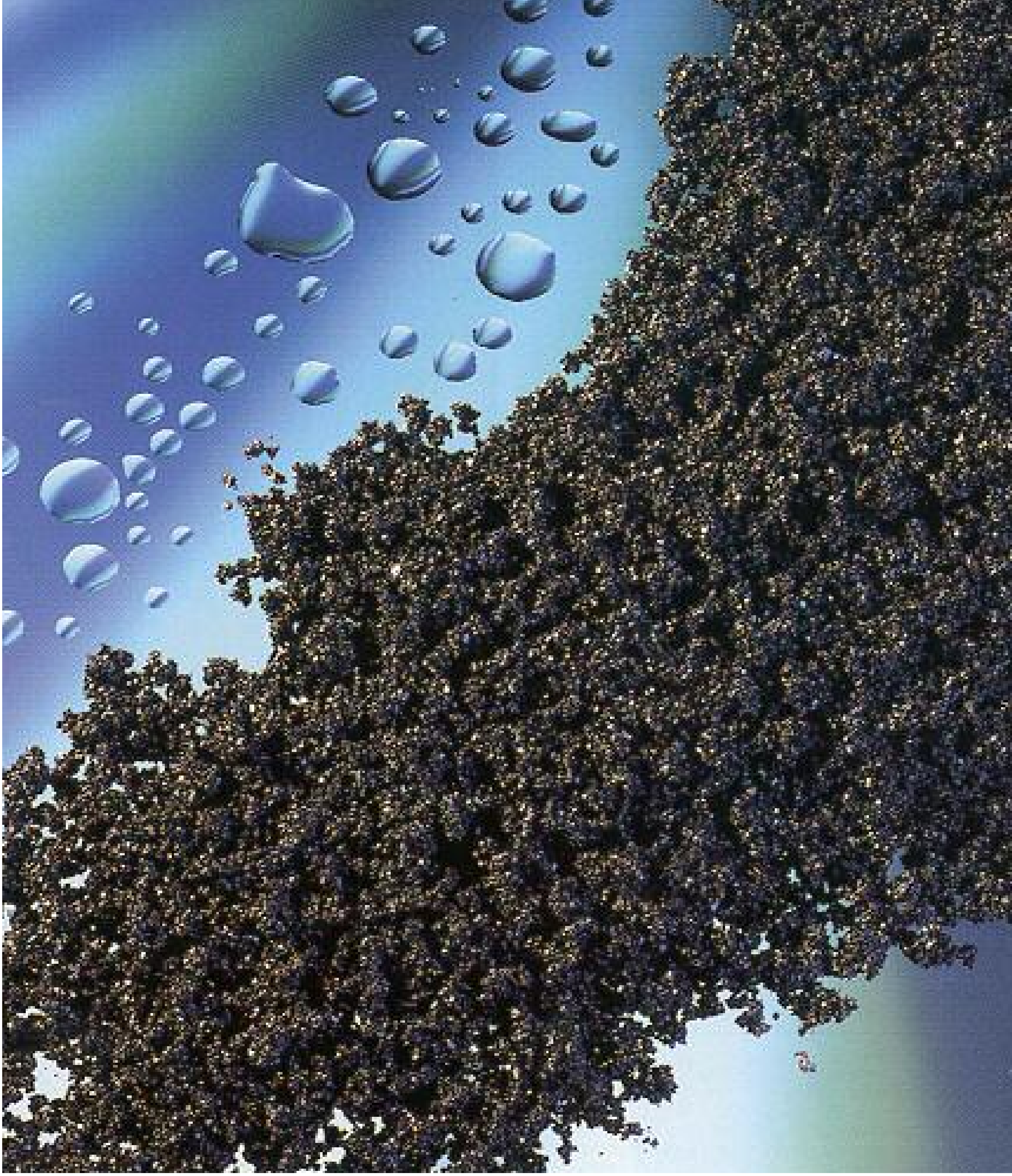


GFH® Media for Arsenic Removal

Water Technologies

SIEMENS

Simple, Safe Arsenic Removal

Municipalities concerned with arsenic in the drinking water can employ Granular Ferric Hydroxide (GFH) to comply with Environmental Protection Agency (EPA) Arsenic Rule. The GFH® system is an adsorption process capable of removing arsenic and other heavy metals from raw water supplies. Arsenic is common in groundwater sources and the health effects associated with high concentrations in drinking water include skin lesions, skin cancer, and several internal organ cancers. Siemens Water Technologies realizes the importance of arsenic removal and the GFH® system is one of our solutions to meet the standards of today, as well as tomorrow.

