

ULTRAFILTRATION FOR ARSENIC REMOVAL IN INDUSTRIAL APPLICATIONS

TEMPORARY ULTRAFILTRATION SYSTEMS OFFER SOLUTION TO COAL ASH POND TREATMENT



Overview

The presence of elevated concentrations of arsenic in water sources from contamination associated with common industrial processes is a health and regulatory concern that has been identified by the EPA. As a naturally occurring element, arsenic is listed as the primary contaminant of concern at an estimated 47 percent of superfund sites. Addressing arsenic contamination in remediation efforts requires establishing effective treatment technologies to consistently meet low level discharge standards, typically 10 ppb or less. In these case studies, ultrafiltration (UF) systems are demonstrated as a versatile, flexible solution for heavy metals removal in difficult industrial wastewaters. These packaged units are designed for rapid installation and effective temporary solutions.

In power generation, coal combustion processes generate a powdery waste byproduct, coal ash. Arsenic is a major constituent of coal ash, along with other heavy metals like mercury, lead, selenium, cadmium, and chromium. A common disposal method for the ash is to combine the material with water and store it in retaining ponds or surface impoundments. Arsenic can contaminate groundwaters and drinking supplies through failures in retaining structures or leaching from unlined ponds.

Arsenic speciation is dependent on the oxidation-reduction potential and pH of the water. Pentavalent arsenate, As(V), dominates in oxygen-rich environments, such as most surface water sources. Trivalent arsenite, As(III), is more prevalent in reducing environments like wastewaters and natural groundwaters. High removal efficiency can be achieved with appropriate pretreatment chemistry and coprecipitation to produce a filterable particulate. This is done by grouping and forming floc or adsorption to another substance. Following oxidation

Project Summary

Ultrafiltration

Location:

Southeastern, USA

Application:

Arsenic removal

Process:

Metals precipitation ►

Ultrafiltration

Highlights

- **Complete packaged UF systems**
- **Temporary installation**
- **Site-specific safety requirements**
- **92.7% reduction**

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from arsenite As(III) to arsenate As(V), ferric salts are used to react with arsenate and form a filterable precipitate. Low-pressure UF membranes remove particles by size-exclusion with a small nominal pore size of 0.01 μm .

At two separate sites, temporary UF systems with pretreatment chemical dosing were used to dewater existing ponds with arsenic reduction as a target contaminant to meet site-specific discharge permits. The process consisted of hydrogen peroxide dosing for oxidation of arsenite to arsenate plus ferric-based coagulant addition for coprecipitation, followed by UF. The backwash waste stream was recycled to the retaining ponds.

At both sites, UF was successful in achieving targeted filtrate arsenic concentrations, as demonstrated in Table 1. In both case studies, the system performance was sustainable, as shown through the clean-in-place frequency consistently greater than 30 days, no fiber breakages, and reliable operation at or above target design flux rates. ■



Table 1. Design Criteria and Performance of Ultrafiltration Systems at Two Sites

Parameter	Site A	Site B
Flow Rate, Net	190 gpm	250 gpm
Estimated Feed Arsenic	300 – 600 $\mu\text{g/L}$	800 $\mu\text{g/L}$
Permit Filtrate Arsenic	< 50 $\mu\text{g/L}$	< 150 $\mu\text{g/L}$
Average Filtrate Arsenic	16.3 $\mu\text{g/L}$	36.3 $\mu\text{g/L}$
Operation Duration	10 Months	6 Months
Pretreatment Chemicals	H ₂ O ₂ , Ferric Sulfate	H ₂ O ₂ , Ferric Sulfate
Water Recovery	≥ 95%	≥ 95%
Clean-in-Place Frequency	> 30 Days	> 30 Days