EVALUATION OF AN INDUSTRIAL WASTEWATER TREATMENT PLANT [+]

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Abstract:

Evaluation of an industrial wastewater treatment plant in the Starch and Dextrin Factory (at Hashimiya/ Babylon) Prevealed that biological treatment was stopped and that the effluent wastewater was out of the effluent standards as prescribed by the Iraqi Regulation no . 25 for the year 1967.

تقييم محطة معالجة المخلفات الصناعية

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المستخلص:

من خلال تقييم محطة معالجة المخلفات الصناعية الخاصة بمصنع النشأ و الدكسترين (الهاشمية / بابل) تم التوصل الى ان المعالجة البيولوجية متوقفة تماما وان المخلفات الخارجة من محطة المعالجة تتميز بخواص خارج مدى معايير المطرحات الى مصادر المياه كما تم توصيفه في المواصفة العراقية ذات العدد 25 لسنة 1967 .

Introduction:

The contaminants in wastewater are removed by physical, chemical and biological means .The individual methods usually are classified as physical unit operations , chemical unit processes, and biological unit processes .Biological treatment is used primarily to remove the biodegradable organic substances (colloidal or dissolved) in wastewater.

Basically ,these substances are converted into gases that can escape to the atmosphere and into biological cell tissue that can be removed by settling . Biological treatment is also used to remove the nitrogen in wastewater.

Aerobic (suspended growth) biological processes are , [2] :-

1- Activated sludge process.
2- Extended aeration process.
3- Waste stabilization ponds.
4- Mechanically aerated lagoons.

The simplest treatment method is waste stabilization ponds . Oxidation ditches (Pasveer and Carrousel type) are extended aeration systems and are often preferred for small installations.

Table -1- is a summary of typical design criteria for treatment of domestic sewage in extended aeration systems.

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Table - 1 - Summary of Typical Design Criteria for Treatment of Domestic Sewage in Extended Aeration Systems

Parameter	Value
1 -Mean cell residence time θ_c , days	
Warm	10-20
Temperate	20-30
Cold	Over 30
2 -F/M ratio,kgBOD5/kgMLVSS . day	
Warm	0.2-0.25
Temperate	0.1-0.2
Cold	0.1or0.2
3 -Hydraulic detention time t , hr	0.1 or less
4 -MLSS , mg / liter	4000-5000
5 - MLVSS / MLSS	0.5-0.8
6 - Effluent Suspended Solids (Se), mg / liter	10-30
7 - Power required in aeration , kWh / person . year	15-19
8 - Biodegradable fraction of MLVSS , Fb	0.3-0.5
9 - BOD5 of MLVSS , mg / mg MLVSS	0.4-0.65

After [2]

For definition of the terms θ_c, F/M , t, MLSS, Se, MLVSS, Fb and BOD5 .The following references may be consulted [3] , [4] .

Ramalho [1983] [5] proposed the following limits for the power level(P_V) in extended aeration Systems:

$19.7 < P_V < 39.4$

where: P_V, in (k W / 1000 M^3 of aeration tank volume)

Description of the Industrial Wastewater Treatment Plant :

Fig.1 is a plan of the proposed industrial wastewater plant treating the industrial wastes disposed from the Starch and Dextrin Factory . Except for the as built dimensions , the plant was without design records.

The only design information left was that: -

1- influent BOD5 = 300 mg / l

2- influent Suspended Solids (SS)= 300 mg /l

3 - influent wastewater flow rate = 15 m3 / hr.

Brush aerators were deteriorated and need to be replaced

Oxidation ditch volume = 160 m3.

The depth of the final clarifier = 3 m.

The Factory contains also a Vacuum Filter which reduces the SS before disposing off the wastewater to the treatment plant, converting the SS into a filter cake. This device is out of order now.

The objective of the study was to evaluate the biological treatment occurring in the oxidation ditch.

Experimental Procedures:

Representative samples were taken from the influent box, effluent box and Oxidation ditch on 15 / 8 / 2001 and 22/8/2001 to be analyzed for (temperature, pH, S.S, Po_4^{-3}, BOD_5 , VSS and TKN).

For a full description concerning sampling , sample preservation and experimental procedures , the following references may be consulted, [6] , [7] .

