Ass. Univ. Bull. Environ. Res. Vol. 14 No. 1, March 2011

AUCES

TREATMENT AND CONVERTING OF INDUSTRIAL WASTEWATER INTO POTABLE WATER

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ABSTRACT:

The objective of the study is to treat the textile wastewater and convert it into potable grade water in the laboratory scale. The study is involved a rigorous treatment procedure involving screening, coagulation, flocculation, aeration, biological treatment, filtration and ion exchange. From the analysis of the treated water, it is found that the industrial waste water can be converted into potable grade water.

INTRODUCTION:

Jordan has faced the problem of water scarcity for many decades and improved the efficiency of water use which is an important part of its effort to deal with this problem. The increase in water demand in addition to water shortage led to a growing interest in using treated wastewater in irrigation, industries and for recharging groundwater (Malkawe S., 2005).

Treated wastewater from the existing treatment plants is an important water resource component (Barjenbruch, M., 2008). Potable water should be free from contaminates and its quality should obey the applied national potable water standards.

In Jordan, synthetic and food fabric is one of the major polluting industries and the effluent from the dyeing and finishing section is a major source of water pollution. Its effect is becoming more evident with the increase in the number of fabric in the Zarqa City (Barjenbruch, M. *et al.*, 2008, D.E. and A. K., 2000). The wastewaters which are characterized by high alkalinity, high BOD and high suspended solids are often disposed off to nearby Zarqa river or ponds without proper treatment (Malkawe S., 2005, Barjenbruch, M. *et al.*, 2008 and Alzboon, K. *et al.*, 2009).

Wastewater form a synthetic fabric dyeing and finishing plant is analyzed in the laboratory to establish a treatment procedure to convert the wastewater into potable grade water in the laboratory.

Depending on the characteristics of wastewater, waste contents and pollutants, treatment techniques may vary. Treatment of

wastewater from a textile industry will be different from treatment of wastewater from a fertilizer plant or from a Tannery (Ziadat, A. H., 2005, American Water Works Association, 1984).

The most important factor that should be taken here is the production facilities and the raw material used for an industry for any particular period (unless it is continuous and regular process plant). Wastewater quality may vary from time to time. So that treatment techniques will be different.

Should be taken as the basis: In general waste water treatment stages can be classified as: a) Preliminary Treatment, b) Primary Treatment, C) Secondary Treatment, d) Natural/Biological Treatment, e) Tertiary or Advanced Treatment, f) Disinfection and g) Effluent Storage (Statistical Department. 2006, and Ziadat, A. H., 2005).

For this purpose wastewater samples were collected from the finishing and dyeing section of a renowned textile industry situated in Zarqa city. The wastewater was first analyzed in the laboratory to get an idea about its metal content, acidity, solid content other biological aspects. It then was treated in the laboratory using the standard treatment procedures (J. S., 1995).

EXPERIMENTAL PROCEDURES :

In this work, sampling at collection point of textile, dying, and food industry output effluents were taken for analysis and treatment test. Collected samples were then subjected to a number of treatment stages (Fig. 1).

First stage:

Each sample was passed through a cloth filter to remove course particles, and pH & TDS were measured. The pH was then controlled by using sulfuric acid (H_2SO_4) along with aeration.

Alum (aluminum sulphate) as a coagulating agent, was then added and well mixed with a stirrer to maintain a homogeneous solution. Caustic aqueous solution (Na OH) was also used to control pH variation during mixing for few minutes and the solid particles were separated.

Second stage:

The sample was treated with a flocculating using polyelectrolyte, agent, mainly is a to flocculate small particles and get larger sizes. The sample was well stirred with the polyelectrolyte to get homogeneous floc suspension which was separated by filtration. Now the water sample becomes ready to enter the next stage.

Third stage:

Which is mainly biological treatment. In this stage, the sample was aerated for a period of 24 hrs. In this stage, urea, phosphoric acid were added periodically with a continues mixing and aerations and then water stage during was passed through a fitter bed sand for solid separation.

Forth stage:

The sample from third stage becomes free of suspended particle, and what left were mainly dissolved ions. In this case, water sample was subjected to ion exchange treatment, passing an ion exchange bed, composed of cation and anion resins with a ratio of cation to anion equal to 2 to 1. After removal of ions, the sample was taken for analysis and compared with standard specifications.

