

PROJECT PROFILE SERIES # 8

Zero Discharge System Handles German Power Station's FGD Wastewater

Evaporator/Crystallizer Combined with Salt Exchange Pretreatment is the Answer for this Demonstration Plant.

The Facility

A major European utility has several power block units fitted with wet limestone FGD scrubbers at their 600 MW power station in southern Germany. The blowdown from the scrubbers is treated to remove the heavy metals and suspended solids. The blowdown is discharged into the adjacent Rhine River.

The Problem

Future new power block units and retrofit of some existing units in Germany will be subjected to stricter environmental permit regulations. The utility was looking for new technologies to make their power station more environmentally sound. One waste stream they wanted to eliminate from discharging into the river was the FGD scrubber blowdown. Although already treated, physically and chemically, the blowdown still contained high concentrations of chlorides and nitrates.

The Solution

After thorough evaluation of the problem and possible alternative solutions, the utility selected the team of Philipp Müller and Aqua-Chem ICD to provide a zero discharge demonstration plant. Philipp Müller, Aqua-Chem ICD's joint venture partner for FGD wastewater treatment plants, has provided over 20 heavy metal reduction plants to power plants. Additionally, for this current treatment plant, they provided the pretreatment system which removes the magnesium and converts calcium to sodium ions. This allows the evaporator/crystallizer to produce a final product salt purity > 97% for use in cation exchangers.

Special Features

The evaporator and crystallizer system was designed with the flexibility to handle sodium chloride or calcium chloride based solutions, either unseeded or seeded with gypsum. With the high grades of materials used (i.e. titanium, Hastelloy, Alloy 20), it can handle a wide range of chemistries, concentrations and temperatures. It also has many built-in automation features to reduce operator attention.

The Results

The demonstration plant was fabricated in the USA and in Germany. It began operation in the spring of 1993. Several different trials were made to demonstrate the optimum performance and operating characteristics.

Technical Data: Design Feed Chemistry Range (Before Pretreatment)

Na ⁺	500-2,000 mg/l	SO ₄ ⁻	800-2500 mg/l
*Ca ⁺⁺	6,000-28,000 mg/l	NO ₃ ⁻	0-5000 mg/l
*Mg ⁺	800-2,000 mg/l	Br ⁻	50-1,500 mg/l
K ⁺	40-700 mg/l	T.D.S.	3,000-30,000 mg/l
SiO ₂	0-50 mg/l	pH	4 - 10

* Note: After pretreatment, these are replaced with Na⁺ and exist only in residual quantities.

Design Flow 0.4 m³/h (1.8 gpm)
** Final concentration 90-90% solids

** Solids Purity > 97% NaCl
Distillate Purity < 20 ppm T.D.S.

** With pretreatment salt exchange



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Flow

The FGD wastewater, after heavy metals removal and gypsum desaturation, is pretreated to remove the magnesium and change the calcium to sodium. The wastewater is then concentrated in two steps. In the first step, the falling-film evaporator concentrates the solution to about 25% T.D.S. (just under the solubility limit for NaCl). Gypsum seed crystals are added if necessary to maintain a seeded slurry operation. In the second step, the forced circulation evaporator/crystallizer concentrates the solution further to produce a slurry with suspended salt crystals. A portion of the slurry is discharged to a filter press to remove the salt and the mother liquor is returned for further concentration. If required, the salt crystals can be washed in a batch mode for higher purity.