Results and Discussion:

Tables (1) and (2) show results of laboratory testing for samples taken on 15 / 8 / 2001 and 22/8/2001

Table(1)Laboratory Testing for the sample taken on 15/ 8 / 2001

Constituent	Influent	Effluent	Oxidation Ditch
1-Temperature (°C)	33	32.5	32.5
2- pH	4.7	9.0	4.0
3- SS[a] (mg/1)	4400	500	4400
4- Po_4^{-3}	62.5	60	61.0
5- BOD_5[b] (mg/1)	1320	1320	1320
6- VSS[c] (mg/1)	Zero	Zero	Zero
7- TKN[d] (mg/1)	0.001	0.001	0.001

(a) SS = Suspended Solids
(b) BOD = Biochemical oxygen Demand (5 days , 20° c)
(c) VSS = Volatile Suspended Solids = MLVSS
(d) TKN = Total Kjeldahl Nitrogen

Table (2) Laboratory Testing for the sample Taken on 22 / 8 / 2001

Constituent	Influent	Effluent	Oxidation Ditch
1- Temperature (°C)	32.5	30.5	32.0
2- PH	5.5	8.2	5.7
3- SS (mg/l)	3700	600	3700
4- Po_4^{-3} (mg/l)	25	15	25
5- BOD_5 (mg/l)	980	980	980
6- VSS (mg/l)	Zero	Zero	Zero
7- TKN (mg/l)	0.001	0.001	0.001

Table (3) Lists Iraqi Regulation No .25 for the year 1967 concerning the allowable limits for discharge of sewage effluents to water sources [8] .

Table (3) Iraqi Regulation No . 25 for the year 1967

Item	Constituent	* Column B1
1	Color	-
2	Temperature	Less than 35°C
3	Suspended solids	60 mg/l
4	PH	6-9.5
5	BOD_5	Less than 40 mg/l

* Column B1 is the first grade out four grades (B_1 , B_2 , B_3 ,and B_4) describing the limits for the discharge of pollutants to the water source.
Comparing the constituents given in Tables (1) and (2) to the limits given in Table (3) ,the following observations were confirmed :-

1 - Biological treatment was stopped due to the constant value of BOD_5 in the influent and effluent box.

2 - BOD5 and SS were out of the acceptable limits in the effluent box.
3 -Lime addition must be transferred to the influent box to raise the pH around 7 if biological treatment is to be started.
4 - The wastes are nitrogen deficient due to the small value of (TKN). Nitrogen as a nutrient must be supplied in order to start biological treatment ,[4] .
5 - Brush aerators must be replaced after calculating the actual transfer efficiency, [3].
6 - The high value of SS in the influent box compared to the design SS reported in (Description of the Industrial Wastewater Treatment Plant). In order to reduce the SS a Vacuum Filter (which is out of order now) must be maintained and operated in the factory before the wastes are disposed to the influent box .The same thing holds true concerning BOD5 values. (MLVSS or VSS)
7 - There is no (MLVSS or VSS) in the oxidation ditch which enforces the fact that biological treatment was stopped.
8- It should be noted that using the effluent wastewater for irrigation purposes is wrong due to the fact that the wastewater under study is nitrogen deficient.

Recommendations for Further Studies:

The following recommendations may be suggested :-
1- To redesign the treatment plant according to the future extensions of the factory.
2- To study the industrial wastes by a pilot — scale model in order to evaluate the biokinetics used to design the biological process under study.
3- To study a statistical correlation of BOD_5 data (weekly data for example)in order to decide the average and maximum values of BOD5
required in the design of industrial wastewater treatment plants.

References:

1- Metcalf and Eddy , Inc . , (1979) ," Wastewater Engineering: Treatment ,Disposal and Reuse" , McGraw Hill , Inc. , New York , Revised by Tchobanoglous , G.
2 - Arceivala , S . J. (1981) , Wastewater Treatment and Disposal:Engineering and Ecology in pollution Control, Marcel Dekker, Inc ., New York.
3 - Eckenfelder , W. W. ,Jr. (1980) ,"Principles of Water Quality Management ", CBT publishing company ,Inc.
4 - Eckenfelder , W . W . , Jr. (1989) , "Industrial water Pollution control", McGraw Hill , N. Y.
5 - Ramalho , R. S . (1983) , "Introduction to Wastewater Treatment processes ", Academic press , London.
6 -APHA , AWWA , WPCF (1985) "Standard Methods for the Examination of water and wastewater , Fourteenth Edition American public health Association.
7 - Sawyer , C . N . and McCarty , P . L . , (1978) "Chemistry for Environmental Engineering , McGraw Hill Book.
8 - Division of Relations and Environmental Awareness , (1998), "Environmental Legislations" , Protection and Improvement section , Ministry of Health, Iraq (in Arabic).

