INNOVATIVE WATER TREATMENT SOLUTIONS

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Arsenic Removal for Drinking / Tap Water and General Industry

A Novel Approach based on Good Environmental Practices

History

Arsenic poisoning has been known and recorded early as 1,500 BC (Ebers papyrus). In 1993 WHO has set a standard of 10 ppb, the lowest level of detection and treatment at the time, but for costs reasons(!) does not want to lower this standard. WHO accepts a risk for skin cancer of 6 in 10,000 people during lifetime exposure is acceptable! Scientific reports suggest to lower this to < 5 ppm. More recent findings show that consumption of water with levels as low as 0.17 ppb over long periods of time can lead to **arsenicosis** (source Wikipedia). 200 million people in 70 countries in S-Europe, S-America, S-Asia and N-America are affected by arsenic poisoning.

Our parent-company ***ENVIRO-PURE FOUNDATION of The Netherlands*** *in 2006* was asked by **MIT**-Boston USA and **UNESCO-IHE** in Delft-NL to come-up with an alternative for existing arsenic removal technologies.
In collaboration with leading suppliers of absorbents in Europe and USA some products were identified that gave promising results, but most were based on the same theme: absorbance by Ferric-hydroxide, a cheap industrial waste product for iron-removal filtration, and ash or activated carbon-based solutions, but all leaving a residual toxic sludge that needs special treatment. A product by a leading chemicals producer showed good results but was very expensive and had a higher, but still limited absorption capacity.

Chairman of the Foundation, Eng. Dick van Dijk, was and is a well-known water specialist, active member of IWA, IUVA and German FIGAWA, Netherlands Water Partnership, Fresh Water Innovators Network, and consultant / guest lecturer to Austrian Standardisation Institute (Ö-Norm), UNESCO-IHE-Delft and Universities of Athens, Barcelona, Istanbul and Vienna, and presenter during multiple water conferences worldwide and a track record of now 45 years in design & build innovative treatment solutions such as Ultraviolet (UV) disinfection, Ultrafiltration (UF), Electro-Dialysis (ED), Cryogenic-Separation, Vacuum-Distillation and more in industrial and municipal water-and wastewater in Europe, Middle East, N-America, Africa and activities in **ASEAN** in 2010, starting a licensed company in Thailand in 2019, called ***ENVIRO-PURE (ASIA) LP.***
From 1976 onwards our group members and management have focussed on optimal solutions with emphasis on lowest possible impact on the environment through lowest energy consumption, optimal recycling, minimal or no waste production and ease of operation, at affordable cost.

In 2014 cooperation started between ***ENVIRO-PURE FOUNDATION*** and ***Tami*** *in Singapore* who had developed a new variation of an existing, but never widely used, technology.
Tami, had been granted funds by the government of Singapore and support by the National University (**NUS**) where all scientific research and analysis was carried-out. Test-units were built in Thailand and Singapore and results surpassed expectations, and internationally acclaimed German Accreditation Institute **TÜV**, through its Singapore branch **TÜV-SÜD** confirmed and certified presented findings. ***Asxban Technologies Pte Ltd*** was founded.

Many hundreds of systems were successfully installed in villages in India (Bihar) in the following years, saving thousands of lives and preventing hundreds of thousands serious cases of **arcenicosis,** a tumor promoting disease caused by the presence of even minute traces of arsenic in natural waters in many countries, a problem existing already thousands of years.

As and Fe removal in Bihar – India
Gravity Asxban purifiers village-drinking water 2 m3/day

General Process Information:

Raw water containing **AsIII** or **AsVI** typically is groundwater, as arsenicum is absorbed in groundwater streams from the rocks and sediments such as the Himalayan basin. According to our information few surface waters are polluted with As.

The unique developed product developed by Tami, ***AsxbanSorb*** is a specially conditioned granulate of the metal ***Zirconium***, in the form of **ZrO_2**., Zirconium Oxide. Zr-ore is abundantly available the world over. In its patented conditioned state it has the highest absorption capacity per kilogram of all known products, and on top of it, it binds As permanently and renders it insoluble, preventing any leaching of As in the environment after disposing the saturated product on a regular landfill (certification available). This means that ***no regeneration with harsh chemicals*** is required and no by-products are formed. The challenge in powder-based adsorbents such as **ZrO_2** with small particle size results in loss of the active material in a treatment process. Ultra-, Micro-, Nano-filtration, all membrane based, are basically the only technologies to retain this material within a reaction-column with the option to recover it, but for large flows are too costly in investment and use.

Concentrating on a wide range of capacities and raw water qualities, and by thinking out-of-the-box, our proven unique innovative approach, an automatic, virtually maintenance free up-scalable process has been developed.

Technology:

Depending on the origin of As-contaminated raw water and existing or absence of pre-treatment we offer various, unique and tailored solutions.

