Water Purification in Paraguay

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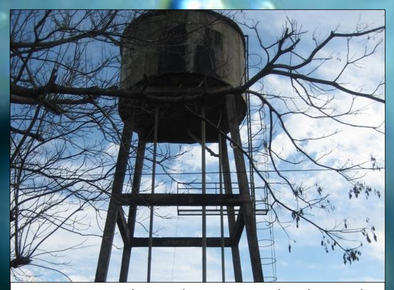
Abstract

Many rural communities in Paraguay are disadvantaged by their inability to access safe drinking water. The drinking water is often purified by inefficient means. Therefore, a new method of cheaply and efficiently filtering water is vital to the long term health of the communities. We were able to focus our research into a few key areas. First was the removal of bacteria and coliforms from the water. The communities are able to sanitize the water; however, a new system based on less harsh methods is a major objective of the project. Another main concern is the suspected presence of iron in the water. The community water boards believe that iron is causing health problems. Unfortunately, we were unable to confirm the presence of iron, making it difficult to make any final recommendation. However, it is possible to provide the relevant research and request that a series of tests be done.

Background on Paraguay

- Small country in South America
- Abundance of Water supply
- 45%of population has access to potable water
- Water Boards regulate water
- Community operated
- Insufficient funds

Picture from Paula Burt of decaying pipes and contaminated water samples from a Paraguayan water source.



A water tower in rural Paraguay that is used by the water boards to store water for use by the community.

Methods

- Researched under the pretenses that the system had to be both cheap and effective and that it needed to remove coliform bacteria and iron from the water
- Research databases included ScienceDirect and Google Scholar
- We obtained information via our sponsor contact, Paula Burt through email communication
- Professor Plummer provided expert insight into water purification systems

Objectives

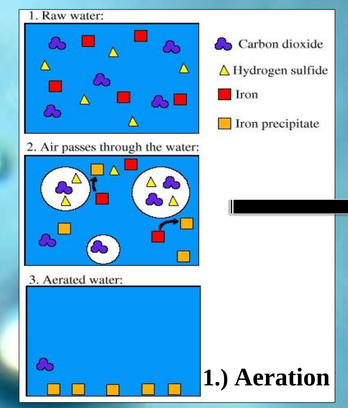
- Reduce the quantity of contaminants in the Paraguay water
  - Coliform bacteria
  - Iron content
- Keep cost low and materials available
- Make need for electricity minimal
- Simplify system to match skill of local community

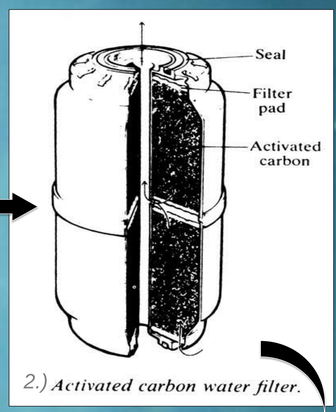
Bacterial Purification

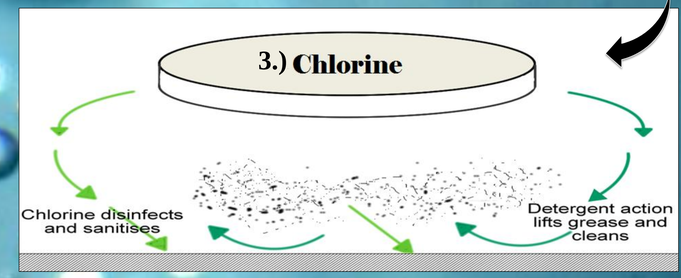
System	Method	Benefits	Drawbacks	Requirements
Boiling	Water is boiled then rises as steam into a condenser tank leaving behind contaminants	Removes almost all organic and inorganic contaminants, easy to maintain	Time consuming, not sustainable, expensive, lose of healthy minerals	Mineral additive Residual sanitizer
Exposure to Sulight	UV radiation from sunlight kills organic matter when exposure is long enough	Cheap, effective	Dependanat on weather conditions, time consuming	None
UV Lamps	UV radiation form lamps kills organic matter	Kills most bacteria and viruses	High cost, requires maintenance, requires electricity	Residual sanitizer
Ceramic Filtration	Water is run through ceramic material where contaminants are caught in pores in the filter	Can be cleaned for reuse, removes most bacteria, viruses and some inorganic contaminants	Costly, maintenance, unreliable, does not remove iron	Cleaning equipment Residual sanitizer
Chlorination	Reacts with microorganisms in the water to destroy cell bodies	Kills most bacteria and viruses, provides a residual sanitation effect	Can react with substances to form hazardous particles	None
Active Carbon	Captures contaminants in pores through chemical processes	Removes most bacteria and viruses, remove some inorganic contaminants, reliable	Costly, requires maintenance, periodic expenditure	Residual sanitizer

Iron Removal Techniques

System	Method	Benefits	Drawbacks	Requirements
Aeration	Air is bubbled through water, oxidizing iron, so that it forms insoluble compounds	Cheap, easy to maintain, easy to moderate	Can react with anything metallic in system pH sensitive Changes pH of water	Buffer eg CO_3^{2-} Bubbling mechanism
BIRM Filter	Water is pumped through the filter, where iron is removed	No chemicals, durable design, very low maintenance	Expensive to install Sophisticated system required to function Requires specific pH	Backwash mechanism
Boiler	Water is boiled into steam, and then precipitated, leaving pure water	Very effective, easy to run and maintain	Incredibly energy intensive	None
Organic Media Filter	Water is pumped through the filter, where metallic salts are caught in the filter	High purification rate, small space use, simple to create	Additional chemicals necessary Needs skilled maintenance	Backwash mechanism
Active Carbon	Water is forced through the filter, where contaminates bind to filter	Can be replenished on site, easy to maintain	Very ineffective	None







Conclusions

- Based on the information that we were provided with by the water board and our contact at the AVINA Foundation we cannot provide a concrete purification system
- We offer recommendations based on testing that will hopefully be done in the future
- For high iron content an aeration filter is recommended
- To remove coliform bacteria an active carbon filter is recommended
- Chlorine should then be added to keep the water free of bacterial contaminants

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