The arsenic standard implemented by the EPA of 10 parts per billion (ppb) in drinking water has prompted municipalities to comply with strict and increased guidelines when considering arsenic removal options. The GFH® system can meet the standards set by the EPA with a simple design process that requires minimal operator attention and produces a low liquid waste volume.

The GFH® system utilizes a ferric-based, non-regenerative media to adsorb arsenic, selenium, phosphate, chromium and other heavy metals from drinking water. Like other adsorption processes, the water is simply passed through the media to remove the contaminants. Once the media has depleted its adsorption capacity, it is removed from the vessel and replacement media is installed. In many cases, the exhausted media can be discarded in landfills and classified as non-hazardous waste after passing a TCLP test. On-site storage of regeneration chemicals and concentrated waste disposal issues are eliminated with the single use media.

The adsorption life of the media relies on raw water pH, arsenic concentration levels, and operating cycles per day. GFH® media does not require preconditioning or pre-oxidation procedures in most cases, and the use of non-regenerative media are design features that are ideal for small and wellhead applications, particularly where no treatment currently exists.

GFH® Pilot unit

Typical raw water quality:

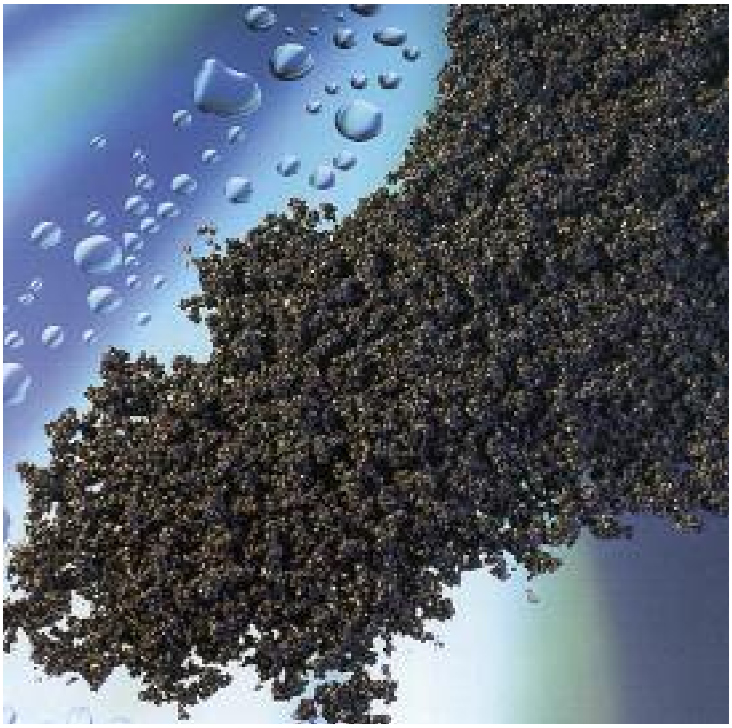
pH	5.5 – 9.0
Oxygen	> 0.5 ppm
Ferrous Iron	< 0.2 ppm
Manganese	< 0.05 ppm
Aluminum	< 0.2 ppm
Silica	< 20 ppm
Phosphate	< 0.05 ppm

While these are the general requirements, we recommend providing a complete analysis for specific system performance and evaluation. The water supply should be free of suspended material and precipitated iron and manganese as these may affect the adsorption process.

