What Can Industry do to Conserve Water?

Save Water For Future Generations

SAUDI ARABIAN WATER ENVIRONMENT ASSOCIATION WORKSHOP

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SABIC Wastewater Conservation & Reuse

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Environmental Regulations

- The Presidency of Meteorology and Environment (PME) is the Regulatory Authority in the Kingdom.
- Royal Commission for Jubail and Yanbu has Authority from PME to manage the environment of J & Y.

WASTEWATER PRETREATMENT STANDARDS AT THE POINT OF DISCHARGE TO THE CENTRAL TREATMENT FACILITIES

PARAMETER	UNITS	JUBAIL Maximum Limits	YANBU Maximum 24h Average
Temperature	°C	60	50
Total Dissolved Solids	mg/l	2000	2000
Total Suspended Solids	mg/l	2000	500
Ammonia, Total as N	mg/l	120	80
BOD	mg/l	-	800
COD	mg/l	-	1500
Oil and Grease	mg/l	120	100
pH	mg/l	5 - 11	5 - 9
Phosphorus, Total P	mg/l	50	2
Sulfate	mg/l	800	150
Sulfide	mg/l	6	10
Total Organic Carbon (TOC)	Mg/l	800	400

INTRODUCTION

Saudi Basic Industries Corporation (SABIC) was established in 1976 to add value to Saudi Arabia's natural hydrocarbon resources.

Vision :
To be a leading global manufacturer and marketer of hydrocarbon and metal products.

Mission :
To provide distinctive, high-quality industrial products and services to customers, meeting the expectations of shareholders through optimum utilization of available human and natural resources, together with the use of the state of the art technology maintaining safe and environmentally sound practices.

Introduction (Cont…)

SABIC has 18 world-scale manufacturing Affiliates in Saudi Arabia. SABIC also has the largest R&T complex in the Middle East.

As of today, SABIC is one of the world's 10 largest petrochemicals manufacturers and among the world's market leaders in the production of Polyethylene, Polypropylene, Glycols, Methanol, MTBE and Fertilizers as well as the fourth largest Polyolefins producer.

It is also the largest steel manufacturing company in the Middle East and North Africa. It operates globally and is committed to providing outstanding quality and customer care.

Introduction (Cont…)

SABIC is an environmentally conscious organization from the inception.

SABIC is committed to conduct its business in an environmentally friendly manner and with highest regard for the protection of the air, water and land resources by complying with applicable laws and regulations, and applying practical means to prevent pollution, reduce waste, minimize risk of operations, conserve resources and providing safe and health environment for its employees and the community.

It continually seeks new ways to enhance the environmental performance of its operations and to protect the air, water and soil surrounding its plants.

All the SABIC affiliates located in KSA are ISO 14001 certified.

BACKGROUND

SABIC industries consume large quantities of potable water for their processes and generate a significant quantity of wastewater. The water data for the Affiliates located in Jubail is as below :

Potable Water : 96000 m3/d

Wastewater Generated : 44500 m3/d

Currently, the wastewater generated from the industries is pretreated and discharged to a central Wastewater Treatment facility.

The treated wastewater is currently used for landscaping purposes.

The wastewater discharged from the industries fully comply with the Regulatory “Wastewater Pretreatment Standards At The Point of Discharge to the Central Treatment Facilities”.

Background (Cont…)

In KSA, the majority of the potable water is supplied from the desalination of the sea water.

The water consumption rate is increasing rapidly in the area due to the rapid growth in the industrial development. Accordingly, the wastewater generated has also increased resulting into additional load on the treatment plants.

Water is a very precious commodity in our Environment and all efforts should be made to conserve it. Therefore, there is a need to recycle wastewater streams in an industry which consumes large quantity of water.

SABIC Programs For Water Conservation

Realizing the importance of potable waster and the need to conserve the resources, SABIC implemented various programs to conserve the water.

