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INDUSTRIAL WASTEWATER TREATMENT SYSTEM FOR CARBONATED WATER PLANTS

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Industrial wastewater plant soft drinks processing system

i. Abstract

Water is used in most process industries for a wide range of applications. Processes and systems using water today are being subjected to increasingly stringent environmental regulations on effluents and there is growing demand for fresh water. These changes have increased the need for better water management and wastewater minimization. The combination of water demand management and cleaner production concepts have resulted in both economic and ecological benefits. Beverage industry requires huge amount of fresh water, generating considerable amount of polluted waste water during different processes including drink production, washing bottles, plant wash-down as well as washing the floors and the general work area. Most of the industries do not reuse the waste water and consuming bulk of fresh water. The beverage industry is one of the major industries in the world and the present study was conducted on the beverage/soft drink industry, the world to assess the feasibility of reuse of wastewater form bottle washing plant by conducting treatment test, like dilution of the waste water in different ratios, reverse osmosis and ion exchange.

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ii. TREATABILITY STUDY

1. chemical treatment

Different chemicals can be added to the brewery wastewater to alter the water chemistry . Chemical pretreatment may involve pH adjustment or coagulation and flocculation. The acidity or alkalinity of wastewater affects both wastewater treatment and the environment. Low pH indicates increasing acidity while a high pH indicates increasing alkalinity.

The pH of wastewater needs to remain between 6 and 9 to protect organisms. Waste CO2 may be used to neutralize caustic effluents from clean-in-places (CIP) systems and bottle washers . The waste CO2 can also be used as a cheap acidifying agent for decreasing the pH of alkaline wastewaters before the anaerobic reactor, thus replacing the conventionally used acids . Neutralization with H2SO4 and HCl acids is usually not recommended because of their corrosive nature and sulfate

and chloride discharge limitations , which may add to the cost of
effluent treatment operations .
Coagulation and flocculation are physicochemical processes commonly used for the removal of colloidal material or color from water and wastewater. In water and wastewater treatment, coagulation implies the step where particles are destabilized by a coagulant and this may include the formation of small aggregates by Brownian motion (perikinetic coagulation).
On the other hand, the subsequent process in which larger aggregates (flocs) are formed by the action of shear is then known as flocculation . After small particles have formed larger aggregates, colloidal material can then be more easily removed by physical separation processes such as sedimentation,

2. biological waste treatment

biological waste treatment processes play a central role in the way society manage their wastewaters. It is based on the activity of a wide range of microorganisms, converting the biodegradable organic pollutants in the wastewaters. In fact, brewery effluents having both chemical (with very high organic content) and microbial contaminants are generally treated by biological methods . Therefore, after the brewery wastewater has undergone physical and chemical pretreatments, the wastewater can then undergo biological treatment. Compared to physicochemical or chemical methods,
biological methods have three advantages :

(1) the treatment technology is mature,
(2) high efficiency in COD and BOD removal, ranging from 80 to 90%, and
(3) low investment cost. However, though biological treatment processes are particularly effective for wastewater treatment, they require a high energy input

Biological treatment of wastewater can be either aerobic (with air/oxygen supply) or anaerobic (without oxygen)
The aerobic and anaerobic processes are shown graphically. These processes are discussed in more details in the subsequent sections.

Generally, aerobic treatment has successfully been applied for the treatment of brewery wastewater and recently anaerobic systems have become an attractive option .Table 4 presents a general comparison between anaerobic and aerobic biological treatment systems such as activated sludge

iii. System information:

1. Design parameters:

Table 1

Type of waste water	waste water from a soft drink processing plant
Quantity	X m^3/day 24hr/day
Pre-treatment system	
Plant design capacity	X \20 m^3/hr for filter
	X\ 1.3 m^3/hr for flocculation/ floatation system
	X m^3/day for biological system
COD	5000 mg/l
BOD	2200 mg/l
TSS	1850 mg/l
Oil and grease	150 mg/l
Temperature	25-30 C (assumed)
pH	6.5-7

Table 2

Biological system

Type	fill & draw (SBR system)

2. Plant Performance :

Table 3

Based on and for the given design parameters we expect to reach the following treated water parameters after total treatment (biological treatment)

COD	≤ 1100 mg/l
BOD	≤ 600 mg/l
TSS	≤ 800 mg /l
Oil & grease	≤ 100 mg /l
pH	6.9

The wastewater effluent from gravity separator is heated and treated in a special incinerator while the wastewater resulting from washing and cleaning the reactors must be treated to comply with Environmental Law no. 93/1962 modified by decree 44/2000 for discharging into public sewer system. Wastewater characteristics: composite samples were carried out in this search for the effluent of resin factory. Table (3) shows the results of these analyses. The results show that the plant violates the law in pH, COD, BOD and Oil & Grease

Subject to confirmation by jar test.

