WATER

ActiGuard™ Series

Multiple Contaminants Removal with ActiGuard™ Adsorbents for Water Treatment

Water Stress: A Challenge for Water Treatment

Annual population growth and climate changes as well as industrial demand are putting much stress on fresh water resources with increasing consumption and pollution. Today, 2.1 billion people continue to not have access to a safely managed drinking water supply and only 20% of waste water is collected and treated. Trends for water treatment and recycling have become major issues for all type of water applications including potable, storm, agricultural and industrial uses. New challenges are also emerging, linked to new pollutants and zero liquid discharge targets that are being adopted worldwide.

Water Contaminants

Activated Alumina is considered as one of the best Arsenic and Fluoride removal technologies and has been applied in many applications for water treatment and environmental remediation.

Arsenic is a highly hazardous substance for human health and has been regulated in water with Maximum Contaminant Levels (MCL) ranging from 50 µg/L (ppb) to less than 5 µg/L (ppb) depending on jurisdiction. **Fluoride,** is a highly hazardous substance as well, typically regulated with a common Maximum Contaminant Level (MCL) of 1 -2 mg/l (ppm). New regulations, not limited to potable water, will lower this value to 2 mg/l maximum in many jurisdictions with 0.8 mg/l as the recommended level to maintain dental health benefits.

Phosphate in excess can cause eutrophication of sensitive aquatic ecosystems. In areas of high discharge or high sensitivity it is becoming increasingly necessary to mandate removal. The main source of Phosphate is agriculture along with detergents and sewage waste. Moreover, many metals (Copper, Zinc, Lead and Selenium) found in storm water and industrial effluents are facing new scrutiny.

BENEFITS

- Ability to remove Fluoride and Arsenic to compliant levels
- **NSF/ANSI Standard 61 approved,** meets specifications of EN 14369 and EN 13753
- Spent media passes both the US EPA Toxicity Characteristic Leaching Procedure (EPA-TCLP) and California Waste Extraction Test (CA-WET).
- High particle mechanical resistance
- Axens' solutions are applicable to both gravity and pressure systems depending on applications.

ActiGuard™ AA400G

- High Fluoride adsorption capacity ranging from 1 to 20 mg/g depending on water chemistry
- Co-adsorption of Fluoride and Arsenic in a single step
- **Simple regeneration possible through three-step acid-base treatment**

ActiGuard™ AAFS50

- Three times greater Arsenic adsorption capacity than unpromoted alumina
- The most cost effective solution for Phosphate removal
- **Multiple contaminant removal (Fluoride, Phosphate, Copper, Zinc, Silica, Lead, and Selenium)**

ActiGuard™ AA400G: The Industrial Standard for Fluoride Removal

AA400G has been developed in order to remove several contaminants in one-step with specific focus on Fluoride.

AA400G has the ability to be regenerated for a more cost effective operation. Regeneration is the best choice for Fluoride removal and may be the most economical route for very large-scale Arsenic systems.

In fact, regeneration is most suited for applications with high contaminant concentrations or high flow-rates, in order to minimize operating costs. ActiGuard AA400G is also employed as a polishing step after "lime treatment" for instance.

As a rule, the performance of activated alumina in contaminants removal depends on the composition and characteristics of the raw water such as pH, Fluoride and competing ion concentrations.

Finally, regeneration will generate a concentrated effluent high in Aluminum and Fluoride. This effluent is normally acceptable for transfer to a sewage treatment facility or can be sent to drying ponds if existing, typically in arid regions.

ActiGuard™ AAFS50: Three Times Greater Arsenic Uptake Capacity

Axens developed ActiGuard™ AAFS50 to enhance arsenic adsorption capacity versus unpromoted activated alumina. The greater adsorption capacity extends service life and allows cost-effective single use. A regenerable system might be the most economical solution depending on specific case conditions.

ActiGuard™ AAFS50 is a patented Iron enhanced activated alumina (IEAA) used for removal of Arsenic, Fluoride and Phosphate. It can also remove Silica, Zinc, Copper, Lead, and Selenium in certain applications.

Actiguard™ AAFS50 has outstanding mechanical properties and resists to harsh treatment conditions. Apart from maintenance phases, backwashing is usually not required thanks to a high resistance to fouling and attrition of the product.

› A Wide Range of Applications for ActiGuard Portfolio:

- Potable Water: both Arsenic and Fluoride removal, ranging from simple hand pump applications to municipal water systems.
- Bottled Water: Removal of undesirable ions from bottled/mineral water sources to optimize quality or taste
- Industrial effluents: Arsenic, Fluoride, Phosphate, Silica, Zinc, Copper, Lead, and Selenium from contaminated waste streams
- Agriculture : Phosphate removal from effluents
- Environmental Remediation near sensitive aquatic environments

{ CASE STUDY }

Quick and Effective Solution to remove Fluoride in a Major Refinery in United States

During periodic maintenance activities at oil refineryHF alkylation units, the fluoride concentration in wastewater can increase to high levels (>50 mg/L).