Typical contaminants removed:

- Arsenic (III & V)
- Phosphate
- Chromium
- Selenium
- Antimony
- Copper

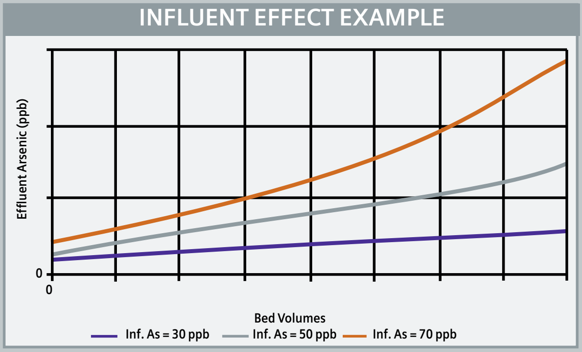
The standard GFH® system consists of three vertical pressure vessels with factory installed internals for distribution and collection of influent and backwash flows. The vessels include fully finished, painted interiors for superior corrosion protection. GFH® media is field placed on a 9” heavy media bed. All face piping and valves are included in the standard system to streamline installation. A backwash process flow rate of 10-12 gpm/sq. ft. (24-29 m/hr) is typically required once every 2-6 weeks to prevent compaction of the bed and remove captured particulate. GFH® systems are ideal for plants that have limited waste handling facilities since the unit produces unusually low volumes of liquid waste and on an infrequent basis.

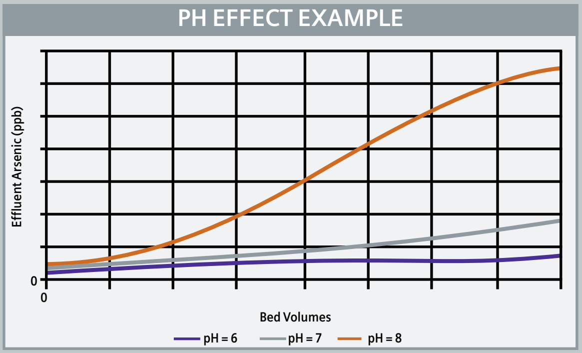


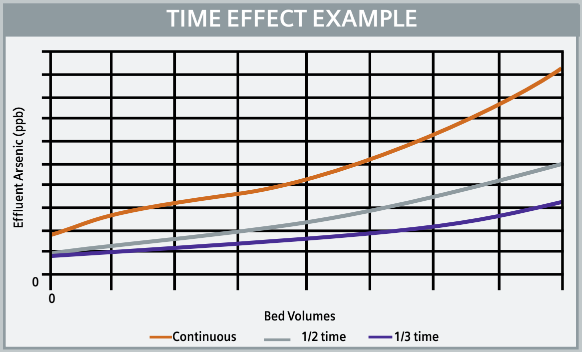
Influent, pH and Time Effect

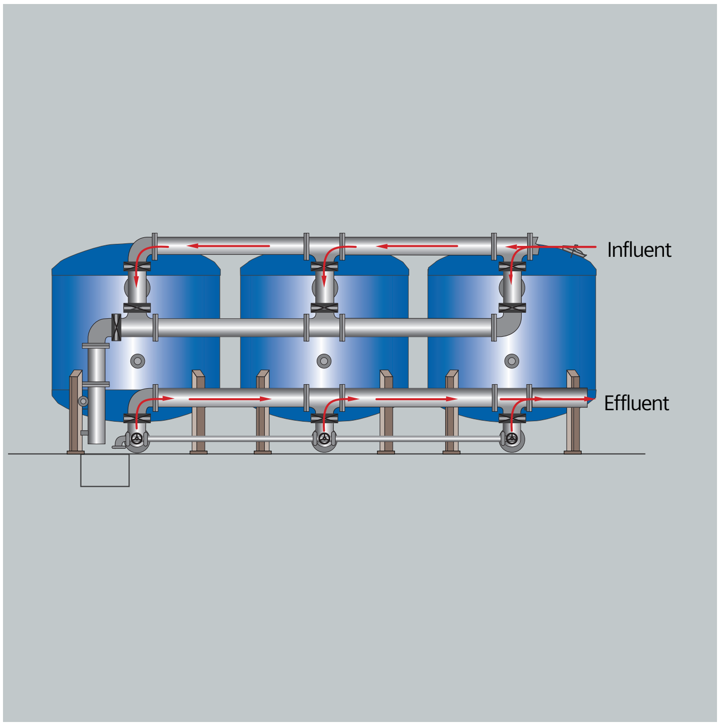
The graphs show the effect of influent arsenic concentration, pH and duty cycle on GFH® systems. As expected, lower influent concentrations lead to a longer media life. Lower raw water pH also has a positive impact on media life. In many cases, pH may not require adjustment. For higher influent pH, a correction step can be included to extend media life. The most interesting operating parameter is the duty cycle. As shown in the graph, systems that allow the media a "rest" period will see an increase in effective media life in terms of bed volumes treated. The rest period allows for an inter-particulate diffusion of arsenic to expose fresh adsorption sites, thus extending the media's useful life.