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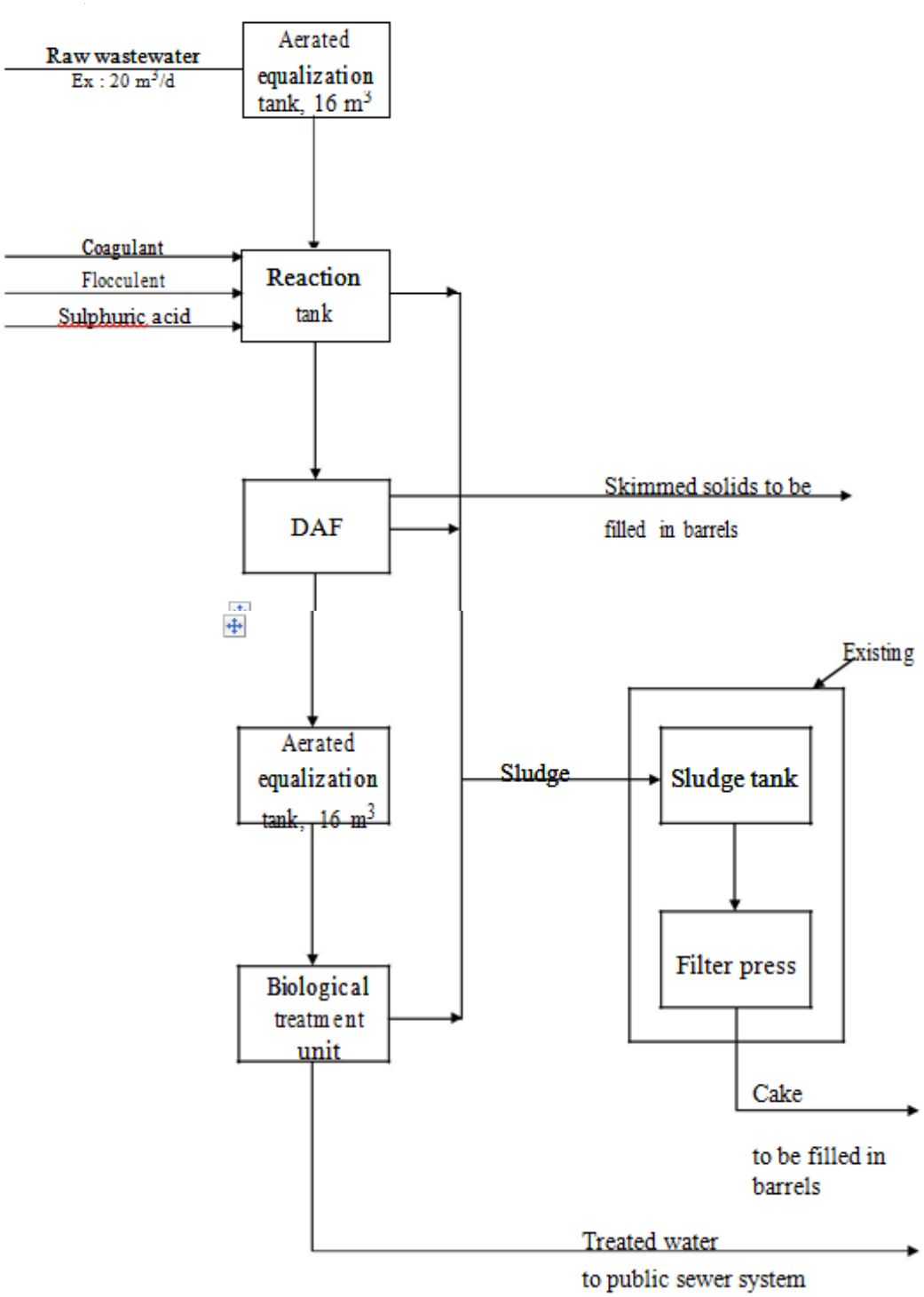
iv. System diagram



