DOWEX™ UPCORE™ Mono Ion Exchange Resins

Power Station Improves Process Water Quality and Cuts Costs with UPCORE™ System

Site Information

Location:
Bulgaria

Size:
3 lines at 250 m^3/h each

Purpose:
- Reduce water and waste water treatment costs
- Increase treatment reliability

Time in Operation:
4 years

Comparative Performance:
- 40% reduction in final water costs
- 70% reduction in waste water
- Over 80% reduction in Na and SiO_2 leakage

The Deven JSCo power station chose the UPCORE™ system to improve their process and reduce costs. (Photo courtesy of Deven JSCo)

Introduction

The Deven JSCo thermal power station was built in 1965 and was integrated into the Solvay organization in 2000. The power station is located in Bulgaria and produces 0.4 million megawatt-hours of power per year and 3.5 million tons of steam per year at 36 bars. The demineralization plant treats Kamchia River water for use as boiler feed water.

In 1997, after 22 years of operation, station management decided to modernize the water treatment plant, seeking performance improvements that would achieve the following objectives:

- Reduce chemical costs
- Reduce service water
- Increase reliability of water production
- Reduce waste load to the environment

In 1998, the plant initiated a major retrofit of the existing co-current water treatment system by installing an UPCORE™ system using DOWEX™ UPCORE Mono ion exchange resins. The UPCORE system was chosen because it would help them to achieve the goals described above with minimal retrofit work.

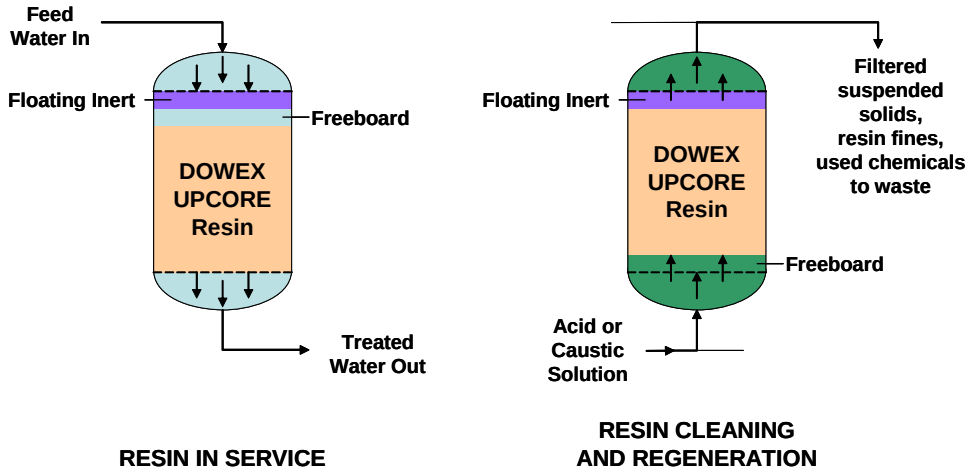
UPCORE™ System

The UPCORE™ system is based on the following principles:

- Counter-current ion exchange technology
- Packed bed design
- Upflow regeneration/downflow service
- Uniform particle size (UPS) resin technology

In the service cycle, a wide operational flow flexibility is possible. In this cycle, the feed water enters the vessel from the top (Figure 1). Before regeneration, compaction water flows at high velocity from the bottom to the top and compacts the resin bed against the inert resin and upper nozzle plate. Without flow interruption, the regenerant and subsequently the rinse water passes through the resin bed in an upflow direction. There is no need for a separate backwash tank because the suspended solids are automatically removed from the surface of the resin bed during the compaction step of each regeneration cycle.

Figure 1. The UPCORE™ system



The advantages to the UPCORE system include

- Excellent water quality
- High chemical efficiency
- Short regeneration time
- Simple construction and control
- Self cleaning
- Insensitivity to production flow variations and interruptions
- No risk of carry-over of resin fines
- Layered bed design without the need for a middle plate

The UPCORE system uses DOWEX™ UPCORE Mono ion exchange resins, which provide high operating capacity and chemical efficiency, reduced waste production, and outstanding mechanical integrity. These resins have high resistance to attrition, preventing generation of fines as the resins age in service.

Water Treatment Operation

The feed water is taken from the Kamchia River and pretreated with lime decarbonization. Table 1 gives the typical river water analysis.

Table 1. Typical analysis of Kamchia River water

Component	Kamchia River
Cations, meq/L (ppm as $CaCO_3$)	
Calcium	1.9 (95)
Magnesium	0.6 (30)
Sodium	0.9 (45)
Total	3.4 (170)
Anions, meq/L (ppm as $CaCO_3$)	
Sulfate	0.7 (35)
Chloride	0.5 (25)
Nitrate	—
p alkalinity	—
m alkalinity	2.2 (110)
Total	3.4 (170)
Other, mg/L or ppm	
Silica (as SiO_2)	4.4
Organic matter (as $KMnO_4$)	8

Plant Design

The original water treatment system used co-current regeneration and had five lines, each with a capacity of 120 m^3/h (529 gpm). The first line to be rebuilt using the UPCORE™ system was completed in April 2000; the second and third lines were completed in January 2002. The UPCORE system at Deven currently has three lines with a capacity of 250 m^3/h (1100 gpm) each. Each of the lines treats 6000 to 6500 m^3/day (1.6 to 1.7 million gpd) decarbon-ized water. Table 2 gives the mechanical details and Table 3 gives the process details.

Table 2. Mechanical details of the UPCORE system

Parameter	Cation	Anion Layered Bed
Vessel diameter, m (ft)	3.0 (9.8)	3.0 (9.8)
Cylindrical height, m (ft)	3.1 (10.2)	3.1 (10.2)
Distribution system		
Top	Nozzle plate	Nozzle plate
Bottom	Nozzle plate	Nozzle plate

Table 3. Process details of the UPCORE system

Parameter	Cation	Anion Layered Bed	
DOWEX UPCORE Mono resin	C-600	WB-500	A-625
Volume, m^3 (ft^3)	19.5 (689)	8.3 (293)	7.2 (254)
Operating capacity, eq/L (kgr/ft^3 as $CaCO_3$)	0.95 (20.7)	1.025 (22.3)	0.55 (12)
Regenerant	HCl	NaOH	
Regeneration efficiency (% stoichiometry)	120	128	

Water Treatment Performance

Installation of the UPCORE™ system significantly improved production efficiency and the quality of treated water. Table 4 shows the decrease of regenerant consumption and waste water, and the excellent water quality obtained.

Table 4. Performance improvements

Parameter[a]	Original System	Results from UPCORE System
NaOH, kg/m^3 (lb/1000 gal)	0.62 (5.2)	0.18 (1.5)
HCl, kg/m^3 (lb/1000 gal)	0.98 (8.2)	0.41 (3.4)
Waste water, L/m^3 (gal/gal)	165 (0.17)	50 (0.05)
Conductivity, µS/cm	4.0	0.3
Silica, µg/L or ppb	80	15

[a]Before mixed bed filters

Conclusions

With the retrofit to the UPCORE system, regenerant consumption dropped by over 60%, and the amount of waste water declined by 70%. The hardware inventory (vessels, valves and piping) and, as a consequence, the maintenance needs, decreased by 50%. Overall, water costs dropped by 40%. Based on the excellent results, the power station decided to retrofit a fourth line in September 2002.

DOWEX™ Ion Exchange Resins
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