The wastewater treatment plant typically cannot handle such a high level of contamination and operators must either ship quantities of wastewater off-site or develop a specific treatment system.
A major refinery in the United States had to face fluoride concentration in wastewater >200 mg/L after periodic maintenance. Millions of liters of water needed to be treated either or off onsite to reach compliant levels of fluoride.

Axens' partners quickly supplied a temporary transportable treatment unit, pre-loaded with ActiGuard AAFS50.

During the campaign 8 million liters of contaminated water were treated with oustanding results: **Water Fluoride Contamination in mg/L:**

BEFORE	AFTER
> 200mg/L	<10 mg/L

BENEFITS

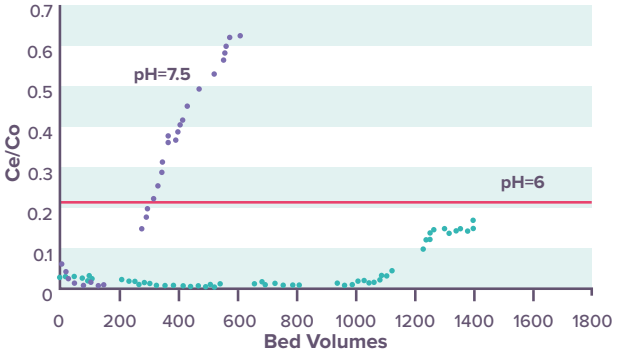
- Quick Deployment and Efficient treatment
- Significant disposal costs savings
- No capital expense
- The process was repeated with same results 3 years

Water System Design

› Tailored Performance Models

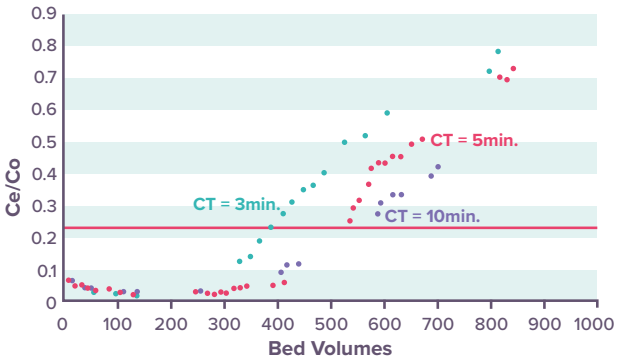
Adsorption capacity and thus service life or cycle time between regenerations is strongly dependent on water composition and characteristics. Over many years, Axens has developed comprehensive models to predict adsorption capacities and thus adsorption performances. These models have been validated using experimental data at laboratory and industrial scales, including equilibrium Jar tests to confirm capacities with actual water composition.

- **Contaminant Influent Concentration:** typical with adsorption, a greater contaminant concentration increases the adsorption "driving force" and ultimately the product pick-up capacity.
- **pH Level:** Depending on the impurity to remove, pH has a major influence on performance. Different impurities require different pH ranges for optimum removal. For example, a pH ranging from 6.0 to 6.5 is optimal for Arsenic removal while a range of 5.0 to 6.0 is recommended for Fluoride removal.



↑ Figure 1: Effect of pH Adjustment Influence

- **Contact Time:** Five minutes empty bed contact time (EBCT) is recommended to achieve optimum capacity. Figure 2 provides an example of breakthrough curves with differing EBCT.



↑ Figure 2: Effect of Empty Bed Contact Time (CT) Influence

- **Coadsorption:** Competing ions and the concentration thereof can greatly affect adsorption capacity. In some cases, it is possible to mitigate the detrimental effect of competing ions. For example: silica (SiO_2) at high concentration will limit the Arsenic adsorption capacity of ActiGuard® AAFS50, particularly at high pH conditions. This effect can be greatly reduced with limited cost by reducing pH.

TESTIMONY

Fluoride Removal Application

The Twentynine Palms Water District has been using Axens activated alumina for the last 7 years. The District switched to the Axens product after extensive pilot study testing was performed and exceptional performance results were achieved. To this day the District has not been disappointed and theproduct consistently meets the District's performance standards. In addition to the product that is obtained, Axens provides customer support that is second to none. Axens regularly checks in with the District to determine if the product continues to perform to our expectations and offers technical support when needed. Excellent companies provide value for the product they offer and Axens meets this commitment to excellence.

