

Selecting Proper Technology for Successful Wastewater Treatment for Gulf Climate: Technical and Economical Perspective

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Introduction

□ Important Facts:

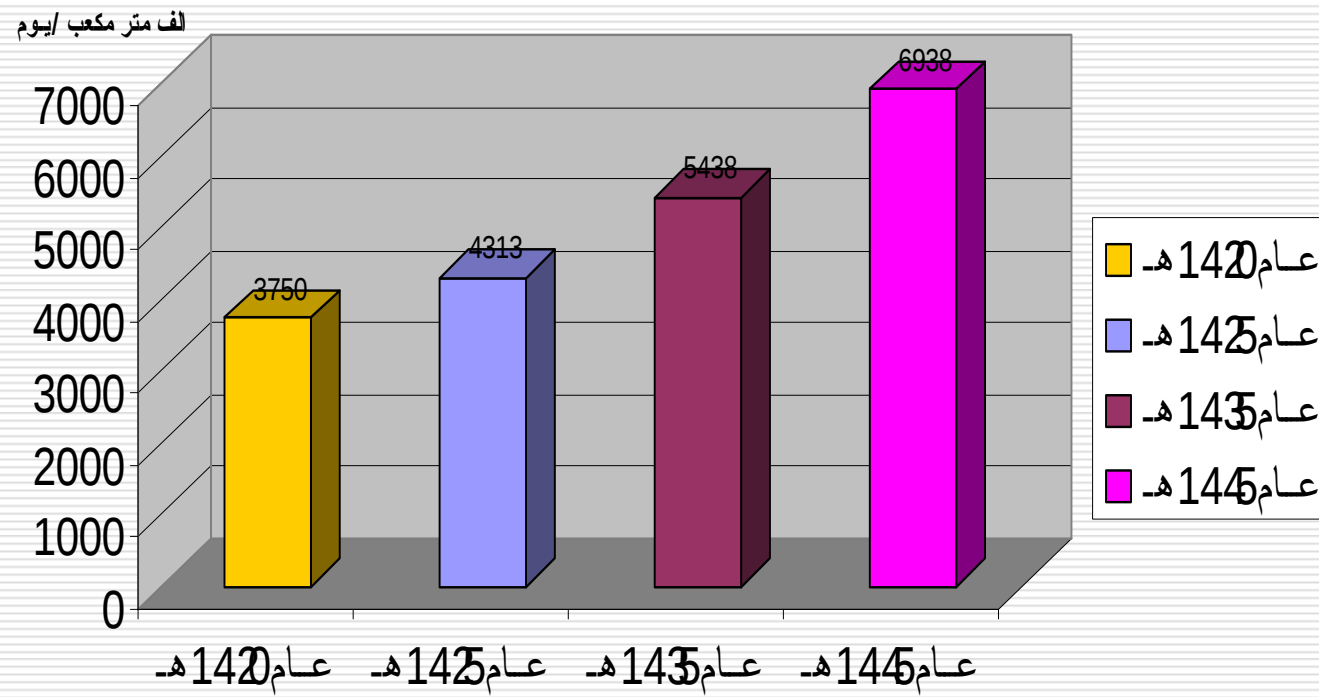
- 1. In the past few decades GCC countries gave higher allocations to water supply than to wastewater projects.**
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2. Today, wastewater services with safe disposal of wastewater is considered one of top priorities

- The increased environmental awareness which calls for the protection of mankind and his environment**
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3. GCC countries have only witnesses, up-to-date, limited number of wastewater plants as compared to the required number.

