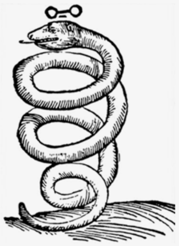

ARSENIC REMOVAL

GENERAL MINERAL ANALYSIS
& DESIGN DATA BULLETIN

Arsenic (As) is a non-metallic element found in group Va of the periodic chart. The physical appearance of arsenic is similar to a metal, and it is referred to as a metalloid to distinguish it from a true non-metallic element. Arsenic rarely occurs in the native state, is the twentieth most abundant element on the crust of the earth, is a principal component of six arsenic minerals, and may occur as an impurity in as many as 245 (non-arsenical) minerals. Arsenic and its compounds are mobile in the environment, and water is a primary means of Arsenic transport. Arsenic is dissolved into water as rain falls on weathered rocks and soils, and as it flows through aquifers containing the most common arsenic bearing rocks such as limestone, granite, and marble; and minerals such as arsenopyrite, cobalt, copper, gold, lead, orpiment, tin, zinc, realgar, serpentine, tungsten, iron, and manganese.

The current EPA maximum contaminant level (MCL) for arsenic is 0.010 mg/l (milligrams per liter of 10.0 µg/l (micrograms per liter). The agency published the final arsenic rule in January 2001 lowering the level from 0.050 mg/l (50 µg/l. States must adopt the Federal MCL within two years of promulgation. The effective compliance date for the arsenic rule is February 2006.

Arsenic can be removed from drinking water supplies, industrial process water, and mine wastewater to meet current EPA standards by several processes including co-precipitation with hydroxides of iron, either in conjunction with existing iron and manganese removal filter, or as part of an enhanced coagulation process. If sufficient Iron is not present in the raw water supply, a ferric chloride solution can be fed ahead of the filter to form the iron hydroxide necessary for the co-precipitation and adsorption of arsenic. Other arsenic removal processes include disposable media such as GFH (Granular Ferric Hydroxide) reverse osmosis, ion exchange, activated alumina, microfiltration, and coagulation assisted membrane filtration. The selection of the process best suited for the raw water is determined by water quality parameters and flow rates.

The General Mineral Analysis and Design information requested in this bulletin will provide us with the water quality information that is required to assure that the test data provided to Pureflow© is accurate, complete, and current. This data is essential for the proper design of the pretreatment and filtration systems regardless of the process selected. The field and laboratory tests must be performed by qualified personnel with appropriate water quality test equipment. We suggest that an independent certified laboratory perform all the required tests. **Please complete the following test data form for each water supply to be treated and return to Pureflow© for evaluation in preparing our system design and quotation.**

TEST PROCEDURES:

a) **Laboratory Test Reports.** All field raw and filtered water samples must be marked with the Well No., date and time the sample is taken. Laboratory water quality test samples must also include the source, date and time that each sample was taken.

b) **Sample Bottles.** Must meet AWWA standards and should be supplied by the laboratory performing the tests. Three one (1) quart bottles are to be marked with Well No., date, time, sample category (Arsenic and Heavy Metal, Gen. Mineral, T.O.C.) and customer name.

c) **Arsenic and Heavy Metals Analysis Sample.** Arsenic, Iron, Manganese, Cadmium, Zinc, etc. samples are to be collected in acid washed glass or plastic bottles. Adjust pH to 2 or less with approximately 2 ml of nitric acid per liter to prevent any metals from plating out on the bottle. If raw water is highly buffered it may require more acid. **Atomic Absorption** method should be used for these tests.

d) **General Mineral Analysis Sample.** Should **not** be acidified. If it is acidified, it will alter the pH and bicarbonate/carbonate values.

Note: This sample will be used to analyze for anions, cations, and pH.

e) **Total Organic Carbon Sample.** A glass bottle with a Teflon lid is required for T.O.C. samples. Refrigerate, or add hydrochloric acid to a pH less than 2.0.

f) **On-site Testing.** Hydrogen sulfide, carbon dioxide, and pH should be determined on-site because of the volatility of these gases and their effect on pH. The "Standard Methods" test utilizing methylene blue is acceptable for hydrogen sulfide determination. Carbon dioxide levels can be determined in the field by the titrimetric method. However, this test should be confirmed by the nomographic method in a laboratory. pH should be determined by the glass electrode method. **Note: pH tests are to be made at the well site, and in the laboratory.**

TESTS TO BE PERFORMED AT WELL SITE

Hydrogen Sulfide (H_2S)________mg/l Carbon Dioxide (CO_2) ________mg/l pH______
Ground Water Temperature _____of Storage Water Temperature _____of Turbidity_____NTU
Chlorine Demand ________mg/l (Break point curve with Free and Total Cl_2)
g) After examining the above data, additional testing may be required to verify data. If sufficient data cannot be determined by standard test methods, additional special laboratory tests may be required.
h) Reference "Standard Methods for the Examination of Water and Wastewater" for additional information regarding analytical protocols.

NOTES:

i) Please provide schematic drawing of system including well(s), distribution main, reservoir, and proposed treatment plant site plot plan. Include minimum and maximum gal. of water stored in reservoir, and maximum water flow (gpm) from main that can be used to backwash filter.

j) After complete, accurate and representative water quality test data is obtained an on-site, continuous flow, pilot study is strongly recommended. Please consult Pureflow© for information regarding our skid mounted Pilot Plant.

k) If the Pureflow© filter media is to be backwashed from the filtered water main, the hydraulic parameters (flow, pressure, velocity, etc.) must be evaluated by the Municipal Project Engineer, and/or Consulting Engineer, to assure that the required backwash water is available from the distribution system, and that the water main is properly sized to deliver the flow and pressure required. If the water main cannot supply sufficient flow and pressure, a separate backwash water holding tank and pump may be required.

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