WATER PURIFICATION

DESIGN REPORT

Team Dream Team

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Abstract:

Appropriate technology serves well to modernize third world nations by providing improvements for health, education, and convenience. Many underdeveloped communities suffer from problems with tremendous negative effects and do not have the technological means to over come them. Often times, the solution is simple to many of these problems, and developing communities only need guidance to overcome technological obstacles. One type of developing community that often goes overlooked in the pursuit of modernization and humanitarianism is the urban community. These areas are just as primitive as most underdeveloped rural areas and have even greater problems due to high population density.

Urban communities along the Ganges River in India are particularly notorious for having many health problems because of the river's large amount of pollution. Most of this pollution is caused by industry, particularly leather. Furthermore, biological waste is also a huge pollutant. Nearly one billion liters of excrement enter the Ganges daily. Another unhealthy practice includes the religious dumping of corpses in the river. All developing communities along the Ganges are dependent on the river for drinking, bathing, and cleaning. All of these activities are practiced with untreated, dangerous water. One third of the deaths in India are credited to water contamination, as are over 80% of all general health problems. It is clear that action must be taken, and appropriate technology is the way to approach this epic problem.

Challenge Statement:

Considering the primitive state of the developing urban communities along the Ganges River, it is important that the solution to creating clean and safe water is simple and straightforward. Also, it is very much in the spirit of appropriate technology to implement an idea that makes use of locally available materials.

Team Dream Team created the task of making a water purifier that could filter highly contaminated waste and create safe water to drink and use for daily life. This device would have to be large enough for a family (about a five gallon capacity) and be easy to build and maintain. After great toil and hardship, Team Dream Team encountered a solution that fit these criteria: a colloidal silver ceramic filter. This filter is made by mixing dry red clay with sawdust to create a porous ceramic surface of any desired shape. The filter is then saturated in colloidal silver, which kills harmful bacteria on contact.

In Team Dream Team's design, the basic structure of the device is made up of two five-gallon ceramic pots that are stacked on top of each other. Draped over the first pot is a cloth, preventing any large debris from entering the filter. After passing through the cloth and ceramic filter, the clean water is stored in the bottom pot, awaiting use.

After testing this technique, Team Dream Team realized they had achieved their goal with enormous success. All harmful pollutants, such E. Coli, were removed.

"Hurray!" Exclaimed Team Dream Team.

Design Requirements:

- Functional Requirements:

  -To be able to provide clean water for a group of 4-6 people living on the Ganges River.

  -To remove animal and human remains, sewage and trash.

  -To kill coliform and E.coli bacteria.

  -To reduced nitrates and turbidity.

- Qualitative Requirements:

  -Safe

  -Easy-to-use

  -Low maintenance

  -Should use readily-available resources

- Quantitative Requirements:

  -Maximum height 1.5 meters

  -Maximum width of 1 meter

  -Less than 50 pounds when empty

  -Under $200

Final Design Description:

We kept our final design as simple as possible in order to continue with the appropriate technology theme. There are very few parts to our water purification system. The initial filter can be almost any type of material as long as it allows water to pass through but keeps large debris from entering the system. We used a sheet folded over several times but an old shirt or a cloth bag would do the same function. This cloth will be tied on with any sort of string or rope to keep it in place. The next piece is the upper reservoir with ceramic filter fitting inside. The ceramic filter, coated with colloidal silver, needs to have a lip that overhangs the top of the container so that no water can splash around and make it past the filter. The filter is constructed out of 50% red clay and 50% sawdust so that when fired the sawdust burns out leaving a porous container that water can pass through following a hazardous path. Then after it is dried it is coated in the colloidal silver to complete the filter. The container needs to be made through domestic pottery means and will have a hole in the bottom of it so that the filtered water can pass through it to the bottom container. The size of these two containers depends on the amount of water you want to be able to store while it is being filtered. Ideally it would be made large enough to hold an entire days worth of water (approximately 5 gallons for 4-6 people) so that it could be filled just once each day. The next piece is the clean water reservoir. It is made the same way and approximately the same size as the upper container so that all the filtered water can be stored until use. There needs to be a hole in the bottom of this reservoir also but it needs to be small enough that a hose fits snugly inside it. This connection needs to be sealed with sealant so that clean water doesn't leak out around the hose. The hose diameter doesn't need to be exact but approximately 1" is recommended. The hose needs to be long enough so that when the free end is elevated it is above the level of water in the bottom reservoir. This will act as the valve to stop the flow of water in between uses. The whole system needs to be elevated on a stand so that the hose at the bottom of the lower reservoir isn't touching the ground. A stand made out of wood or a table with a hole cut in it will work. The actual assembly will be the bottom container sitting on the stand with the hose through the bottom. Sitting on top of that will be the upper water reservoir with ceramic filter fitting inside. Then tied on the very top will be the cloth filter.

