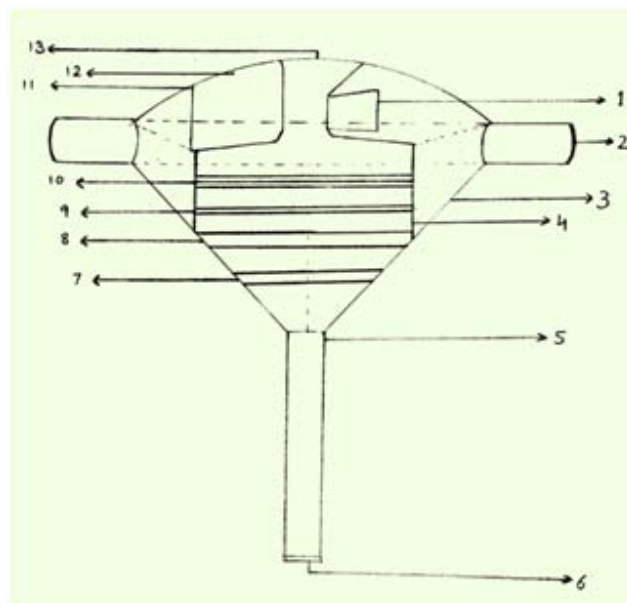


fish and particulate matter. The pipe leads to the container in the cylindrical body. The container is about another meter thus making the total length of the device 10 meters. The diameter of the container is 1 meter. This container holds all layers for neutralization of the chemicals. The container has four layers. Each layer has a reagent encased in a fine sieve so that it doesn't move. Above this is a narrower pipe which has a pump. This pump is responsible for sucking the water up from the lower portions of the pipe and out from the outlet located above. The pump creates a flow of water with a volume rate of 1.5 lit/sec. The reason for keeping the inlet some distance below the surface of the water is that the water below contains a little more concentration of the chemicals to be removed which settle down due to weight. The gross weight of the device is estimated to be from 15 to 18 kilograms with the reagent layers weighing around 8 kilograms. This weight is held up by the help of a circular float.

The device requires a power supply for the working of the pump. This power supply can be provided from the shore or can be provided using an on-board battery. If the device is close to the shore, the supply should be taken from the shore. The reason for this is that the battery drains quicker than the chemicals situated in the container. Thus, the device will need more frequent servicing to change the battery. Also a battery can be risky during mishaps in the water. The leaking of battery chemicals will do serious damage to the ecosystem we are trying to protect. The device sucks up water and removes the chemicals while taking the water up to the surface. This process continued repeatedly over a period of time removes the unwanted chemicals.

A. Parts of Construction

1. Pump – Motor assembly
2. Float
3. Main body
4. Container
5. Pipe
6. Inlet with sieve
7. Phosphate Filter (Lime)
8. Activated Carbon Layer
9. Micro-sieve
10. Deionizer
11. Dome-shaped Lid
12. Storage compartment for battery
13. Outlet



B. Working

The device sucks in water from point 6 – the lower end of the pipe. This is fitted with a 325 U.S. grade sieve which allows only particles less than 44 microns to enter. This sieve prevents the entry of aquatic life and dirt particles into the container. The water then enters the container at point 5 and encounters the phosphate filter.

The phosphate filter (7) consists of a layer of lime. This layer reacts with the organic phosphates present in the water to release a calcium salt. Thus, organic phosphate is turned into inorganic (ionic) phosphate. The water now becomes ionized and heads toward the next filter. But, this introduces another harmful component i.e. calcium ions. These calcium ions can be harmful to aquatic life if released.

The next filter is a mesh of activated carbon (8). This carbon adsorbs chlorines, chloramines and organic matter. Along with adsorbing these chemicals, the carbon layer gives out minute strands called 'fines'. These 'fines' are then collected on the micro-sieve (9) located next along the stream of water. The water leaving this filter is rich in calcium and clean of most harmful organic compounds. However, this layer also removes a natural disinfectant – Chlorine. Thus, the area above the carbon layer is susceptible to garner bacteria growth.

After the carbon filter, the water goes through a layer called the deionizing layer. This layer has two kinds of resins – cationic and anionic resins, each having their own sub-layer. The water first encounters the cationic resin which replaces all calcium ions for H^+ ions. Then the water enters the anionic sub-layer. Here, the phosphate ions are replaced for OH^- ions. Thus, both harmful ions i.e. calcium and phosphate ions, are removed from the water.

