Long term preservation of rainwater for the exploitation of potable water

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Abstract: For millennia, the water cycle provides enough water for everyone on earth. Presently this entire cycle is severely affected by overpopulation and global warming. Due to poor rainfall, drought sets in, crops fail, adding to urban water problems, most of the harvested rainwater is used for agriculture, cleaning, cooling agent, flushing, etc. This project aims to promote personal involvement in water conservation by suggesting a rainwater conservancy system. Polypropylene based filter is used to filter the filtered water. The purity of water level is improved in a notable manner. Water can be saved by dams and canal which is expensive whereas at home it becomes free and cheap.

Keywords: Rainwater, Potable water, Polypropylene filter, Rainwater harvesting.

1. INTRODUCTION

For millennia, the water cycle provides enough water for everyone on earth. Now this entire cycle is severely affected by overpopulation. Due to poor rainfall, drought sets in; crops fail, adding to urban water problems [5]. Most of the harvested rainwater is used for agriculture, cleaning, cooling agent, flushing, etc. Rainwater harvesting is becoming a modern tool in water conservation and stormwater management [8]. In early days the practice of rainwater harvesting was lost due to the readily availability of municipal water supply. In later days, due to the unavailability and some issues in municipal water, rainwater harvesting has been obtained by some houses and buildings [9]. Rainwater harvesting means the collection of rainwater during the rainy season in the rooftops and storing the rainwater in the tanks for the purpose of other potable and for the non-potable purposes [1]. For example, drinking, cooking rainwater and irrigating lawns and irrigating, washing cars, or even flushing toilets, etc respectively.

Rainwater harvesting system can range from a simple barrel at the bottom of a downspout to multiple tanks with pumps and controls. Rainwater harvesting is also effective in reducing stormwater runoff pollution entering the river. Collecting the rainwater from the rooftops and directing it into the storage tank reduces the volume and rate of runoff [2]. If we can reduce runoff, we can reduce flooding, water pollution, erosion and stream habitat degradation. The rainwater collected in the rooftop should be filtered and the clean and clear water can be used for other potable purposes [4]. Generally, the collected rainwater is filtered by conventional methods, then the rate of purification around 85% to 90% but in the case of our project we introduced polypropylene filtercloth for better and best results. In the case of the introduction of polypropylene filter, it gives better results between 90% to 95% of pure water. This filter cloth can filter large to fine particles. It is a good resistance against acid attack, alkalis, and reducing agents. It is free of mildew and oxidation, and it has excellent gas permeability filter. It has the lightest weight among synthetic fabrics, and it shortens the filter cycle of the rainwater
collected [3]. This filter cloth is used in chemical, pharmaceuticals, sugar, non-ferrous metals smelting, sewage treatment plant. We used three types of filter cloth for better results such as polyester 550, polypropylene 701, and polypropylene 303. In which the polypropylene 701 gave the best result [10]. Stephen Leahy 2017, international environmental journalist has discovered the global environmental interconnections such as the climate, climate change etc. The climate change in order to overcome the water scarcity in the earth, such as the brave conservation of rainwater during rainy season without wasting and filtering it and using this filtered water during summer season for our needs. [11]

2. PROBLEMS IDENTIFIED

- Water shortage is certain to intensify the divide among rich and poor, advanced and underdeveloped inside the 21st century.
- This maximum precious of resources is having a decade devoted to it via the united nations because the global company seeks to rally its member countries to address a hassle that threatens to get worse the lives of billions.
- Shortage of water exacerbated via climate alternate or humanitarian disasters can purpose tensions among people, groups, and nations.
- The water shortage hassle is one of the maximum severe risks dealing with the world at each stage social, monetary, political and environmental.

3. FLOWCHART

Storage of rainwater during the rainy season is an advantageous process during scare of water so that it does not become waste and the rainwater is diverted and collected [2]. With the collected rainwater sample different test had been conducted, in order to save the rainwater for long term usage. For commercial and consumption purposes the portability of the rainwater is checked with various tests. Here, design criteria for slow sand that is the single step treatment can be applied and water is stored in the tank prepared. Multiple test had been done in the preserved rainwater for various purposes (conserve water, decrease contamination, avoid long termscarcity, etc.). So, in this filtration process a fabric filter cloth is introduced for further purification and further operation. After the completion of the above process, potable clean water is available from long term preservation process.
4. DESIGN OF SLOW SAND FILTER WITH FOLLOWING DATA

