Western area is drained towards Paharang Drain which eventually discharges into River Chenab. The east area of the canal slops towards the South-East and drains into the Madhuana Drain which discharges into the Ravi River. The WASA Faisalabad annals revealed that around 72% population of city Faisalabad (2.23 million populations) is served through 34 functional disposal stations located across the city. Construction, building up and restructuring the channels of sewage infrastructure for dumping into the water channels or drains or the responsibility of local and state govt. (MoEF, 2012).

The average daily inflow into the treatment plant is 79,300 m3 per day, of which 42,100 m3 per day (59%) is diverted before it enters the treatment plant. A much smaller quantity of water is also diverted from the anaerobic and facultative ponds.

Punjab Assembly Resolution passed on 03-12-2013 is: “The opinion of Punjab Assembly is that there are 144 industrial units in District Faisalabad which are discharging their toxic waste water into Sammundry drain, due to which thousands of peoples are suffering with different diseases and dyeing every year. Ask them to stop the discharging of toxic waste water; otherwise install the Treatment Plants for the treatment of Toxic Waste Water within 3 Months”.

3.5 USE OF TREATED WASTEWATER IN AGRICULTURE FIELDS

Irrigating the crops is dependent on the amount and quality of the water or wastewater. Crops are sensitive in sense of temperature variation or climatic condition and in that area the major threat is because of the wastewater quality. In the region where high evaporation rate like arid and semiarid, cause the water to become salted or high salinity that helps in the favor for the growth of different varieties of crops that tolerates

high or with varying salt concentration. For this saline water can be used for the irrigation of fodder crops in the rural or in urban and might be adjacent part of urban areas to support the fodder for cattle's because of increasing demand of the dairy or meat products. But the question will still be in mind the health risk of both the livestock and human beings because of the waste water that may contain major health risk like in the Hyderabad.

WSP authority is working day and night to bring the wastewater into the facility by pumping from different drains and collecting wastewater into aprimary drains that joins the WSP facility for treatment. WASA permitted the local farmers for the outlets with a quantity of five as an irrigation purposes. And in returns the locals farmers paid WASA total amount of PKR 0.44 million annual in return. While farmers used this wastewater for their main crops like wheat, fodder and as well as some types of vegetables. Different varieties of vegetables crops cultivated from this wastewater is consist of tomatoes, chilies, aborigine, cauliflower and spinach.

According to the (WHO 2006) report both the effluent and wastewater are not suitable for the irrigation purposes for these crops. Whereas in Faisalabad most of the crops are being irrigated with these water and these vegetables are being used cocked or uncooked in that area but overall the wastewater being used with the harmful impact. According to the WHO recent guidelines still wastewater need extra measures to reduce the risk associated with wastewater use in for the irrigation purpose (WHO 2006).

At the same time this waste water become the home for the employment generation for the many peoples in the area. These people use this water to fed irrigated water to their crops for the cultivation of range of different varieties from fodder to flower included with wheat etc. while these crops becomes the supports in form of money for many families after selling into nearby markets. Same as the case happen with the people that live adjacent to downstream i.e. some part of Gujarat and Vadodara that contributing in the national economy with the worth of PKR 266Million. Our neighboring country is also producing surplus of nutrient approximately 1MT of nutrient and these nutrients fields are irrigated with wastewater (Minhas and Samra, 2004). India irrigates their fields a total land area of 1-1.5 million hectors Mha.

Indeed there are many complications as well as limitation in concerning with the use of treated waste water and same as for the treatment of waste water. It includes the use of WW when it is not required by the crops, location and setup of land or soil quality of land, use of fertilizer and its competition with or between fertilizer and WW, maturity of crops or fruiting, application of pesticide etc. whereas the accumulation of this water in form of salt in the land, contaminating the ground water quality or also affecting the water quality of the adjacent areas from upstream to low stream. (Satyawali and Balakrishnan, 2008).

3.6 Farmers Perception for WWTP Chokera:

The absence of another water source; the greater reliability of wastewater than regular irrigation water; high nutrient content of wastewater, which meant that the application of chemical fertilizer was minimized this reluctance to pay for or even use final effluent as farmers felt that it was unfit for use because of higher salinity (100%) and a lower

nutrient value (61%) as compared to untreated wastewater, untreated wastewater application alter the values of EC, TDS, Chloride and Nitrates. This not only degrades soil structure but also contaminates the groundwater

4.0 Conclusion and Recommendations

The study concluded that the concentration of pollutant parameters in sewage waste water is higher than permissible limits of NEQS in influent and reduced in effluent, but in some cases i.e. COD, BOD, TSS and FC the concentration of pollutant is also higher than NEQS.

WSP removal efficiency in summer is higher than the cold winter. The removal efficiency of COD, BOD, TSS, TN, EC, FC in summer are 66.1 %, 72 %, 63 %, 58 %, 85 % and 82 % respectively, while in winter are 59 %, 61 %, 43 %, 54 %, 40 % and 78 % respectively. Temperature and pH showed negative sign that mean these parameters increased after the treatment. This treatment plant is not as better for treatment as stabilization ponds should be.

This treated water is again dumped into the drain rather utilization in the crops, because farmers resist the salinity of water after treatment and they use the untreated water for crops cultivation, this highly polluted sewage water can give more nutrient to the crops but it is highly unhygienic for human consumption.

At present in Pakistan approximately all installed wastewater treatment systems are not working appropriately due to operation and maintenance troubles associated with these systems. Consequently there is dire need to look for an alternative wastewater treatment system, like macrophyte waste stabilization pond system utalization the local macrophyte species for wastewater treatment.

The treatment should 1stly done in the drains through cost effective technologies

- Aquatic weeds will also help to increase the performance of ponds by holding them in the ponds. Aquatic weeds will in the improvement of removal efficiency of different matters that pollutes the water and will help in the reduction of BOD, will decrease the phosphate and metal in the ponds and by the removal of suspended solids. And will also the enhance the efficiency of pond by providing them natural ingredients.
- In developing countries like Pakistan where salinity is already a problem. So before using the wastewater it should be meets the national standards to avoid from the further loss of land. And also the major factor that increase the degree of salinity is climate condition should be taken into account.
- WASA should go to these low cost treatment technologies like lagoons, and stabilization ponds rather to the other treatment plants.
- The solid waste system in the chokera should be improved so that they could not mix into the water
- Sewage system should improve, as sewage is lying open on the roads and open places that affect the esthetic beauty as well as cause many problems related to health

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