v. system consisting of :

chemical treatment

- Filter feed pump+ level
- Curved screen
- Mixer for balance tank
- Feed pump flocculator –flotation until + level controller
- Flocculator
- Chemical dosing unit for coagulant
- Chemical dosing unit for neutralizer
- Chemical dosing unit for flocculant + post –dilute station
- Flocculant make-up station
- pH measuring and control device
- flotation unit
- Pneumatical control panel
- Electrical control panel.

Biological system consisting of:

- Mixer for selector
- Influent pump biological system
    - level controller
- Electrical valves for tank selection
- Floating surface aerators
- Level controller aeration tank
- O_2 measuring and control systems.
- Floating discharges
- Excess sludge pump
- Electrical control panel with Siemens

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vi. About system component

- **Curved screen**

The static curved screen is a very simple screen since the screen itself does not contain any moving parts. The waste water is fed ontop of the curved screen and flows downwards the spacings between the wedges. Solids larger than the spacings will be retained on the screening surface and will fall down into collecting skip. A spray cleaning device is installed to keep the screen clean.

- **Flocculator**

The chemicals will be dosed into a pipe flocculator. This pipe flocculator is equipped with special mixing pipes which take care of perfect mixing of the chemicals with the waste water in such a way that dosing can be adjusted at a optimum. The pipe flocculator is designed specially for this type of waste water because mixing energies and mixing times are unique for different waste waters.

- **Flotation System**

After the flocculator the waste water will enter the flotation unit. The particles will float to the surface and will automatically and continuously be removed by a scraper mechanism. A sludge dewatering grid is installed which will produce an optimal sludge consistency. The flotation nit is equipped with a lamella plate pack which increase the separation area and thus ensures that even the smallest flocks are removed from the waste water. The on-built recirculation /aeration system is equipped with proprietary/patented non-clogging aeration devices and its unique design ensures formation of the very fine air bubbles required. The flotation until includes automatic drain valves for removing any settled material.

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vii. Biological treatment methods

- **Single batch aerobic biotreater:**

The mainly soluble organic matter is removed by biological treatment. Biomass converts organic matter to water carbon dioxide and new biomass with the air of oxygen. For this application a double batch biotreater is selected and considered best available technology. The treatment cycles of the two batches interchange in such a way that the total biotreater works on continuous flow.

The Sequencing Batch Reactor

The Sequencing Batch Reactor (SBR) is an activated sludge process designed to operate in a batch mode with aeration and sludge settlement both occurring in the same tank. Difference between SBR and activated sludge system is that the SBR tank carries out the functions of equalization, aeration and sedimentation in a time sequence.

An appropriately designed SBR process is a unique combination of equipment and software. Working with automated control reduces the number of operator skill and attention requirement. There are basically five stages to treatment: Fill, React, Settle, Decant and Idle.

Aeration times vary according to the plant size and the composition/quantity of the incoming liquor. The settling stage is usually the same length in time as the aeration. The sludge is allowed to settle until clear water is on the top 20%-30% of the tank volume. The decanting stage most commonly involves the slow lowering of a scoop or “trough” into the basin. SBR is ideally suited when nitrification, denitrification and biological phosphorus removal is necessary