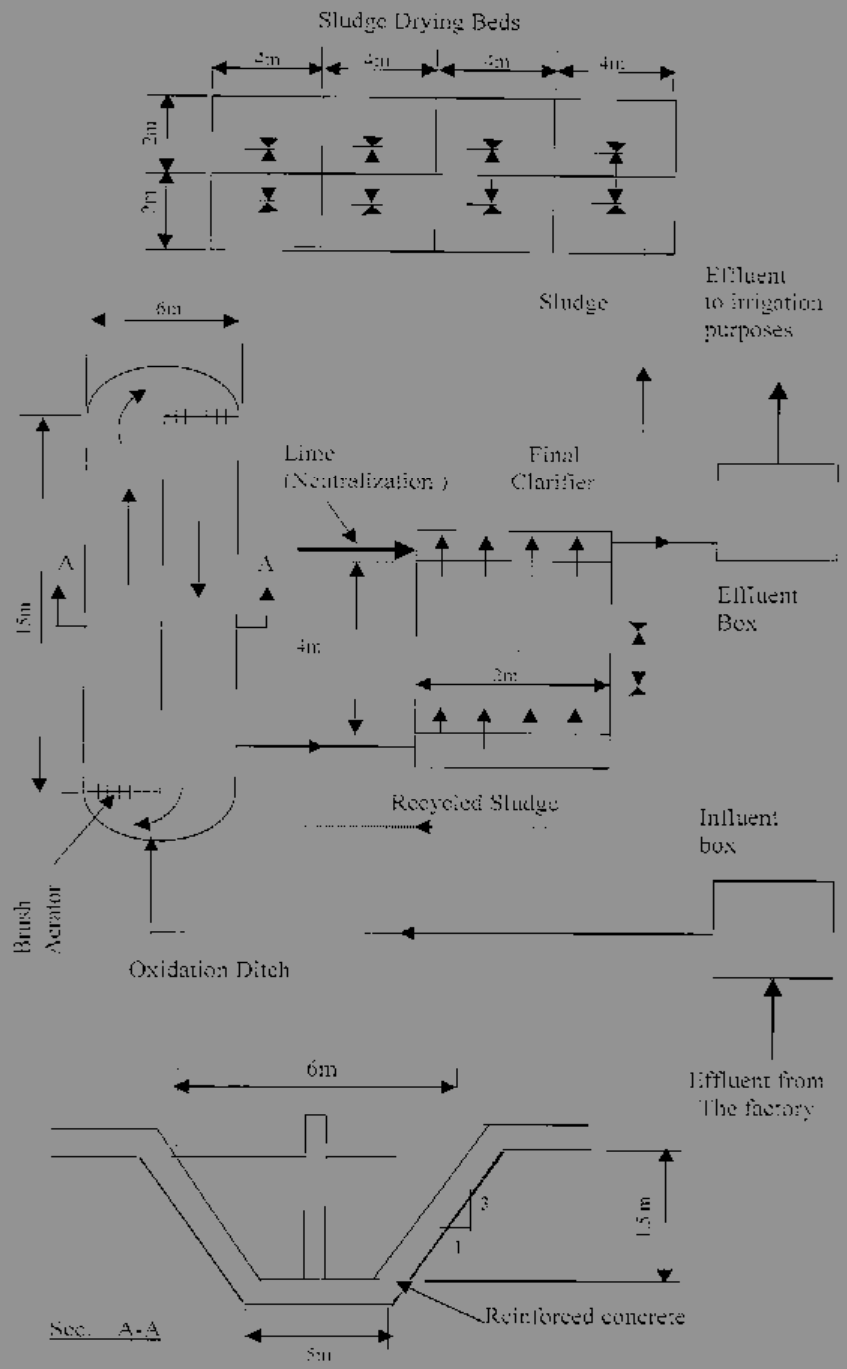

Fig.1 Plan of the Industrial Wastewater Treatment Plant