Abstract

More than 5 million people die every year from not having clean water. The second leading cause of death for children under 5 is from diarrhea. 88% of deaths from diarrhea are caused by drinking unsafe water. With our Coagulation Filtration System, you can save many, many lives from diseases caused by unsafe drinking water.

Our Coagulation Filtration System is a water filtration system that filters, coagulates, flocculates, and sediments water in a clean, efficient way. With our Coagulation Filtration System all you do is put wastewater in and the microbes will eat at the microplastics in the water, the water will then go through a coagulation, flocculation, sedimentation process using a natural coagulant. Then, the water will go through a filter which will catch the flocs of solid waste or any impurities which can be used as a fertilizer. After that, the water will have chlorine power added and the water will be disinfected. Once everything is done you will have clean, safe drinking water. Our Coagulation Filtration System will save lives!

Present Technology

The technology we chose was water filtration. Now there are many ways to filter water, so it is safe to drink. The current form of water filtration involves coagulation and flocculation. First, after the water reaches the treatment plant, the water will receive chemicals with a positive charge. The positively charged chemicals will the cause the negatively charged dirt partials and debris to bind together creating larger clumps called flocs. After the process of coagulation and flocculation, comes the sedimentation. Sedimentation is when the flocs sink to the bottom because they become heavier and denser. The sinking to the bottom leaves the cleaner than before drinking water above.

After the coagulation, flocculation, and sedimentation comes the filtration. Once the floc is settled at the bottom, the water above it goes through multiple filtering processes. It will pass through sand, gravel, and charcoal to filter out dissolved particles such as dust, parasites, bacteria, viruses, and chemicals. The water will also pass-through different pore sizes. After the water has gone through all the previous filtering processes, it is disinfected. A disinfectant is poured into the water, a disinfectant such as chlorine or chloramine. It is used to ensure that any remaining bacteria, parasite, and viruses were killed. It is also used to guarantee that the water would remain clean in the pipes, as it traveled to faucets and different waterspouts.

History

History of Water Filtration:

General water treatment: Purifying water is complicated but needed. People who don't have clean water may ingest water that may cause diarrhea, cholera, dysentery, typhoid, and polio in some cases. Dating back to as early as 2000 BCE people would boil, place hot tools in water, and filter water through sand or charcoal filters to purify water. This was to make it taste better, there was little known about water-borne diseases. One of the earliest devices of water purification was the "Hippocratic sleeve" which was where one would strain boiled water through a cloth bag to purify it. Water treatment experimentation dates to 1627 when Sir Frances Bacon believed that when you were to dig a hole near a saltwater shore the water would pass through the sand leaving behind the salt particles. Sadly, this was not correct, and he was left with undrinkable water, but this information has helped the later experimentation for sand filtration which is still used today. One of the biggest breakthroughs for water purification knowledge was discovered by John Snow. During 1854, scientist John Snow found that cholera was transmitted through water. After much testing he found that chlorine could be used to purify water, which would lead to chlorine becoming a very popular way of water filtration. There are many ways of purifying water and early examples of this are not safe.

Coagulation: Coagulation is very important in water filtration and more. There is evidence that as early as 1300 BCE Egyptians were using coagulants to separate clean water from contaminants like alum. Back in the 18th century in Scotland the Scientist Robert Tholm included coagulation-flocculation in his filtration system. Most commonly, coagulation is used in testing for blood clotting. Coagulation is also used in the cooking of eggs by forcing the proteins together to force the water out, to make the egg cooked and solid.