□ **Projected Wastewater Generation for KSA.**



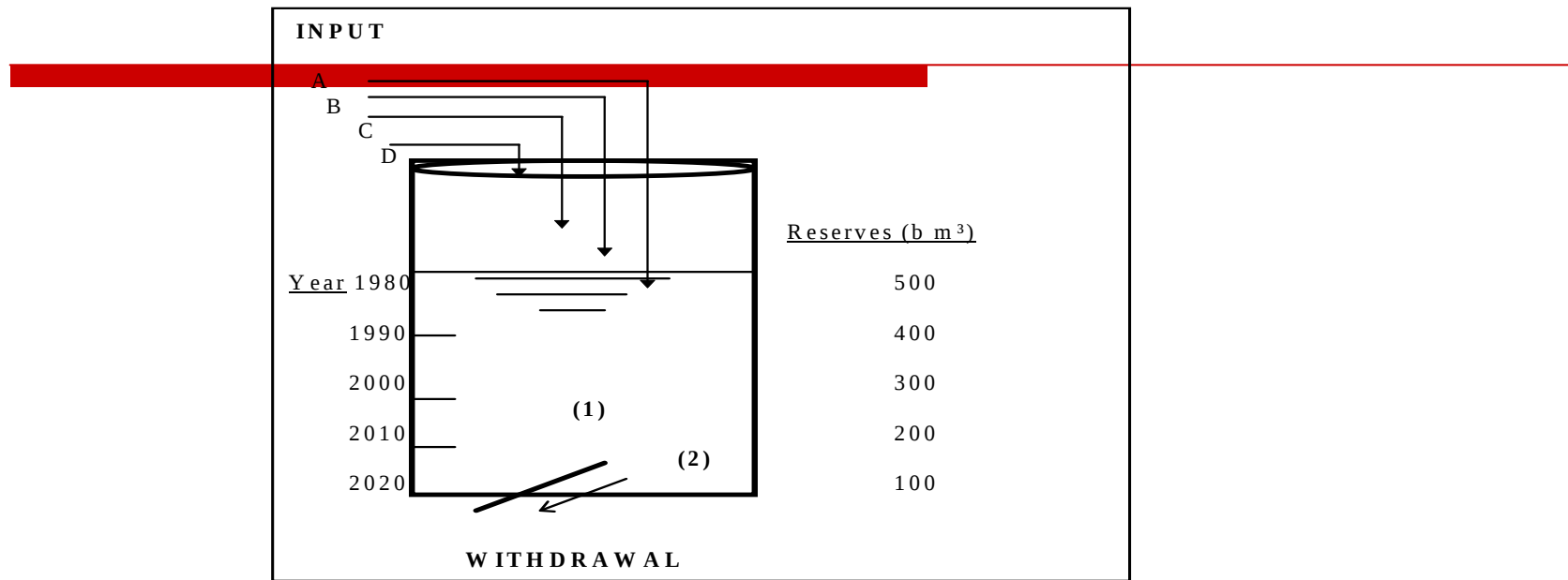


Figure 2.3 Schematic presentation of water balance in Saudi-Arabia. Based on mean daily total water consumption using mean annual water budget.

A: from desalination plants	+ 2 M m ³ /d
B: natural recharge of surface water:	+ 2 M m ³ /d
C: natural recharge of shallow aquifers	+ 3 M m ³ /d
D: natural recharge of deep aquifers	+ 3 M m ³ /d
(1): agriculture demand	- 30 M m ³ /d
(2): domestic demand	- 6 M m ³ /d
Total water deficit	- 26 M m³/d

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- Therefore the next decade will be the period of sanitation and thus rational selection of wastewater treatment scheme will help to save allocations, financial and resources, to build more wastewater plants.**
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Wastewater Treatment Plants

- ☐ **Selection of Wastewater treatment plants**
WWTP is not a simple task. It requires deep understanding of unit process and unit operation as well as the economical issues involved
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□ Some criteria that to be considered are:

- i Studies to minimize the construction and maintenance costs by selecting best building construction materials and architectural finishes and grouping buildings & unit processes of similar environmental condition in one building.**
 - ii. Investigations to ensure a complete economic analysis before selecting treatment process. The economic analysis should include both capital and operation and maintenance costs.**
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- ☐ **iii. Review the design criteria to be adopted or selected for each unit process to ensure that it is sized within acceptable limits.**
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- ❑ iv. To evaluate the potential for optimizing the number and size of each type of equipment item used in the treatment process in order to attain a lower operation and maintenance costs.



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- ❑ **v.Consider duplication/combination of similar units around the site and /or other sites (Ideal treatment model).**



Selection of Wastewater Treatment Scheme

- ☐ **Many technological advances have been achieved in the wastewater treatment field.**
 - ☐ **Similarly, new concepts of policies created new environmental laws and guidelines which should be considered during the selection process of a wastewater treatment scheme for a certain project.**
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❑ Factors for selection of treatment processes include:

- ❑ ❖ Nature of Wastewater.
 - ❑ ❖ Effluent requirements.
 - ❑ ❖ Process reliability.
 - ❑ ❖ Sludge production.
 - ❑ ❖ Air, water, and land pollution.
 - ❑ ❖ Space requirements.
 - ❑ ❖ Safety.
 - ❑ ❖ Costs.
 - ❑ ❖ Size of the project.
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□ specific factors to be considered during the process of selection of wastewater treatment plant:

- -Study of service area and site selection
 - -Obtaining design calculation for population
 - -Effluent limitations and degree of treatment
 - -Equipment selection and energy requirement
 - -Environmental Impact Assessment, EIA
 - - Value Engineering, VE
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- ☐ **Location of WWTP should be at low elevation in order to permit gravity flow and prevent high cost of pumping.**
 - ☐ **Pump stations are weak points therefore should be minimized as many as possible to avoid high costs of operation and maintenance.**
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- ☐ **Accurate population prediction is quite difficult because many factors influence the growth of the city.**
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- ☐ **Main conduits, channels, and appurtenances that can not be expanded readily, should be designed for periods of 50 years**
 - ☐ **but treatment units, mechanical and electrical equipments should designed for shorter periods usually 20 years**
 - ☐ **Minimum flow for pumping should be 33-50 percent of average flow.**
 - ☐ **Design for BOD loading should not exceed 55 g/Cap d⁻¹**
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Table 1. Staging of project component

Flow growth, designed Q/initial Q	Staging, years
< 1.3	20
1.3-1.8	15
>1.8	10

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- ☐ **Process energy utilization and conservation should be of particular value during preliminary engineering design.**
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Comparison of Treatment Processes

□ The various secondary sewage treatment processes normally employed are:

1. Conventional Activated Sludge.
 2. Trickling Filters.
 3. Extended aeration. a). Aerated lagoon, b). Oxidation ditch.
 4. Rotating Biological Contactors (RBC).
 5. Waste Stabilization Ponds.
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Type of Process	Annual Cost; SR/m ³	Power Kwh/ mgd.	Land Acres
Primary treatment	0.137	71	-
Low rate	0.43	300	1
High rate T.F.	n.a.	480	1
Activate Sludge	0.50	600-900	0.5
Oxidation ponds		Negligible	35 acre in warm climate
RBC	0.154	600-900	0.5
Chlorination		25	-
Filtration	n.a.	60-80	300-500 m
Aerated Lagoon	n.a.	23-30	About 12-15 acres
Oxidation ditches	n.a.	56-75	About 4-5

Table 3: Comparison of Processes; application and performance

Description of Process	Population Served	% Removal Efficiency			
		BOD	SS	Bacteria	Viruses
1 Activated Sludge.	For large cities any numbers.	90-95	90-95	60-90	90
2. Trickling filter	For large cities	60-80	70-80	80-90	30-40
3. Oxidation Ditch	20,000 – 60,000	85-95	85-95	60-95	<90
4. Aerated lagoon	20,000-30,000	80-90	80-90	>90	>50
5.Stabilization ponds	5,000-10,000*	60-70	60-70	99	99

Table 2: Comparison of Relative Construction & Maintenance Costs :

Processes	Relative Construction Costs	Relative maintenance Cost
Trickling Filter Standard.	100	25
High Rate Trickling Filters.	85	35
Activated Sludge	70	100
Aerated Lagoons	60	20
Oxidation Ditches	62	25
Stabilization Ponds	40	15

Conclusions

- ☐ **In the view of huge investment programs of GCC countries in the sector of water and wastewater, it is a paramount important to plan, design, construct, and maintain these projects rationally on cost effective basis**
 - ☐ **Unified codes for planning, design, construct, operation, and maintenance are important tools toward this strategy.**
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- Rotating Biological Contactors is a small scale wastewater treatment process which is a mechanical driven method involving lot of mechanical equipments and requires higher energy and more skilled manpower than other treatment processes. Thus is not as suitable for treatment of municipal wastewater GCCs.**
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- ❑ Oxidation ponds treatment does not require much mechanical/electrical equipments nor highly skilled personnel resulting in low operation & maintenance costs. This process may be used for smaller communities of 5000 to 10000 persons.**
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- Conventional Activated Sludge process is more efficient, reliable, and suitable for larger communities discharging domestic and partly industrial flows. It is a compact process requires less land and is a most reliable process where very stringent effluent standards are required.**
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- The oxidation ditch provides full treatment for a small community at the same cost per capita as by the conventional activated sludge system**
 - Aerated Lagoon as secondary treatment process is the most cost effective provided that it is established on government land with good soil conditions. This process may be cost effective only under above cited conditions for population up to 20,000 to 30,000**
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Thanks