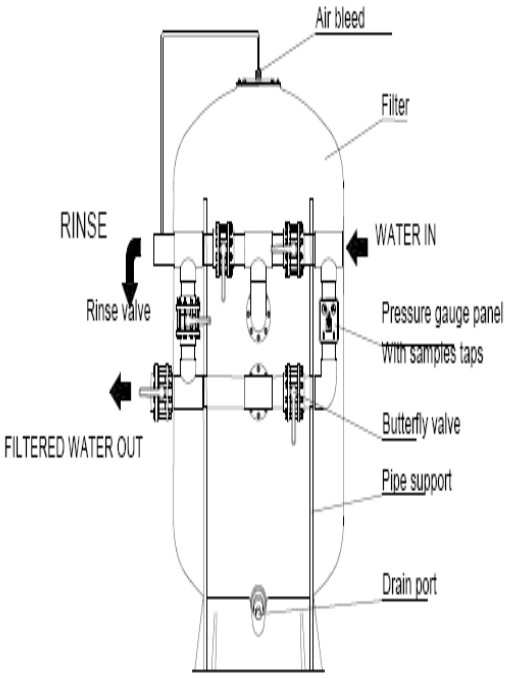
Advantages of Sequencing Batch Reactor–

- Small footprint
  - Simple Design.
  - Maintains consistent effluent quality due to batch settling method.
  - Suitable for variable organic and hydraulic load.
  - No Clarifier required reducing the spare requirement
  - Effective quiescent settling
  - No sludge recirculation
  - Biological Nutrient removal.

viii. Final filtration system

Removal due to the impurity's particle size. The filtration of suspended solids by occlusion removes particles based on size. Particles are occluded, or held back, due to their inability to pass through the pores of a barrier of some sort. The barrier might be a packed bed of sand, a fiber mat, or a membrane surface. Filtration by occlusion is often called "surface filtration", since it occurs on the surface of the filtering media. Sand and Multi-Media filters are some of the filters working on this principle

Filtration velocity	m3/h.m2
Diameter	" * "
Filtration area	0,2 to 0,8 m2
Flow rates	? : ? m3/h
Pressure ratings	4 to 7 bar
Vessel Materials	
	Stainless steel 316
Bed depth	x meter
Filtration media	
	Sand 0.4-0.8 mm
	Sand 1.0-2.0 mm
	Gravel 2.0-3.15 mm
	Gravel 3.15-5.6 mm



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ix. Sludge dewatering

The dewatering packages are as the name clearly implies, equipment to remove water from sludge. Sludge dewatering is typically the final step for industrial wastewater treatment processes and plants. After wastewater treatment the sludge remaining is very high in water content (>95% as minimum) that can be reclaimed through sludge dewatering.

Apart from water reclamation, most wastewater treatment plants pay for sludge disposal by weight, and water is heavy. So if one removes as much water as possible, dewatered sludge is lighter and thus costs less to dispose of sludge and increases the number of recycling options and reduces risk of outlet availability. The bottom line is that effective Sludge dewatering saves money.

The most common way to dewater sludge is to physically squeeze the water out of the sludge. As with all sludge dewatering technologies one can approach dewatering in various ways depending on requirements and eventual disposition of sludge.

Normally following methods are applied:

– Pressure filtration dewatering,

– Belt press dewatering filtration,

– Air sludge drying processes,

– Vacuum filtration,

– Sludge dewatering by centrifugation.

In addition a sludge drier can be utilised at the end of the process. Driers are oven like equipment that actually bakes out the water.

x. calculations

1. Chemical treatment test & calculations

- **Jar test and chemical dose calculations :**

It can be concluded that two thirds of wastewater is in soluble form and other part is in colloidal matter which could be removed by using an appropriate coagulant without addition of calcium oxide or any alkali (because the pH value is in the alkaline range).

To define these key design parameters, a series of jar tests using aluminum sulfate and two poly-anionic electrolytes at different doses were conducted. We took into consideration the pH, turbidity, total suspended solids and chemical oxygen demand as monitoring parameters to compare between them and define which one is the best and most economically effective for evaluation.

- **Chemical treatment**

(a) **Using aluminum sulfate (Alum):**

The solution of the Alum has been prepared at concentration of 50 mg per each ml of the solution. Flash mixing is started at 180 RPM and continued for two minutes during which the Alum has been added at concentrations of 0, 100, 200, 300, 400 and 500 mg/1. pH of the jars has been adjusted at 9 using sulfuric acid. Following the flash mixing a flocculation for 15 minutes is done after which sedimentation for 30 minutes is carried out, then the samples have been withdrawn using siphon and analysis is then proceeded as shown in Table (4).

(b) Using poly-anionic electrolyte:

The same procedure has been conducted for the two poly-anionic electrolytes like Alum. The two polymers are prepared at concentration of 1 mg / ml of the solution using distilled water. Two sets of jar test have been conducted; one set for each polymer. The concentrations of the polymers were 0, 4, 8, 12, 16 and 20 mg/1.

