Affordable and Sustainable Water Filtration for Ningxia

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Introduction

Last summer, we went on a trip to Ningxia, one of the poorest regions in rural China. There, most villagers got their drinking water from the nearby Yellow River. In addition to being polluted, we found extremely high pH levels in the water as well.

We discovered that high blood pressure and kidney stones, prevalent among the villagers, both have a correlation with the villagers' consumption of dirty drinking water with high mineral content and high pH levels. There is a close relationship between hardness (mineral content) and pH, because minerals like calcium and magnesium are basic and would thus increase the pH.

We have since been dedicated to resolving this issue of hard water (water with high mineral content) in the rural village. Our goal is to design a sustainable, cost efficient, and environmentally friendly water filter that can successfully filter out toxic pollutants specific to the water in the section of the Yellow River that runs through Ningxia, while also lowering the hardness and pH levels of the water by at least 1.5.

Research Methodologies

Our research consisted of collecting qualitative data through water testing and quantitative data through interviews and surveys.

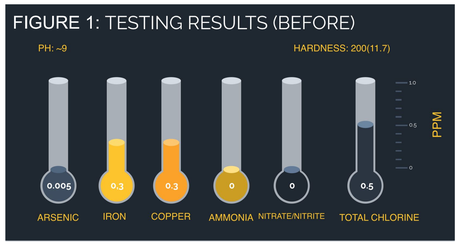
We first conducted interviews with the village doctor to learn which diseases were prevalent in the village and confirmed that they were caused by the intake of dirty water from the Yellow River. We also conducted surveys with individual village households as we looked for other potential causes to the diseases.

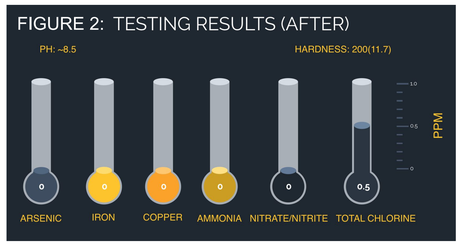
Before focusing on any one aspect of the muddy water, we sought to learn about the original content of the water as well as the effects of the Mesopaper filters. Through the use of a general water testing kit, we tested water samples from a section of the Yellow River that runs through the fields for mineral content, hardness, pH level before and after they were ran through the filters.

Then, we focused on the issue of lowering the pH level of the water. We used Insta-Test test strips to test the pH of hard tap water from southern California (mailed to us by Dr. Maruya of the Southern California Coastal Water Research Project) as well as bottled Brita alkaline water before and after they were run through the following filtering materials: Mesopaper, MesoNode granules, activated carbon paper, and Brita filter.

Results and Findings

General Water Characteristics





We found that the Yellow River water contained heavy metals such as arsenic, iron, and copper and had a pH of 9, which is considered unhealthy by the EPA. After running the water through the Mesopaper filter, the heavy metals were removed and the pH was lowered to 8.5, which is considered within the healthy range by the EPA but still borderline.

PH Level

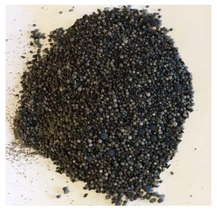


Figure 3: MesoNose Granules

Figure 4: Finer Granules

Figure 5: Mesopaper

Figure 6: Activated Carbon Paper

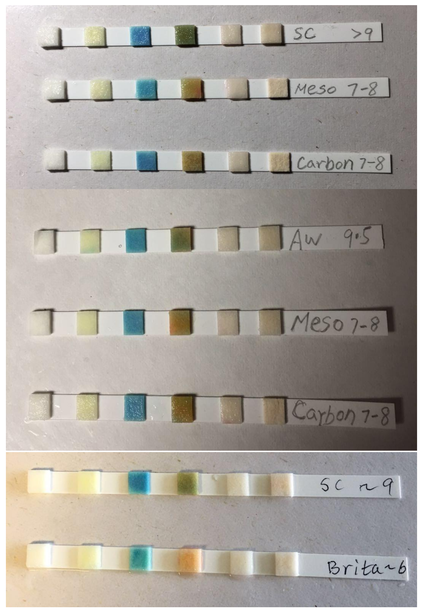


Figure 7: Test Results

We found that the Southern California tap water had a pH that was over 9 and that the Brita alkaline water had a pH of 9.5.

Mesopaper reduced the pH of the southern California tap water from over 9 to between 7 and 8 and the pH of the alkaline water from 9.5 to between 7 and 8. Overall, Mesopaper tends to reduce pH by around 2, due to the tiny MesoNose granules embedded in it.

The MesoNose granules failed to reduce the pH level at all in both the tap water and the alkaline water, because we were unable to control the filtration rate of the relatively large granules; the water passed through them too quickly.

Our home Brita filter failed to reduce the pH level of both the tap water and the alkaline water.

The active carbon paper failed to reduce the pH level of both the tap water and the alkaline water.

Conclusions

Our tests yielded contradictory results. We have concluded that our first test with Mesopaper that we conducted on the Yellow River water (which yielded a pH reduction of only 0.5) was inaccurate, because our more recent and numerous trials on Southern California tap water and Brita alkaline water indicate that Mesopaper reduces the pH level of hard water by around 2.

Activated carbon paper does not lower the pH of hard water, but it does eradicate the aftertaste left in the softened water by Mesopaper.

We conclude that Mesopaper would provide an adequate filtration device for lowering the pH levels of relatively hard water and soften it in the process (reduction in pH is a direct result of a reduction in mineral content). Activated carbon can serve as a good aftertaste remover. A combination of Mesopaper and activated carbon can be a possible cheap, efficient, and accepted filter for the villagers in Ningxia.

Implications and Next Steps

We hope to move this project forward by designing a simple filter using a combination of activated carbon and Mesopaper to remove contaminants and heavy metals, sufficiently lower the pH and hardness of water, and leave the taste of the resulting drinking water uncompromised.

This summer, we will visit Ningxia again to distribute or sell our filter for very cheap and affordable prices to the villagers in Ningxia, taking note of any changes in circumstances and adapting our product accordingly.

We could also potentially expand the distribution of our water filter to southern California sometime in the future; there, the ion exchange method is used to soften hard tap water, but this method puts too much salt in the water for it to be healthy for consumers of the water.

We plan on working closely with Mesopaper Inc., as our filters will be largely based on their products.

Acknowledgements/References

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