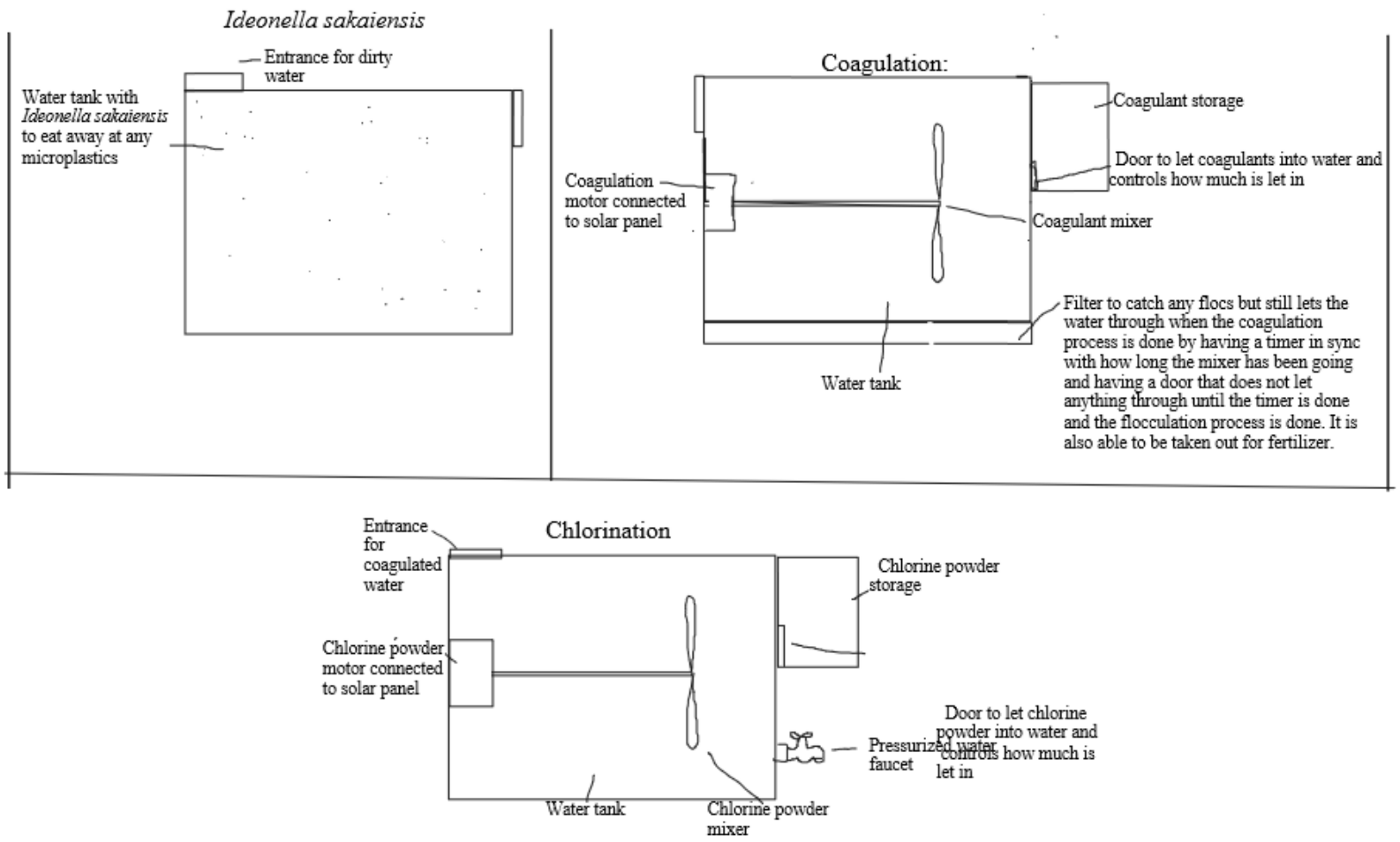
Future Technology – Slide 1

Our project will create a safe and efficient water source, but not leave microplastics in the water like water treatment plants do. Our technology combines coagulation, flocculation, sedimentation, and plastic eating microbes called *Ideonella sakaiensis*. The mixing chambers in the filter would be powered by powerful solar batteries, with enough energy stored for long periods of time. After, the water would go through filters that would trap larger particles, the water would go into the rapid mixing chamber, to be stirred with the organic coagulants such as Polyamine and PolyDADMAC. After that, the water would enter a slow mixer and more coagulants would be added. After the final flocculation and sedimentation process, the water would flow through a final filter and be disinfected.