RESULTS AND DISCUSSION:

Different qualitative parameters can be investigated to decide upon the type of water samples whether, waste, treated and potable in addition to a number of physical and chemical factors associated with it. The physical factors will include, but not limited to, specific conductance, turbidity, color, pH and TDS, etc. The chemical factors are the metal ion concentration, DO, COD, BOD, etc. These factors were measured according to best practices and international standards methods available in the laboratory (JISM, 2001, and Tarawneh, Kh. *et al*., 2000). The results are given in tables (1, 2) and in the Figures (2, 3). Comparison of the laboratory treated water samples with the international standards potable water, as well as with the raw waste are also included to get a good effective representation and show the main value added in.

The main findings, as a result of the comparison, that all the factor's values mentioned above for water samples are within the permissible limits according to the World Health Organization (WHO) standards (WHO: 1998- Nalco water Treatment Handbook, 1988). The Total Dissolved Solid weight TDS was decreased from (1100 mg/l) to (272 mg/l) while the higher permissible value is (500 mg/l). The BOD, as an indication of the organic waste content in the sample, reached a higher value equal to (505 mg/l). A gradual stepwise rigorous treatment was used to lower the BOD value to (3.3 mg/l), while the standard permissible value is equal to (6 mg/l).

The Chemical Oxygen Demand (COD) and the Dissolved Oxygen (DO) are yet another two important factors to control the quality of the water. It was noticed that the value of the COD was reduced from (278 mg/l) to (3.6 mg/l) while the DO reached a value of 10 mg/l). Other toxic metals such as (Copper, Lead, Nickel, Cadmium and Cyanide) were reduced dramatically and reached the standard permissible values (APHA, AWWA, WEF. 1998). On the other hand, the organic toxicity of the waste water and the treated water samples were not tested and as a result of that a decision cannot be made that these treated water samples are considered to be safe drinkable water, although the values were according to permissible limit.