••• **TPWD, Twentynine Palms Water District,**
Ray Kolisz,
General Manager

Keys for System Design From EPA Design Model

The adsorption system design is usually based on a lead lag configuration with each vessel achieving 5 minutes empty bed contact time. The lead lag design allows to operate the lead column to full saturation of the media and to run the lag column while performing the adsorbent change out. The lag column then becomes the lead until saturation. The process can be designed to utilize as many columns with sizes that are the best suited to accommodate the water system needs. These may be as small as an under the sink point of use (POU) or large-scale municipal wells of thousands of gallons per minute.

Axens' recommends that each vessel is configured with 30% freeboard to allow for media expansion during backwash. Downflow operation is typical with a flow velocity ranging from 5 to 17 m/h (2 – 7 USGPM /ft^2). At least 1 m (3 ft) of bed height is required to ensure sufficient depth for the mass transfer zone and generally a vessel length/diameter ratio of 2 to 6 is desired.

This flow diagram might be adapted with optional pH adjustement or regeneration system.

Diagram available within the manual: https://bit.ly/removal_fluoride

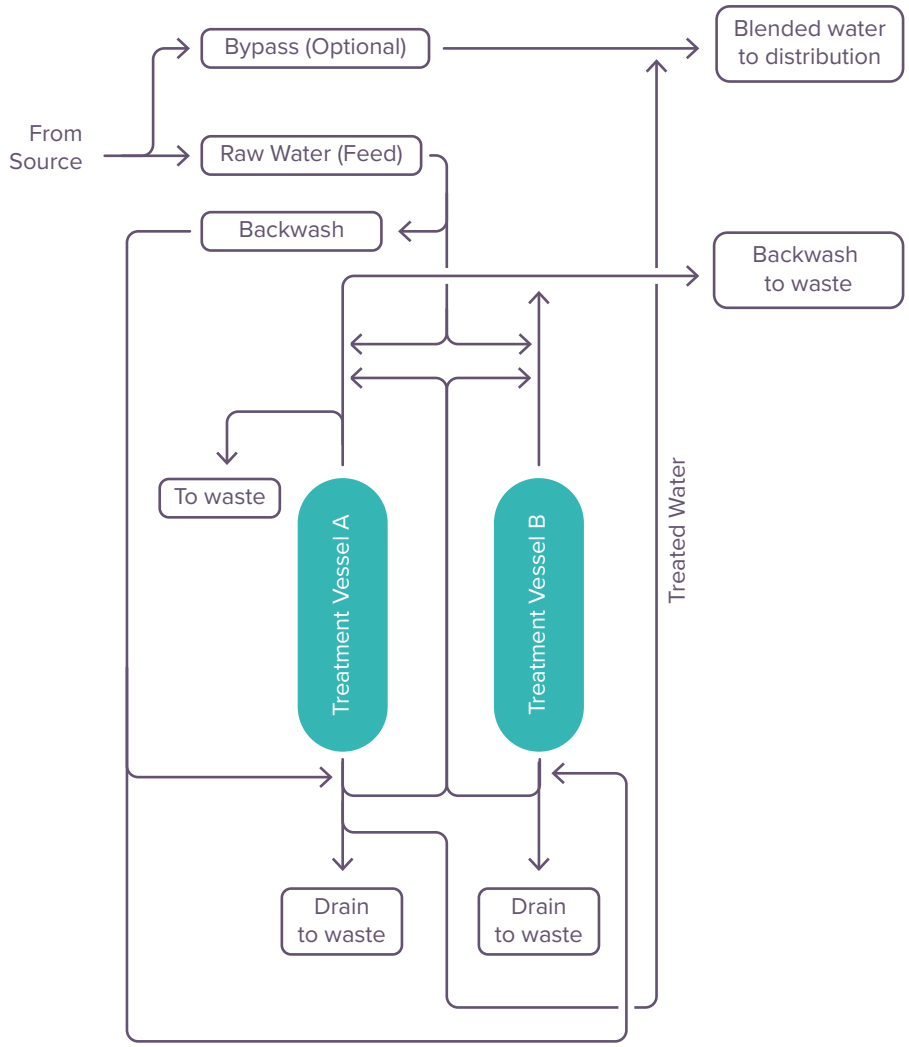


Figure 3: Water System Flow Diagram

Axens and D&F Techniek

As the official distributor of Axens' range of activated alumina for over 25 years, D&F Techniek handles all enquiries on behalf of Axens. With a large warehouse based in The Netherlands D&F Techniek can supply all types of activated alumina for water treatment as well as gas treatment directly from stock. The technical knowledge of Axens and the fast responses of D&F Techniek is a combination which our clients value and appreciate.

For questions or enquiries please feel free to contact: info@dftechniek.nl

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