Future Technology – Slide 2 (optional)

Prior to all these steps a bacterium called *Ideonella sakaiensis* would be in the water. It eats plastics, and could be used to eliminate plastics in water. *Ideonella sakaiensis* can be modified using genetic engineering, allowing it to survive in water. Once it is in the water it would eat the microplastics, reducing the possible waste that could pollute the environment. The bacteria would greatly help with plastic pollution from water treatment.

Future Technology – Slide 3 (optional)



Breakthroughs– Slide 1

There are three breakthroughs; Solar Powered Battery availability, Ideonella sakaiensis Advancement, and Natural coagulants.

Solar Power Battery Availability:

Solar power can allow the water purification to be performed in an entirely renewable way. We will require solar powered batteries because solar energy is not very reliable based on the fact that it is reliant on the weather rather than us. We will need to be able to store any extra energy. This is very realistic because of how many industries are turning to cleaner energy, because of supply and demand there will be much more production towards clean energy including batteries. It does not exist because ever since the discovery of fossil fuels people have relied on fossil fuels rather than sources like solar energy. This led to there not being much production of ways to store clean energy. As the global climate crisis is striving to be solved, new ways of getting power are being put into action.

Breakthroughs– Slide 2 (optional)

Ideonella sakaiensis Advancement:

Ideonella sakaiensis also known as a Plastic-Eating Microbe, will need advancement because we intend to be able to turn the waste in the wastewater into fertilizer, by putting the wastewater through the coagulation process to separate the solids and liquids, then we will have the *Ideonella sakaiensis* eat at the microplastics to make the fertilizer able to go into the soil without harming the soil. Studies have shown that often, wastewater contains microplastics. The advancement is needed because currently, the microbes tested on were often slow and inefficient in the degrading of plastics. We will need this to advance to be able to rely on *Ideonella sakaiensis* to not let plastics into fertilizer because once microplastics get into soil they may alter a soil's physical properties, disrupt microbial communities, and decrease soil fertility. This technology does not exist currently because of how new *Ideonella sakaiensis is.*

Breakthroughs– Slide 3 (optional)

Natural Coagulants:

We will need a sustainable, natural, coagulant for our technology because of the fact that coagulation is a large part of our project. Having a sustainable, natural, coagulant that is available to people in a more rural area would be extremely useful because of how our invention would be especially helpful to people who do not have access to clean water. This does not exist because of the fact that most of the use of coagulants is that of chemical coagulants.

Design Process – Slide 1

Our first rejected idea was that the filter would attach to the faucet externally

Step 1 - the idea: The first idea we rejected was that the filter would attach to the faucet externally, we thought this would be a better idea for maintenance, and for possible replacing of filters.

Step 2 - Processing Water: The idea could not have worked because the processes of filtration that we chose takes time. The amount of time the water takes to pass through the faucet is not nearly enough time to filter anything using the processes that we chose. So, you would be left with undrinkable water.

Step 3 - Energy: Electricity is needed for our filtration process, because the mixing chambers require electricity. In such a small area the electricity would be hard to connect to the attachment, and there would be multiple visible wires.

Step 4 - Efficiency and Consistency: An attachable filter would be less efficient, as it would need to have replacement filters and maintenance most likely. An attachable filter would also not be as consistent because of the amount of time in the filter. It would cause problems in consistency with cleanliness.

Step 5 - Attachment: With an attachable filter, depending on the pressure the filter might not be able to stay attached, making it so the filter would be unstable.

Design Process – Slide 2 (optional)

Our second rejected idea was that we would have a large filter underground per house.

Step 1 – Unoriginal:

Our second idea was very similar to the average process of filtering wastewater. With a similar power source and overall idea. This realization let us to have the idea of having an off the grid water filtration system that is for people who live in a rural place that do not have access to clean water or electricity.

Step 2 – Not Helpful:

We realized this because of how uncommon it actually is for dangerous metals in pipes to get into your water, which contradicts the “problem” we were trying to solve.

Step 3 – Too Expensive:

This is because our idea was to have every house to have their own coagulation system. Having another layer of filtration would be helpful, but the cost of this is far too unrealistic because the ratio to people getting sick that have electricity is far lower than people who do not have access to electricity. This is what led us to having a cheaper, off the grid, full filtrating, disinfecting, and coagulating system.