- ✓ One of the programs implemented was a feasibility study to evaluate the potential for recycling the waste water being generated from its industries.
- ✓ Water Conservation through SHE Award Program

Objectives for Wastewater Recovery

- **Conserving for water production in desalination plants at Al – Jubail**
- **Availability of future water resources for expansions and new plants**
- **Saving of process water costs**

Feasibility Study

The wastewater streams have been sampled from all the industries and analyzed for various physical and chemical parameters at our R&T Laboratory. We hired a consultant to evaluate the data and determine the potential for recycling the wastewater streams.

The study concluded that the wastewater streams can be treated and recycled. The study recommended various treatment technologies specific to the wastewater stream and suggested that the recycling of some of the wastewater is economically feasible.

Wastewater Characterization

Affiliate	Parameters										
	TDS ppm	TOC ppm	pH	Fe ppm	Cu ppm	Zn ppm	Mg ppm	Ca ppm	Mn ppm	O&G	NH4
SITE-1	523.3	5	7.76	5	Nil	Nil	-	-	4.7	-	-
SITE-2	100	100	8.66	3	0.1	0.2	31	44	0.07	-	-
SITE-3	1000	150	8-11	3.3	0.9	15	0.18	0.8	-	-	15
SITE-4	550	60	6.5-7.5	0.9	0.4	0.88	0.78	33	-	30-40	<10
SITE-5	84	30	8	2	48	0.09	-	-	-	-	-
SITE-6	636	200	6.5	0.7	0.05	0	0.2	1	-	12	2-4
SITE-7	1400	240	7.5-8	4.1	0	0	-	-	1.4	-	-
SITE-8	1400	42	9.2	0	-	0	0	0	-	-	40
SITE-9	50	250	6.8-7.3	-	-	-	-	-	-	15	4
SITE-10	2306	150	8.7	0	0	0	0.92	0.4	-	-	100
SITE-11	3000	100	7-9	-	-	-	-	-	-	-	100

Case Study - Treatment and Basic Engg. Evaluation

Based on the positive signs from the feasibility study, SABIC conducted a pilot study and Basic Engineering Evaluation on one of the Affiliate wastewater for treatment and reuse to reduce the freshwater intake and costs for potable water.

The Affiliate currently generates about 10,080 m^3 per day of wastewater from plastics, olefins, and utilities operations. The facility wastewater regularly meets the discharge standards.

Due to the different origin and nature of Plastics wastewater from Olefins wastewater, treatment and recycling is separated in two phases.

Phase I

- Collection, treatment, and recycling of PVC and PS Wastewater
- Collection, Treatment and recycling of Regeneration Wastewater of the existing demineralization units
- Treatment and discharge of VCM Wastewater

Phase II

- Collection, treatment, and recycling of Olefins wastewater

Scope Of The Basic Engineering Study

- Sampling of all the 12 wastewater streams
- Laboratory analysis of samples in consultants laboratory
- Laboratory tests for biological treatment with original wastewater of:
  - Combined wastewater
  - PVC wastewater
  - VCM Wastewater
- Based on the results of the laboratory tests finalize complete treatment system for both phases
- Determine investment and operation cost
- Determine the economics of the wastewater recovery plant based on the potential savings.

Phase-I Influent Wastewater Characterization

Parameter	Unit	Design	Worst Case
Wastewater Flow	m3/d	5760	
TOC	mg/l	113	165
SS	mg/l	326	502
TDS	mg/l	105	130
NH4-N	mg/l	7	
PO4-P	mg/l	0.1 – 0.5	
Temp	^{O}C	45	
pH	units	10.2	12.2

Phase-I Treated Water Characteristics

Parameter	Units	Design	Worst Case
TOC	mg/l	<3	
SS	mg/l	<1	
TDS	mg/l	125	<150

Phase-I Finalized PVC Wastewater Treatment Scheme

- Neutralization, Primary Clarifier, and Equalization.
  About 93% of SS and 60% of TOC removed

- LINPOR Aeration Tank
- Clarifier
- Disinfection
- Dual Media Filter
- Sludge Treatment (Stabilization, Thickener and De-watering)

Final treated water with TOC less than 3 ppm, SS less than 1ppm and TDS about 125 ppm

Phase-I Demineralization Wastewater Treatment Scheme

- Design Flow of Demineralization Plant Wastewater 1650 m^3/d with TDS of 5000mg/l
- Neutralization
- 2 step Reverse Osmosis
- About 66% of feed flow is recovered with TDS below 10 ppm and added to treated PVC water.