Parts List:

As mentioned earlier our project is based on appropriate technology, so we wanted to spend the least amount of money possible. We investigated the situation where we thought our product is going to be most beneficial and found that pottery is something that these people can get their hands on. We needed a container for filtering the water and storing it. Building the filter and the upper container saved us some money as the materials were provided by the art center. On the other hand we bought the lower container which was U$S19.99, that could have been built as well. The other important "ingredient" in our project was the colloidal silver. Although you can make colloidal silver, buying it was a better choice for us. This was one of our most expensive items, it was U$S 26.40. Other expenses were a hose and silicone aquarium sealant. These cost U$S 3.16 and U$S 3.99 respectively. Our initial filter was just an old sheet that we had so it was free. The stand that held the filter was also free because it was built from scrap wood. The last two things in our cost list were for a presentation and Janice, a graduate student that helped us to build the filter and the upper container. The poster board was U$S 13.99. The most expensive part of the project was Janice's time to help us build the filter, it was U$S 30.00. Our grand total was U$S 97.53 that is still cheap for the amazing filter we have.

Project Evaluation:

When we were brainstorming ideas for our project we first decided on a water filter. We all agreed that overpopulated urban areas are as equally important as underdeveloped rural areas. We decided to focus on the Ganges River in India. It's a plentiful source of water but it's so filthy that it's unhealthy for the people to use.

We found that over 10 million people use the river every day for all of their needs. We had to figure out how to remove coliform bacteria from the water since that was the main source of sickness. After we had filtered water we tested turbidity, nitrates, coliform bacteria, and E. coli. The tests were as follows:

Turbidity- We zeroed the sensION with purified water, placed our filtered sample into the compartment and took a reading. The turbidity went from 206 to zero.

Nitrates- We zeroed the sensION with purified water. We then mixed our sample with cadmium for one minute. After letting it sit for five minutes we placed it in the compartment and took a reading. The nitrate level went from 2.2 to .6 (mg/L).

E. coli/ Coliform Bacteria Test One- We placed one mL of our filtered sample on the coliform bacteria plate and put it in the incubator for 24 hours. After the 24 hours we took it out and recorded the number of colonies.

E. coli/ Coliform Bacteria Test Two- We diluted one mL of our filtered water with 10 mL of distilled water, put one mL of that mixture in easy gel, mixed and then poured into a Petri dish. After that we did the same with one mL of just our filtered water. After letting them solidify we placed them in the incubator for 24 hours. When the time was up we took them out and recorded the number of colonies.

As we were going through the design process our biggest obstacle was coming up with a filter that killed essentially all of the bacteria and made the water safe to drink. After some research we found that colloidal silver was the most effective way. The only problem with the actual design was if there was a problem after the testing we couldn't go back and adjust minor details. Overall the project worked very efficiently and was a success.

Recommendations:

Some improvements or challenges that we faced with the filter were that it filtered water at a very slow rate. Although the water came out clean, it still took a long time. We thought that if you put more sawdust in the mixture of the filter before burning it, you would have more of a porous filter so water can flow faster. The problem could be that you might need a higher concentration of colloidal silver in that case. Our filter was close to the limit for the concentration of colloidal silver, so if you produced the colloidal silver you would have to check carefully on the concentration for coating the filter.