Design Process – Slide 3 (optional)

N/A

Consequences

Consequences of our Coagulation Filtration System :
There are negative and positive consequences to our Coagulation Filtration System.

Our Coagulation Filtration System will be able to give clean water and fertilizer to people who do not have access to clean water. This is because our invention is self sufficient, clean, and efficient as long as it has chlorine power and coagulants available. With the 5 million people dying every year from unsafe drinking water, our invention could save many, many lives just by filtering their water.

A negative impact of our Coagulation Filtration System could be the fact that some coagulants could negatively impact the environment. If we are forced to use aluminum sulfate, that can be very harmful to the environment. Which is why we hope for there to be a breakthrough in natural, sustainable coagulants.

There is also the possibility of ingesting any *Ideonella sakaiensis* which has not been tested on in large amounts and could have unknown consequences.

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Home Page

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COAGULATION FILTRATION SYSTEM

Background

The Current use of Technology:

The technology we picked was coagulation and water filtration. Coagulation is used primarily in blood clot testing and water filtering. When coagulation is used in water filtering, it is used in the process of coagulation, flocculation, and sedimentation. First, after the water reaches the treatment plant, the water with receive chemicals with a positive charge. The positively charged chemicals will the cause the negatively charged dirt partials and debris to bind together creating larger clumps called flocs. After the process of coagulation and flocculation comes the sedimentation. Sedimentation is when the flocs sink to the bottom because they become heavier and more dense, so they sink to the bottom leaving the cleaner than before drinking water above.

Limitations of Today's Technology:

With 5 million people dying every year from not having access to clean drinking water it is clear we need to have widespread filtrating. Some limitations of the current technology is that they are designed to be connected to plumbing and electricity with some exceptions that may not be ideal.
According to a study done in 2006, 7 out of 10 people who do not have access to clean water live in a rural area, which means basing a water filtration system off of electricity and plumbing is no longer an option for people without clean water.

Sample Web page – 3

Future Technology

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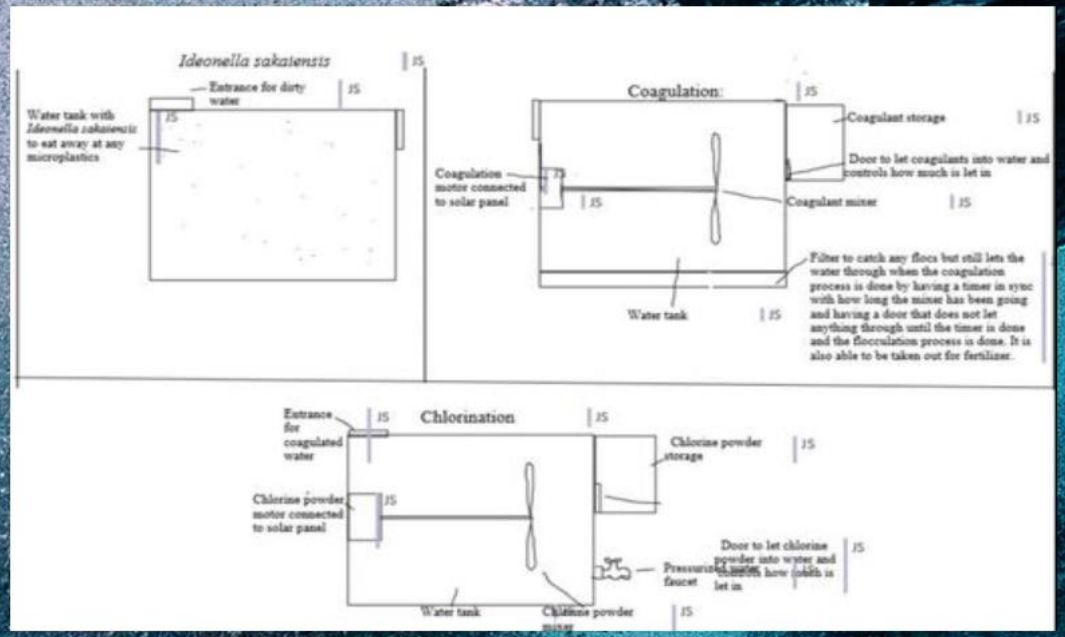