Phase-II Influent Wastewater Characterization

Parameter	Unit	Design	Worst Case
Wastewater Flow	m3/d	5470	
TOC	mg/l	101	272
SS	mg/l	60	120
TDS	mg/l	300	500
NH4-N	mg/l	28	
PO4-P	mg/l	0.4	
Oil & Grease	mg/l	100	300
Temp	^{O}C	65	
pH	units	10.2	12.2

Phase-I I Treated Water Characteristics

Parameter	Units	Design
TOC	mg/l	<1
SS	mg/l	<.1
TDS	mg/l	50

Phase-II Finalized Olefins Wastewater Treatment Scheme

- Pre-treatment in existing facilities (CPI, sludge pond, etc.)
- Dissolved air flotation
- Equalization
- LINPOR Aeration Tank
- Clarifier
- Disinfection
- Dual Media Filter
- Activated Carbon filter
- Reverse Osmosis
- Sludge Treatment (Stabilization, Thickener, and De-watering)

Final treated water with TOC less than 1 ppm, SS less than 0.1ppm and TDS about 50 ppm

Phase (1) Economical Calculations

Recovered PVC WW

4,800 x 365 d = 1,752,000 m^3/a

Recovered Regeneration WW

1092 x 365 d = 398,580 m^3/a

Recycled Water Flow = 2,150,580 m^3/a

Capital Saving

2,150,580 x 6 SR/m^3 = 12,903,480 SR/a

Capital of selling low grade PVC

715 t/a x 187.5 SR/t = 134,000 SR/a

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Economical Calculations

cont'd…

Payback Period:

38,000,000 SR/ (12,903,480 + 134,000 – 2,816,120) SR/a

= 3.72 a

The payback period for the Wastewater Recovery Plant amounts to:

3.7 years

27.2% per year

Saved costs after the payback period 10.3 M SR/a

Phase (2) Payback Period (based on actual flow)

Waste Water Flow	4,560 X 365 d	=	1,664,400 m^3/a
In R.O. as Saline			
Losses (15%)	684 X 365	=	249,660 m^3/a
Recycled Water Flow			1,414,740 m^3/y
Capital Saving	1,414,740 X 6 SR/ m^3	=	8,488,440 SR/a

Payback Period 33,000,000 SR / (8,488,440 – 2,348,632) SR/a = 5.37 a

The Payback period for the second phase of the Wastewater Recovery Plan amounts to:

approx 5.4 years

8.6%/ year

ave. water costs after the payback period 6.1 M water

Other Programs to Conserve Water Resources

SABIC has established an annual Safety, Health, and Environment (SHE) Award Program. In this program, all the SABIC Affiliates participate and top three (3) Affiliates with best SHE performance will receive the award from the CEO of SABIC.

The SHE Award criteria have various requirements related to the performance of Safety, Health, and Environment. One of the requirements is to conserve water.

Natural Resources Conservation. To be calculated by the formula:

Water Conserved = ---------- (A – B) X 100/A

where:

A= Potable Water consumption per ton of product in the previous year

B= Potable Water consumption per ton of product in the current year

The Affiliate claiming the credits for Water Conservation shall substantiate the claim with the programs implemented to conserve water such as cost involved, treatment system installed, process modifications, performance monitoring of the treatment system, reduction in fresh water supply, etc.

Natural Resources Conservation *(Reduction in water consumption per Ton of product)*

> 7 %	*(8 points)*
4 – 7%	*(5 points)*
2 – 4%	*(3 points)*
< 2 % ……	*(0 points)*

CONCLUSIONS

- The Criteria included in the SHE AWARD program helped to achieve about 5% reduction in water consumption.
- Recycling program is feasible.
- The payback period for the Phase-I is encouraging.
- Awaiting Management approval to proceed with the project.

THANK YOU