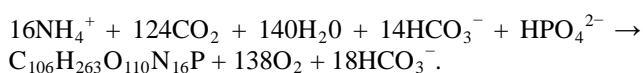
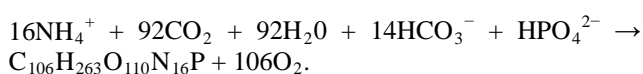
After the water has passed through all these layers it is given back outside through the outlet given on top. The water exiting the device forms a thin layer on the top most surface of the device. Here, the ultra-violet radiations from the sun can kill the bacteria formed after the activated

carbon layer. Thus, keeping the device from promoting the growth of any harmful bacteria.

During the operation of the device it consumes the reagents present in the various layers over time and loses effectiveness. Thus, it is required to have a regular maintenance done in which the reagents are switched for fresh layers. This ensures proper working of the device for the duration it is kept in the water. During the maintenance, the different layers along with the battery can be accessed by lifting the dome-shaped lid (11) of the device. After every service the device is capable of running for 2 to 3 months without any further servicing.

4. Chemical Reactions

The following chemical reactions take place in the presence of sunlight for production of algal bodies:



The device has the following reactions taking place in their respective layers:

Layer 1: Phosphate filter (Lime)



Layer 2: Activated Carbon

Adsorption occurs at this layer. Chlorines and Chloramines get adsorbed on the A.C. mesh.

Layer 3: Deionizer

Cationic resin reacts with cations to release H⁺ ions. Then, Anionic resin reacts with the remaining phosphate anions to release OH⁻ ions.

5. Calculations

The following data are assumed for the device:

Water flow rate = 1.5 lit/sec = $1.5 \times 10^{-3} \text{ m}^3/\text{sec}$
Density of water = 1000 kg/m³
Diameter of pipe = 8 cm = 0.08 m
Head of water above pump = 0.5 m

We have an equation for theoretical power required for pumping action as:

$$P_{th} = \rho \times g \times Q \times H$$

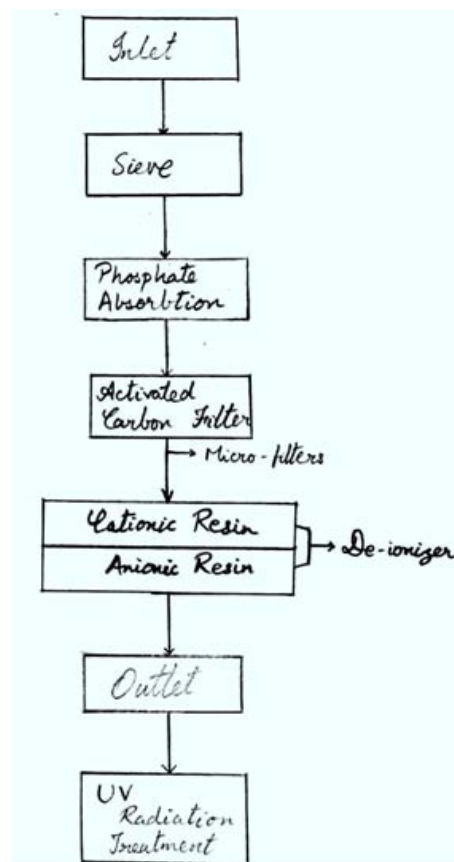
ρ is the density of water.

g is the acceleration due to gravity.

Q is the volume flow rate of water through the pump.

H is the total head in the pipe. It is the sum of static head and dynamic head of water.

Thus, the theoretical power after substituting the values is found to be 140 watts. However, a real pump has lower efficiency than an ideal one. Assuming the efficiency of the pump to be 60 % we can calculate the power required for the device to operate and can supply power accordingly. By this we get the value the requirement as 240 watts.



6. Conclusion

The device works by sucking in water and passing them over layers of meshed reagents to clean the lake water of the harmful phosphates and organic matter which lead to eutrophication. With increasing use of fertilizers across agricultural fields, the increase of chemical run-off is eminent. The need for devices such as these is on the rise and this is but a small step. This device hopes to reduce environment problems in lakes and other small freshwater bodies. This device also aims to propagate the idea of clearing chemicals after they have been introduced to the water body so that the water body can be maintained.

Acknowledgment

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