- **RESULTS AND DISCUSSION:**

-Treatment using aluminum sulfate (Alum:

Referring to Table (4), the measured parameters are pH, turbidity, TSS and COD. The sludge that has been accumulated forms scum layer on the top of the wastewater. Figure (2) shows the turbidity, TSS and COD concentration for effluent wastewater after treatment with alum.

-Treatment using poly-anionic electrolyte:

Referring to Table (5) and Figures (3 & 4)), it can be concluded that, the two polymers are not efficient for the removal of the soluble COD matter and it increases the value of the COD over that of the raw wastewater so it is not suitable for use. Referring to Table (5), the optimum dose of alum is 400 mg/1, which is providing good results (providing effluent with 2400 mg COD/I and 10 mg/1 TSS). According to previous results, dissolved air flotation technology is the best way for preliminary treatment of such type of wastes after coagulation / flocculation stage using Alum with 400-mg/l dose. The treated effluent from dissolved air flotation must be biologically treated to comply with the Environmental Law.

Table (4) Treatments with Alum

Item	Dose, mg/l	TSS, mg/l	Turbidity	COD mg/l	pH value
Raw	0	706	348	5100	11.5
T1	100	191	226	3460	10.5
T2	200	136	218	3285	10.4
T3	300	31	78	2950	10.6
T4	400	10	52	2400	10.6
T5	500	104	152	2480	10.6

Table (5) Treatments with polymers

Item	Dose, mg/l	TSS, mg/l		Turbidity		COD mg/l		pH value	
		Po.1	Po.2	Po.1	Po.2	Po.1	Po.2	Po.1	Po.2
Raw	0	706	706	348	348	5100	5100	11.5	11.5
T1	4	35	16	66	50	6300	3270	11.6	12.3
T2	8	26	22	56	57	6390	3510	11.9	12.3
T3	12	55	25	73	57	7230	4500	12.1	12.4
T4	16	58	33	74	59	7320	4920	12.1	12.4
T5	20	32	42	57	66	7350	7830	12.2	12.4

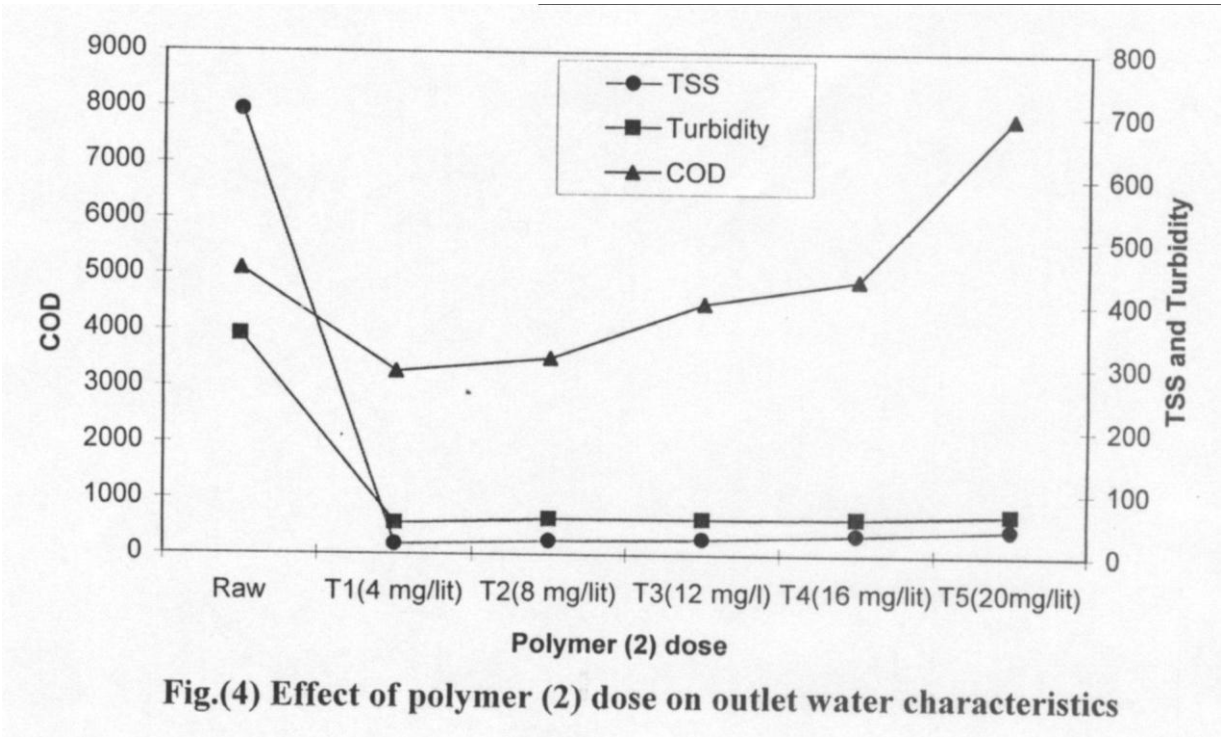
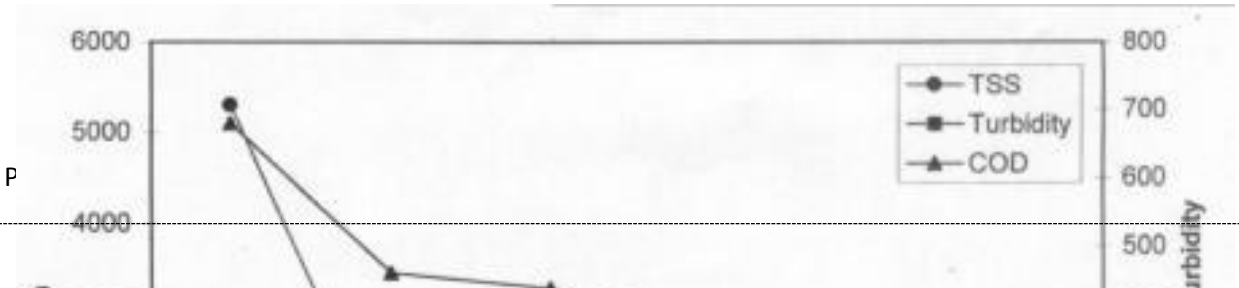


