Option 1: Recommendation of the application of a specific technology, available today, that is not currently utilized in IDP projects.

A. Define the specific community problem being addressed

The shortage of clean water has become a major crisis. In many third world countries, people do not have access to clean water. Currently 884 million people do not have access to safe water supplies.¹ These people are forced to settle for any water that is available to them. This often leads to a lack of clean drinking water, poor hygiene practices, and little to no sewage systems. As a result of this people often defecate in the open which in turn can further contaminate the surrounding water.² Approximately 840,000 people die each year due to a lack clean water.¹

Toxins and heavy metals, such as mercury, lead, cadmium, and copper can be found in our drinking water in trace amounts. The most common of metals found in water are lead and copper. Our water sources can easily be contaminated through rain water as they percolate through rocks and other materials. Although the EPA regulates our water to meet a set standard, other countries do not have this benefit.³

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economic impacts. Benefits stem from many areas. The amount of health services needed would be reduced as people no longer contract diseases related to contaminants in drinking water. The amount of productive work time in countries would increase, as people would no longer be sick as often, and they would not die as early. In the United States, for every dollar spent on clean water, a two dollar economic return can be expected.³ Figure 1 below shows the benefit to cost ratios in different regions when improving sanitation. All of the benefit to cost ratios are greater than one, which indicates that the benefit of having access to clean water is greater than the cost of obtaining it.



Figure 1. Benefit-cost ratios of interventions to attain universal access of improved sanitation, by region (2010).²

Many of the procedures used to filter water into clean drinkable water are either very expensive or require materials that an average person cannot easily obtain. Keratin can be easily found in cheap materials such as chicken feathers, hair, or wool from sheep or unwanted clothing.⁴ Over 5 million tons of keratin wastes are generated annually worldwide.⁷

We are currently in progress of collecting adsorption isotherm data. Our progress is shown in Figure 2 below.

Figure 3. Calibration Curve for Ion Selective Electrode.

Trials were also conducted to determine the minimum volume of sample required to run the Ion Selective Electrode effectively. Because the amount of keratin available is limited it will be necessary to use the minimum volume required in the batch tests. Although it was determined that for batch trials the volume used should ideally be between 75 and 100 mL to get the most accurate results with the ISE, we are limited with the amount of keratin available to us.

Figure 4.



Figure 5. Effect of volume of ionic strength solution HI 4000 on ion selectivity.

Sand Filtration System

A sand filtration process will be constructed with a keratin aerogel layer for filtering drinking water. Sand filters are often used to remove particulate matter from drinking water, and so the added layer of keratin adsorbent will also remove metals from drinking water. FLow through the sand bed will

the permeability of play sand. Our results will form a basis on which we can design and construct a slow sand filter that will filter approximately 25 liters per day and can be implemented affordably in developing communities. The sand filter would contain an amount of the keratin aerogel suitable to the size of the sand bed, the amount of water to be filtered, and the concentration of copper in the water sample. Our keratin-based sand bed performance will be tested and assessed using pond water spiked with selected metals. Success will be measured by the extent of metal removal and particulate removal from the water at a water treatment rate of 25 liters per day.

Keratin Extraction

After demonstrating the feasibility of utilizing a keratin-based sand filtration system for treating drinking water, we will demonstrate that the keratin extracted from a common waste material, such as chicken feathers, can also be used as an adsorbent for metals in water. Washed and dried feathers will be cut into small pieces and soaked in 100 mL of a solution containing 8M urea, 0.5 M sodium metabisulfite, and NaOH to bring the pH up to 6.5. The entire solution will then be placed in a cellulose tube for dialysis with distilled water for three days. The keratin aqueous solution is then filtered with a 5 micrometer pore

size and cast onto a polyester plate for drying. This results in a solid kerain that will be converted to an aerogel and used for adsorption of heavy metals.⁷

agreements laying out the specific roles and responsibilities of each party. The EWB chapter would agree to a five year commitment to the community partner to allow for long term project planning, as well as conducting regular monitoring, evaluation and lessons learned to improve current and future work.

The CDC estimates that average sand filters lasting for 10 years will cost \$100 or 0.068 cents per liter.¹³ The initial cost is estimated at \$15-\$60, but by using locally sourced materials we would aim to be in the lower end of this range. Adding the batch keratin adsorption will increase the maintenance costs, as compared to a typical sand filter. The specific costs would vary based on water use, contamination levels,

Works Cited

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