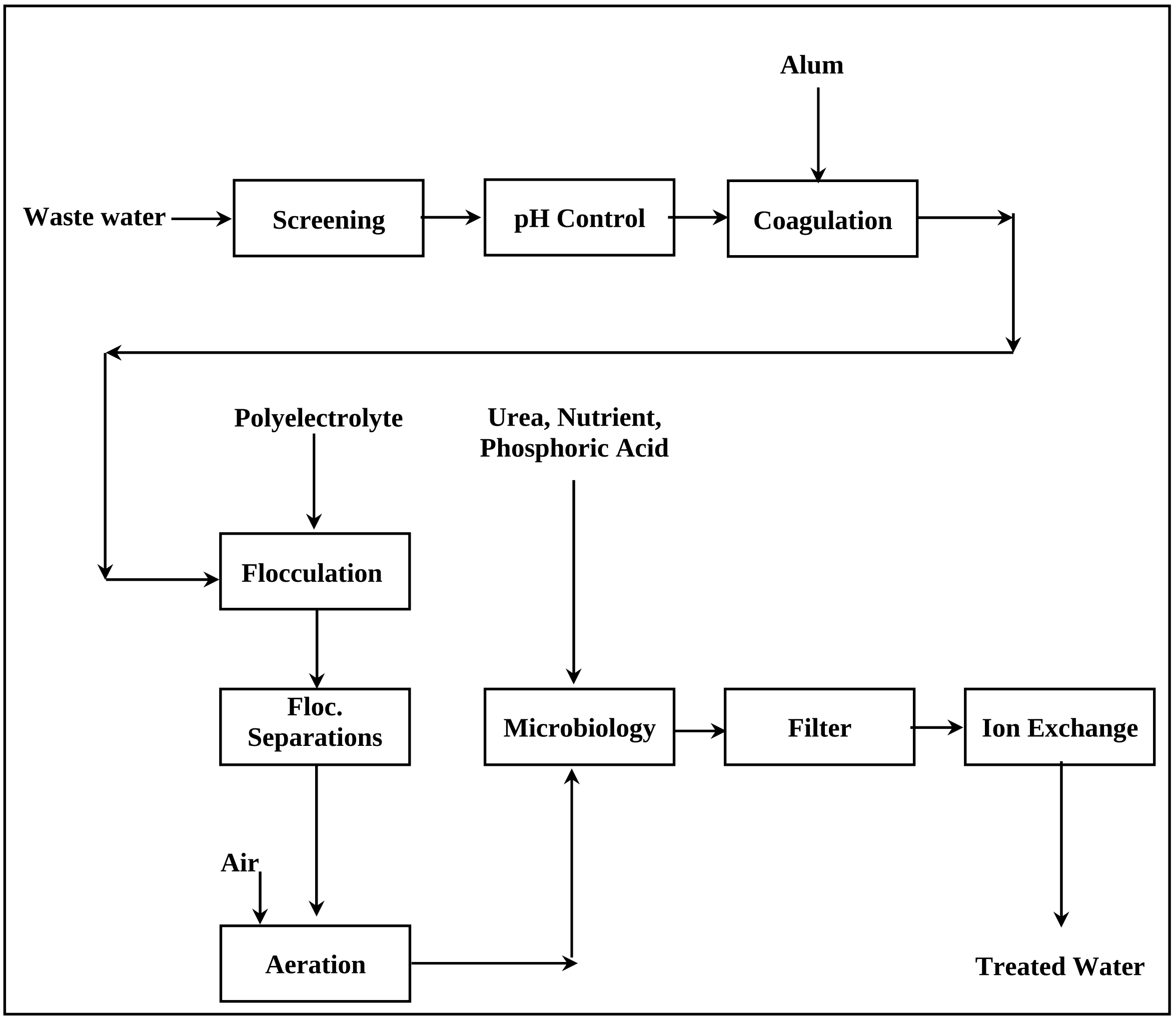
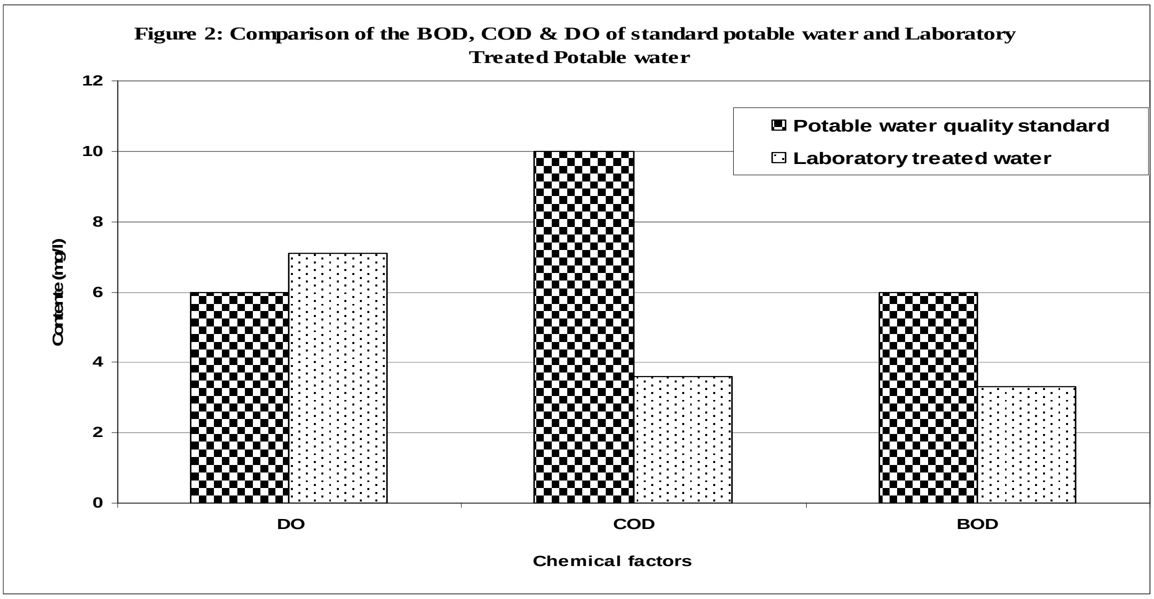


Fig.1: Shows scheme of units of waste water treatment Process

Table 1: The chemical characteristics of wastewater, laboratory treated potable grade water and standard Potable water