Fig.(4) Effect of polymer (2) dose on outlet water characteristics



2. Example for SBR tank calculation

Aeration tank

Aeration system	surface aerator
Power	approx. 30 kW total for surface aerators
Tank volume	640 m^3 for each tank
Tank dimensions	rectangular 12.6 m (length) x 12.6 m (with) x 4
m (height)	
Sludge load (K)	0.12
Influent BOD	1275 mg/l 765 kg/day
Influent N	41 mg/l 24 kg/day
Excess sludge production	167 kg/day dry solids
	Wet sludge production 21m3/day with approx.
1%dray solids	
Typical SBR cycle	24hours
Filling	1 hours/cycle
Aeration	20hours/cycle
Activated sludge setting	2 hours/cycle
Clean water discharge	1 hours/cycle
Clean water discharge	approx. 150 m^3/hr

General

Electricity	230/400 vold+/-5%
	3 phase
	50 Hz
Control Voltage	24V AC

REFERENCES

1- Robin, S. E., "Introduction to Engineering and the Environment", 1st Edition, McGraw Hill, 2001.
2- Metcalf and Eddy, "Wastewater Engineering Treatment Disposal & Reuse", Fourth Edition, McGraw - Hill, New York.2003..
3- Mackenzie, L. D. and C. A. David, "Introduction to Environmental Engineering", 3rd Edition, McGraw Hill, 1998.
4- Linsley, K. R. et al., "Industrial Water Pollution Control and Water Resources Engineering", 4th Edition, McGraw Hill, New York, 1992.
5- Technical proposal for wastewater treatment plant for water based paints. CAIROMATIC Company, Egypt, 1999.
6- Peters, M.S. and K.D. Timmerhaus, "Plant Design and Economics for Chemical Engineers", 4th Edition McGraw Hill, New York, 1991.
7- Perry, R. H. et al."Chemical Engineers Handbook". 7th Edition, McGraw Hill, New York, 1997.
8- Sinnott, R.K., "Coulson & Richardson's Chemical Engineering" vol. 6, 2nd Edition, Butterworth-Heinemann, 1997.

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System Applied for

- slaughterhouse
- food processing factory
- coat & paint factory
- canned food factory
- ice cream factory

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