PROJECT PROFILE SERIES #32

Reverse Osmosis System reclaims 86% wastewater in Singapore

The Problem

Singapore, a small island-state with few natural resources, currently imports about half of the country's potable water supply from neighboring Malaysia and efforts are being made by the Singapore government to reduce dependence on imports. The increased success of recycling and reuse of waste water in Singapore is a key strategy to Singapore's increased self reliance on water supply.

The Facility

The Jewel plant, one of the largest of its kind in the world today, will treat tertiary treated effluent, which is a combination of sewage and industrial waste, and purify it for reuse by industry. The system feed is supplied by the Jurong Industrial Waste Water System (JIWW). The project is the keystone behind the water portion of the Sembawang Utilities Terminal (SUT). SUT supplies various industry with water, steam, electricity, and other utilities to various industrial endusers on Jurong Island. The high grade industrial water (HGIW) produced by the system will be sold to industrial endusers at a lower price than the imported potable water.

The Solution

Aquatech designed and built a plant that made 30,000 m^3/day of HGIW. This system consisted of the following: Five primary Dual Media Filters's each of 375 M3/Hr and Four secondary Dual Media Filters's each of 500 M^3/hr with all the associated coagulant chemical dosing skids; Six Reverse Osmosis trains each of 242 M^3/Hr feed and 210 M^3/hr permeate operating at 86% recovery.

The Results

Since start-up in January 2000, the Jewel Plant has performed well and reliably within the design specifications. The high recovery of 86% pioneered by this project is now considered to be an industry bench-mark in tertiary effluent waste water reclamation.

Aquatech International Corporation
One Four Coins Drive;Canonsburg, PA 15317 USA
T: 724-746-5300 F: 724-746-5359 aic@aquatech.com www.aquatech.com

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Feed Water Design Water Analysis

Conductivity, uS/cm	700-2200
Total dissolved solids, mg/L	500-1300
Turbidity, NTU	0.4-1.7
Color, Hazen unit	13
Total hardness as $CaCO_3$, mg/L	100-160
Total alkalinity as $CaCO_3$, mg/L	40-80
Sodium, mg/L	150-200
Chloride, mg/L	150-500
Sulfate as SO_4, mg/L	120-160
Silica as SiO_2, mgL	120-160
Ammonia as N, mg/L	5-15
Phosphate as P, mg/L	2-4
Biological oxygen demand	<5
Chemical oxygen demand	20-30
Bacteria, CFU/100 ml	<1000
Fluoride, mg/l	0.2-0.7

Design Parameters for RO Units

Flow rate per train, m^3/d (gpd)	5,000 (1,320,860)
Number of Trains	6
Recovery, %	85-86
Temperature, Co	25-35
Feed pH	6.2-7.4
Average flux, L/m2/h (gfd)	<16.9 (<10)
Max. feed pressure,kPa (bar, psi)	980 (9.8,140)

Configuration of each RO Train

Configuration	Three Stages (28-16-8 array)
Pressure Vessels	52 with 7 elements per vessel
Total elements in 1 train	364
Total elements in 6 trains	2184

Layout of RO Train