Parameters	Potable water quality standard (mg/l)*	Laboratory treated water (mg/l)	Waste water (mg/l)
Copper	1.5	0.12	3.3
Nickel	0.02	0.01	0.27
Cadmium	0.01	0.03	2.4
Lead	0.1	7.8	14.7
Iron	1	0.09	27.7
Cyanide	0.05	0.01	0.66
Chloride	150-600	311	42
Nitrate + Nitrite	45	1.2	74
Chromium	0.05	0.03	4.5
Arsenic	0.05	Trace	<10
Ammonia	0.5	3.2	174.8
BOD	6	3.3	505
COD	10	3.6	278
DO	6	7.1	1.69

*** Based on WHO (1998).**



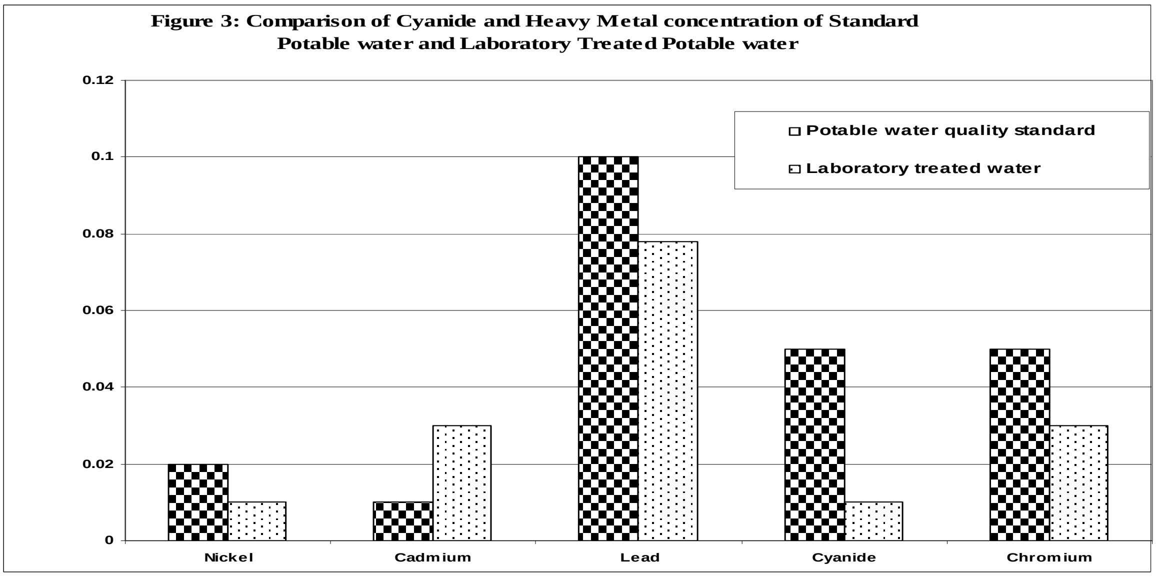


Table 2: The physical Characteristics of wastewater, laboratory treated potable grade water and standard Potable water

Parameters	Potable water quality Standard (mg/l)*	Laboratory treated Water (mg/l)	Waste water (mg/l)
pH	6.5-9.2	7.42	9.3
TS	-	233	2116
TSS	-	22	901
Color (Pt-Co)	15	10	520
Turbidity (FAU)	10	8	38
Specific Conductance (µS/cm)	400	411	1423
TDS	500	272	1100

*** Based on WHO (1998).**

CONCLUSION:

This study is a demonstration of effective industrial waste water treatment. If applied commercially, the industrial waste water can be recycled as potable water to complete the reuse cycle and zero discharge effluent from industry.

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معالجة مياه الصناعة العادمة وتحويلها إلد مياه صالحة للشرب

تهدف هذه الدراسة إلى معالجة المياه العادمة الناتجة عن الصرف الصناعي وتحويلها إلى مياه صالحة للشرب في نطاق المختبر. وقد شملت الدراسة إجراء معاملة دقيقة من المعالجات التى شملت الفرز، والتخثر، التلبد، التهوية، المعالجة البيولوجية، الترشيح والتبادل الأيوني. وأجريت عمليات تحليل مخبري لهذه المياه المعالجة، وأثبتت نتائج تحليلات المياه المعالجة أنه يمكن تحويلها إلى مياه صالحة للشرب بعد إجراء عمليات تحليل مخبري لهذه المياه المعالجة.