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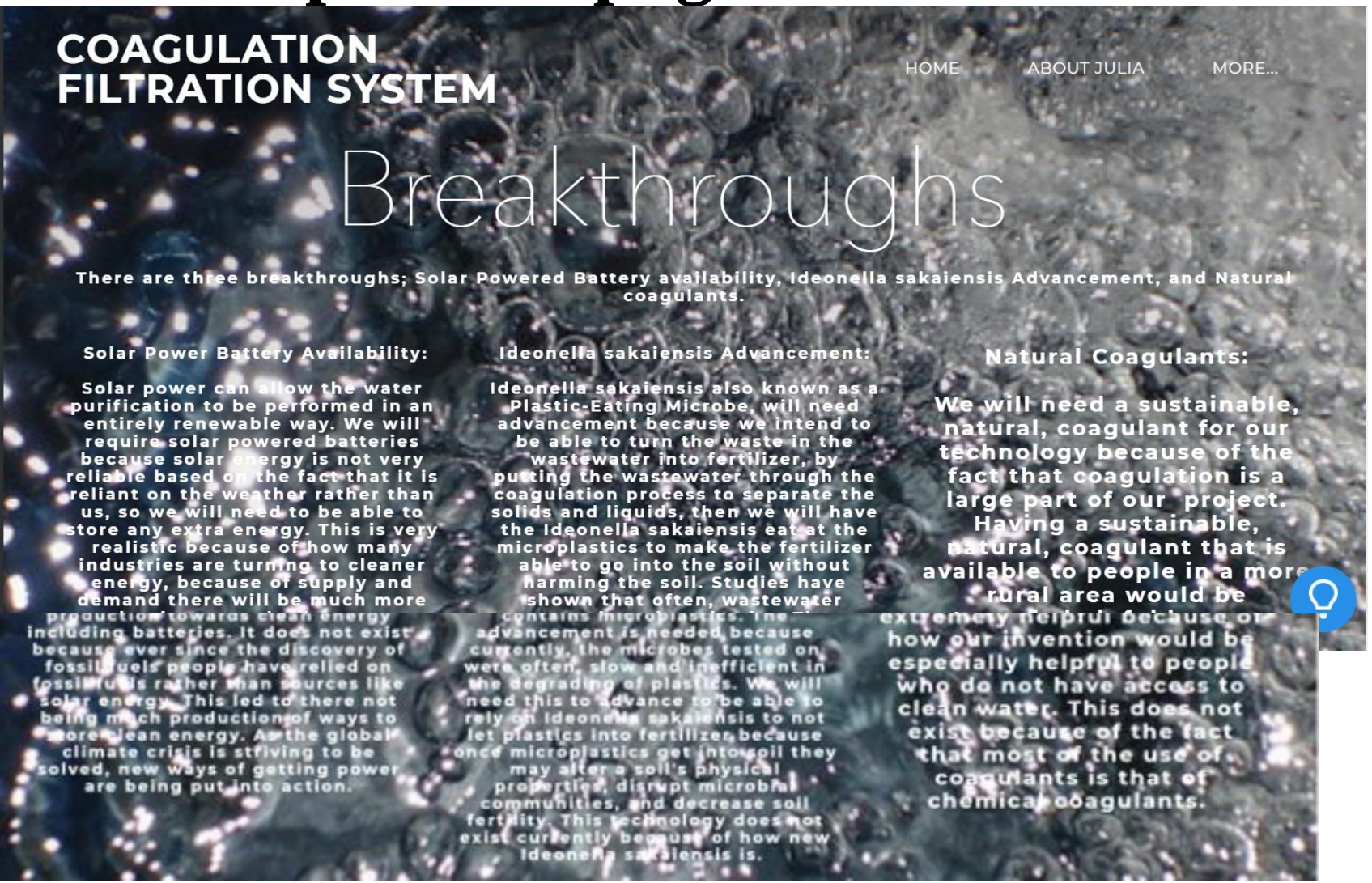

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