The GFH® media can be placed into parallel or series pressure vessel systems depending on your required removal concentrations. If a consistent 90% reduction is needed across the system, the series design is used. However, if the percentage is less than 90%, then the parallel design is typically applied. Consult Siemens Water Technologies for special conditions that may define the use of the series design, particularly if higher removal rates are required.

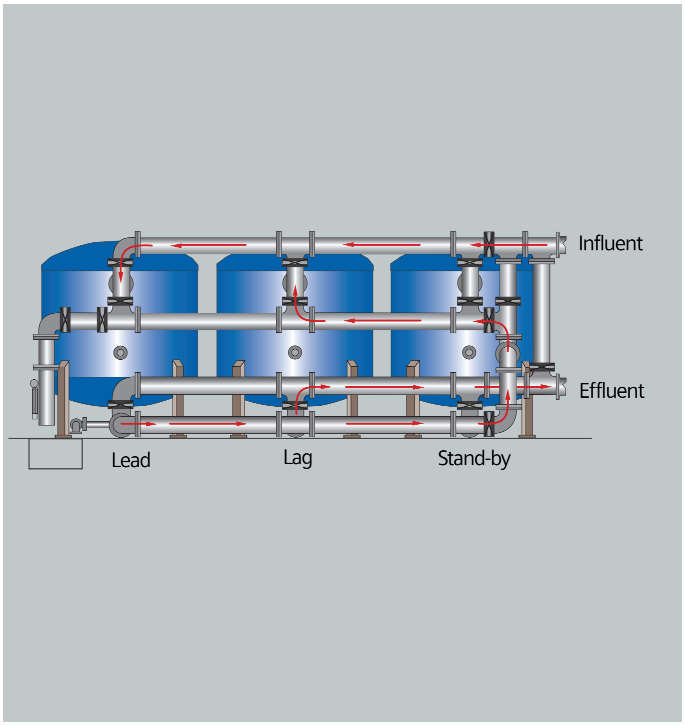








Parallel Flow – service mode, all vessels in–service



Series flow – service mode, two vessels in series – one in stand–by

Parallel Systems, Series Systems

The three, in-service vertical pressure vessels in a parallel system are each designed to treat 1/3 of the incoming flow at a hydraulic loading rate of 5 gpm/sq. ft. (12 m/hr). A five minute Empty Bed Contact Time (EBCT) is provided through the parallel system, plus backwash water is supplied solely from the in-service vessels where they are backwashed during the same event. During the initial start-up of the plant, one vessel is placed on-line where it begins the exhaustion curve. Subsequently, the second vessel is started and later the third one is activated. This process causes all the vessels to operate at varying degrees of exhaustion, and the blended effluent concentration is below the desired level. The blended effluent concentration eventually approaches the acceptable limit, however, and when the media in the longest running vessel is replaced, the overall blended effluent is reduced. Overall media life is extended when operated in this fashion.

In a series system two vessels are operated in a lead/lag mode with a third vessel in stand-by. The hydraulic loading rate is 8 gpm/sq. ft. (19 m/hr) and, similar to the parallel system, provides an EBCT of five minutes total or 2.5-minute EBCT per vessel.

Backwash water is supplied from the raw water source, or returned from the system. Again, as in the parallel system in-service vessels are backwashed during the same event. When the lead vessel media is exhausted, it is isolated and the lag vessel shifts to the lead vessel. At that time, the stand-by vessel progresses to the lag sequence. Following this process, the exhausted media is replaced in this vessel and it becomes the stand-by vessel. The series flow systems include a by-pass line in order to blend raw water with the treated water until the desired effluent is achieved. In a series design, the lag unit receives a lower concentration of contaminants, which creates a more consistent removal throughout the system. The series system, however, treats a lower flow rate than the same size vessels in a parallel unit.

For specific applications, contact Siemens for an estimate of water produced between media replacement. We also offer on-site verification pilot units to confirm process design and equipment selection. The pilot units are provided with the tank, controller and media for an efficient study.

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