Elimination of contaminants in waters for human consumption

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Summary:
The prescence of contaminants in waters for human consumption, such as arsenic, fluoride and salts, affects a wide region of Argentina.
In Argentina, the Argentine Food Code (CAA) modified the permitted maximum concentration values for drinking water.
The INTI developed an intervention model for the abatement of arsenic in consumption waters led to rural and urban areas. For the case of rural zones it has been developed a domiciliary device based on coagulation / filtration, which doesn´t needs use electric energy.
The effectiveness of the device is evaluated by analytical tests, measuring arsenic by two different technics (Atomic Absortion espectromethry and DDTC-Ag), fluoride by a colorimetric method (Spands-Zirconilo) and salts by ionic chromatography.
In field studies, from the obtained results, it is found that the treated water by the residents operated devices, meet the concentration levels of arsenic and fluor allowed for human consumption.

Keywords: elimination, contaminants, waters

Introduction:
The presence of arsenic and other components at high concentrations, such as fluoride and salts affects a wide region of Argentina, including: part of the provinces of Cordoba, La Pampa, Santiago del Estero, San Luis, Santa Fe, Buenos Aires, Chaco, Formosa, Salta, Jujuy, Tucuman, La Rioja, San Juan and Mendoza.
The intervention model for the abatement of arsenic developed by INTI-Quimica adopt a methodology of work that includes:
In situ analysis of the situation: amount and location of wells used as a primary source or surface water intakes if so appropriate. Sampling for subsequent analysis at INTI laboratories. Visits to the treatment plant if there is anyone. Request for records, population censuses and background used in the problem resolution to the municipality or authority which is competent. Irrigation systems, storm drainage systems, regimes of major rivers. System of integrated water management, if there is anyone.
Characterization of water: analyzing arsenic, fluoride, salts and other parameters of interest, required to implement the design of the treatment.
Hydrogeological study: an evaluation of the possibility and convenience of further drilling in the same napa used as primary source, or from wells in other aquifers. It will analyze the burden of the aquifer and its flow. We study the use of superficial water sources, if they exist.
Population analysis: We performed a calculation of consumption and design flows. We consider two situations, namely:

1) Contaminated water sources wich are used for the supply of people throughout distribution systems. Proposal to be presented to municipalities, provinces, towns, population groups, NGOs that have or want to implement a service of distribution system.
2) Poblations that are supplied by private wells, this is that water supplies is not done through a public distribution system. This may be the case for populations in the periphery of urban areas where it has not reached the laying of the net, isolated populations, rural populations. Within this group, we will differentiate in:

- Populations with electricity supply.
- Population without electricity supply. For this case INTI developed a device wich can works with and without electricity. It uses a coagulation/filtration technology optimized to a particular water quality.

Methods:

1) Atomic Absorption Spectrometry with hydride generation, with flow injection, Perkin Elmer AAnalyst 700.
2) DDTC-Ag Standards Methods 3500-As B.

Fluor, by colorimetric method, Standard Methods 4500-FD using a Spectrophometer Shimatzu U-1800.
Salts, (Nitrates, Sulfates and Chloride) by ionic chromatography, Equipment: Dionex, model DX500, column S11.
The developed device uses a coagulation/filtration technology and a disinfection stage. It feeds the equipment with the water to be treated. Reagents are added, shaking mechanically for one minute. Allow to stand for one hour. Is filtered by gravity and get clean water for human consumption. Process time: approximately 70 minutes, treated water volume: 35 liters.

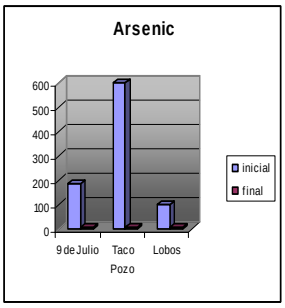
Treatment include this stages:

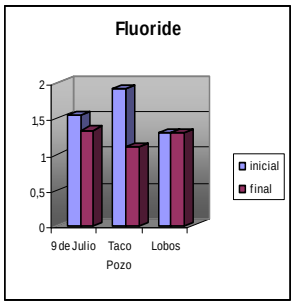
- Pre-oxidation, chlorine (sodium hypochlorite)
- Coagulation: ferric chloride and / or ferric sulphate
- Flocculation: as needed
- Sedimentation: about 1 hour
- Filtration: sand mantle

Results and discussion:

Examples are given of the trials fields done:

Localidad	Initial data (without treatment)	Final data (after treatment)
9 de Julio (Buenos Aires)		
Arsénic (ug/l)	187	<10
Flúoride (mg/l)	1,54	1,33
Taco Pozo (Chaco)		
Arsénic (ug/l)	600	<10
Flúoride (mg/l)	1,9	1,1
Lobos (Buenos Aires)		
Arsénic (ug/l)	103	<10
Flúoride (no excede los valores permitidos) (mg/l)	1,3	1,3





Advantages of the abatement system:

- Easy to operate.
- It doesn´t need electric energy
- The operating principle is tested by the inspection bodies.
- Applied to the groundwater in the town of Lobos and 9 de Julio (Buenos Aires), Taco Pozo (Chaco), and using ferric chloride as a coagulant, the device enables obtain the treated water with arsenic levels belows 0,010 mg/l.
- In treated water it ensures a bacteriological level suitable for consumption.
- Low cost of investment and maintenance.
- Ease of maintenance procedures.

Disadvantages of the system:

- Its efficiency depends on the physical and chemical characteristics of water to be treated.
- It generates a residue that is required to dispose.
- As with the home dispositive is necessary to perform regular checks on produced water in order to evaluate if the efficiency and the mode of operation of the system are correct.

Conclusion:

The intervention model is usefull for sequentially consider all aspects involved in the production of drinking water.

Were achieved, after treatment with the developed device, the WHO guideline value (1995), and the Argentine Food Code (CAA 2007), wich set a maximum limit for arsenic of 0,010 mg/l, as well as the allowed values for fluoride.

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