Population: 5 (assumed – for one family).
Per capita demand (drinking and cooking): maximum 7 l/day. (According to the need).
Assume 25% extra for the peak hours (WHO-world health organization).
Assumed data and solution are given in table 1 and 2 respectively.

| Description | Data |
|-------------|------|
| Rate of Filtration | 100 to 200 l/m²/hour |
| Bed slope | 1in100 to 1in200 |
| Depth of filter | 1.5m (including freeboard) |
| The thickness of the base material | 60cm |
| Thickness of gravel | 70cm |
| The thickness of the sand | 90 cm |

5. DESIGN OF STORAGE TANK WITH FOLLOWING DATA

Table 3. Detail descriptions about the storage tank

| Description | Data |
|-------------|------|
| Population | 5 Nos. |
| Per capita demand | 7 litres [6] |
| Total required a quantity of water | 5x7x365 |
| Add 25% of water for peak demand | 12,775 litres |
| Depth of the tank (assume) | 2m |
| Volume of tank | 16 m³ |
| Area of tank | the volume of tank/depth of the tank |
| Length of the unit is equal to 2 times of Breadth | 2B |
| Length X Breadth X Depth | 4mx2mx2m |
| Required rainfall/year | 16,000/930 |
| Approximately | 172mm/year |

In Tamil Nadu, the average rainfall is 850mm [11] In India, the average rainfall is 300 to 6500mm [11] for the data of table 3.
6. SLOW SAND FILTER IMPORTANCE

- Very effective removal of bacteria, viruses, protozoa, turbidity, and heavy metals in infected fresh water.
- The simplicity of design and high self-help compatibility: construction, operation, and renovation only require simple abilities and expertise and minimum attempt.
- If constructed with gravity waft best, no (electrical) pumps required.
- Neighbourhood substances may be used for creation.
- High reliability and potential to withstand fluctuations in water nice.
- No necessity for the software of chemical substances.
- Clean to install in rural, semi-city and faraway areas, simplicity of design and operation.[7]

7. WATER FILTER MATERIAL

The cloth is effective because most pathogens are attached particles within the water. By passing the water through an effective filter most pathogens are removed. We used three types of water filter cloth polypropylene 701, polyester 550, polypropylene 302. We did our experiment with these three types of water filter cloth but in which polypropylene 701 gave the best result. As a result, polypropylene 701 is used as a water filter cloth in the slow sand filter which we designed. It is having some important characteristics to select, such as available for huge to fine molecule filtration, good obstruction against acids, salts, and diminishing specialists, free of mold and oxidation, excellent gas penetrability, lightest weight among engineered textures, short channel cycle, sleekness surface for ideal cake discharge. This type of materials is well performed in other fields also like non-ferrous metals melting, pharmaceuticals, sewage treatment, sugar, and chemicals.

7.1 POSSIBLE SOLUTION:

i) Rainwater reaping is the best-proposed answer for the water shortage issue.
ii) Rainwater is one of the easiest and most established techniques for self-supply of water for family units often financed by the client.
iii) Long term use of water for consumable purposes.
iv) To serve the adjacent network to beat the water shortage. The physical and chemical and biological test were conducted to the raw rainwater and after 6 months stored water. The results are displayed in table 4. It shows rainwater could be used for long term.

| S. No | Water Characteristics | Fresh State | After Storage |
|-------|-----------------------|-------------|---------------|
| 1     | pH                    | 6           | 8             |
| 2     | Temperature (°C)      | 22          | 18            |
| 3     | Dissolved Oxygen(mg/l)| 7           | 9             |
| 4     | BOD                   | 0           | 0             |
| 5     | Turbidity (NTU)       | 4           | 1             |
| 6     | Electrical Conductivity(µS/cm) | 132     | 128           |
| 7     | Most Probable Number (Pathogens) | Nil | Nil |

8. CONCLUSION

Collecting your own rainwater is an excellent way to conserve this precious resource. The collecting rainwater can be used for our own potable purposes such as drinking and cooking, bathing laundry, flushing toilets, watering lawns, gardens and houseplants, composting, water for wildlife, pets or livestock, outdoor ponds and water features, rinsing vegetables, washing vehicles and equipment, fire
protection etc, usage of rainwater will be effective and eco-friendly method of reducing water bills, easy to maintain, suitable for irrigation, reduces demand on groundwater, reduces floods and soil erosion, can be used for several non-drinking purposes, and for drinking purposes. Designed the slow sand filter tank which can preserve rainwater for a long period. Tested some required rainwater quality parameters for nine months in which the rainwater is used for drinking and cooking purpose.

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