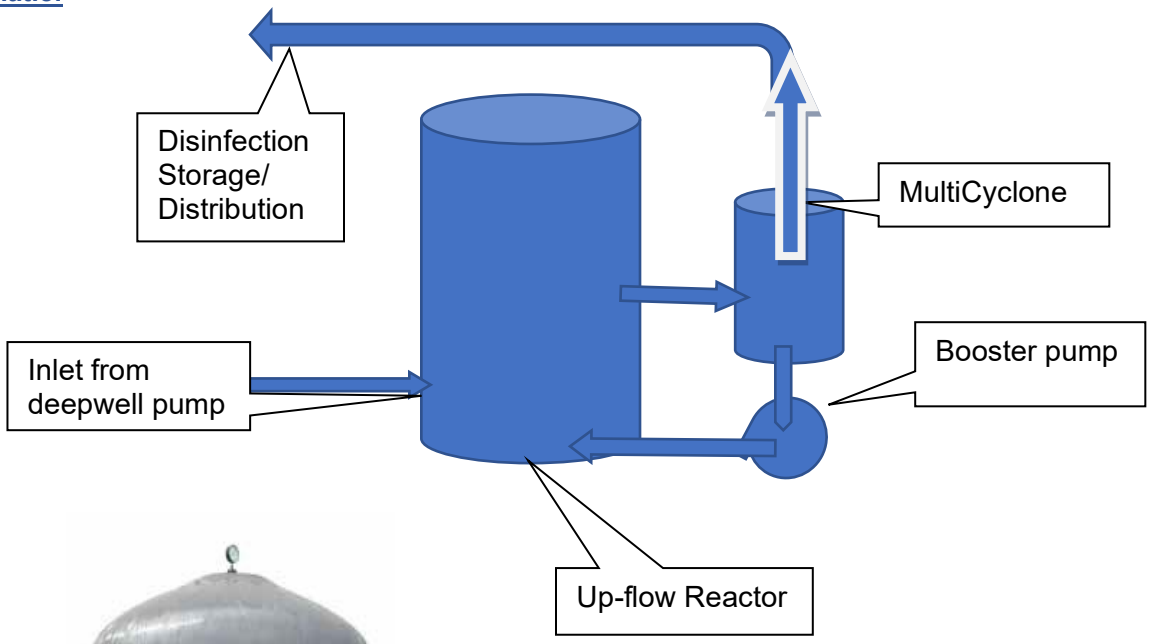
Ground water:

Arsenic is mostly found in groundwater (wells, bore holes) in concentrations from 10 – 2,000 ppb (micrograms per litre, or parts per billion), well above WHO or National Standards, WHO recommends a maximum concentration for potable water of 10 ppb, some National Standards require only 20 or even 50 ppb (USA); in Europe < 5 ppb is required. Due to the fact that As can also be absorbed through the skin it is highly recommended to use the highest standards (< 5 ppb). Infants bathed in water with a higher concentration run the risk of getting a***rsenicosis a tumor promoting disease, affecting kidneys, liver, heart and skin.***

Plants and fruits should not be irrigated by As contaminated water. Over 200 million people in Asia (Bangladesh, India, parts of China, Cambodia, Philippines, Thailand) but also in Europe and S-and N-America show these and other ailments because of As-poisoning.
Ground water in general is free, or low in particles, bacteria and viruses and is mostly only just disinfected before distribution. It may however contain more dissolved minerals next to As such as Iron, Calcium, Lead, Phosphates, Nitrates in elevated concentrations. They will also be absorbed by our process (except Nitrates).

It is the only technology in the world NOT producing a toxic waste product!

Schematic:




Up-Flow reactor


Even Distribution


MultiCyclone


Inverter Booster Pump

Process Description © (copy-rights protected)

1. A feed pump, in existing installations the borehole- or submersible pump, delivers the not yet disinfected, water to the up-flow reactor containing the **AsxbanSorb** absorbent and, depending on the situation, granular Activated Carbon or Anthracite. From the reactor the pre-treated water is fed into MultiCyclones where, under centrifugal forces created vortexes, separation of carried-over powder takes place. Separated and concentrated **ZrO_2** will be fed back to the bottom of the reactor with a small booster pump to return the active product and improve mixing and retention time, thus optimizing the process.
2. The cleared water will now exit the unit, disinfectant-dosing can be done as usual, or with our unique **AQUATABS** NaDCC granulates producing hydrochlorous acid (HOCl), the most potent and stable chlorine-based disinfectant with a shelf life of > 3 years without losing strength and a residual capacity of up to 72 hours in the distribution network and no pH-shifting. An easy and safe to handle, operator friendly technology used since 2003, EPA and NSF approved. Hydrochlorousacid, or HOCl will not create chlorates contrary to liquid chlorine and bleach.
3. Based on analysis of the incoming and exiting now almost As-free water, additional powder may directly be fed in the reactor to maintain the desired As-removal rate. After some weeks it will be known how often, and how much absorbent needs to be added. The initial amount, based on our estimate, will last for a minimum of 3 months operation. The material may stay in the reactor for a long time, assuring all its active ingredients are used to the full and, depending on the treated volume, may be drained from the reactor by just opening the drain valve to a settling tank for later disposal. Backwash is not required and water recovery-rate is > 99.999 % contrary to any other method of As removal.
4. The carrier-media in the reactor is made of recycled and heat-treated glass with a very smooth surface preventing formation of biofilm, lowering required pump capacity by 20% and not needing frequent backwashing and replacement for an estimated 20 years, reducing environmental impact even more by saving water and energy.

Surface water:

In case of surface water we offer **smartUF**-Ultrafiltration to purify river, pond and lake water and innovative flocculation/sedimentation called ***ENVIRO-PURE H2O TECHNOLOGY***, a Dutch invention fabricated in ASEAN with track record > 15 years in ASEAN, that can be applied in combination with As removal as indicated above. Capacities from 2 – 25,000 m3/h.

Safe, clean drinking water from well, pond, lake or river, WHO compliant.

smartUF-Plant 15 m3/h Cambodia - pond

Indonesia: ENVIRO-PURE H20 TECH 300 m3.h- river

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