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Rainwater harvesting technology for water conservative means

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Abstract

Now-a-days it's a big issue worldwide where the deficit or scarcity of drinking water becoming challenging and thus saving of rainwater followed by converting it into potable water is an alternate approach. In general, water conservation means using of less water or recycling used water so that it can be used again. It ismuch important because water conservation helps in saving energy, protect wild animals, and prevent people from using so much water that it cannot be replaced with rain. In the other hand, less water usage means more savings and by saving water, one can reduce the water bill too. The technology of rainwater harvesting for even drinking purposes are discussed here. Three tier filtration technology using gravel, sand and charcoal is used to remove the possible contaminations and reach optimum other traits of the treated potable water.

Keywords: Roof-top rainwater, Re-use of rainwater, Storage model, Water recycling

Introduction and importance of rainwater:

The Earth surface is quantitatively covered with71% of water and 29% of land where 96.5% of all water resources are contaminated within the oceans as salt water, while the remaining 3.5% is fresh water lakes and frozen water locked up in glaciers and the polar ice caps. In this situation, the uses of potable water becoming a challenging issue due to the large gap increment between the earth surface and ground water level. Additionally, at the residential area, all drinking water resources are being polluted day-by-day due to hazardous chemicals, heavy metals, arsenic thus hampering human health. Rainwater harvesting technologycould be an alternative to hit this challenge globally though the use of rainwater is common since ancient period.

However, in this article I want to share the modified natural filtration technology which has successfully converted rainwater (roof top water) into potable water.

Benefits of rainwater harvesting:

Rainwater use and its technology have several benefits like;

- Alternate source of potable water.
- Cost effective and hence reduces water bill.
- Decrease water demand.
- Reduces the need of imported water.
- Promote both water and energy conservation.
- Reduces flooding and erosion.
- Can be used for non-drinking purposes.

Water requirement/family:

Before establishment rainwater storage tank, it is pre-requisite to know how much water you need for drinking and cooking purpose for your family. We could calculate the requirement by using the formula: (No. of family members + 1) x 1,000 Litres.

Say, if the number of members in a family is 6 then the requirement of water for that family for 10 months would be (6+1) x 1,000 L = 7,000 L. If you consider our state West Bengal, the monsoon comes within 8 months we may keep two months' water extra as buffer so that we do not have any problem if rainy season is delayed by one month or so.

Storage tank establishment:

The rainwater is slightly acidic in nature and contaminated withvarious air pollutants and hence non-reactive storage chamber is preferred. The concrete made (cement, brick, sand) rainwater storage chamber (Fig.1b) is ideal where chemical reactions can be avoided and additionally the earthen material may absorb acid ions to adjust the neutral pH level. The size of the main water chamber depends on your requirement as per the above mentioned formula and accordingly can prepare the unit. The indicative budget is mentioned in table1.

Sl. No.	Items/unit	Indicative cost (Rs.)
1.	Concrete tank establishment (including labor charge)	15,000.00
2.	Pipeline work (PVC preferred)	5,000.00
3.	RO filter (additional)	4,000.00
4.	Others (natural filter, maintenance etc.)	1,000.00
5.	Water quality testing (From certified lab)	1,000.00
	Total:	**26,000.00**

Table1: Indicative budget of establishment of rainwater harvesting and treatment unit (5000L capacity)

Catchment area:

The water quality depends on types and sources of rainwater like surface rainwater, pond rainwater, rooftop rainwater. The rooftop rainwater is comparatively less contaminated unlike others as it can be harvested directly. However, the supply of rainwater depends on the amount of rainfall (R), the area of the catchment (A) and its runoff coefficient (C).

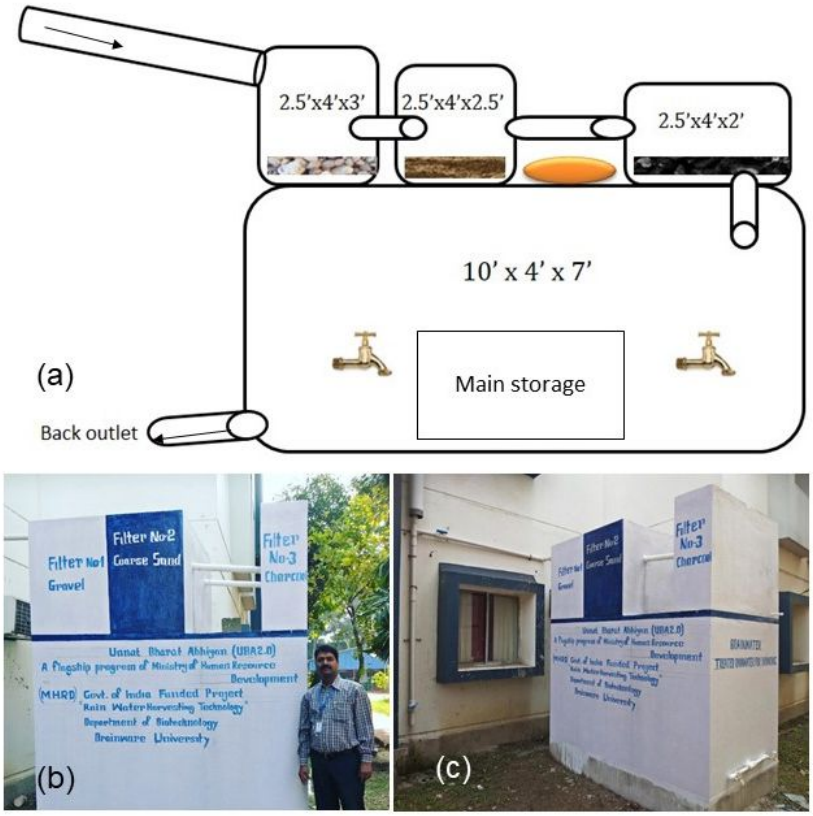

Figure1: (a) An outline of rainwater harvesting tank including filtration chambers. (b) Completed rainwater harvesting model at Brainware University, Barasat campus. (c) Pipeline view of rooftop rainwater collection.

An estimate of mean annual runoff from a given catchment can be obtained using the equation: S = R x A x C; where S = Rainwater supply per annum, R = mean annual rainfall, A = Area of the catchment, and C = Runoff coefficient. The actual amount of rainwater supplied will ultimately depend on the volume of the storage tank or reservoir.

Example: For a building with a flat roof of size 10 m x 12 m in a city with the average annual rainfall of 800 mm;

Roof Area (A) = 10 m x 12 m= 120 m^2

Average annual rainfall (R) = 800 mm = 0.80 m

Total annual volume of rainfall over the roof = A x R = 120 m^2 x 0.80 m = 96 m^3 = 96,000 litres.

If 70% of the total rainfall is effectively harvested,

Volume of water harvested = 96,000 x 0.7 = 67,200 liters

Average water availability = 67,200 / 365 ~ 184liters/ day.

Conversion of rainwater into potable water:

The rooftop rainwater is harvested through PVC pipeline into a main storage tank via three tier filtration system (Fig.1a). Direct rainwater from rooftop (Fig.1c) comes first in filter1(4-inch gravel layer) followed by purification in filter2 (4-inch coarse sand layer) and finally in filter3 (6-inch

charcoal layer). The fecal matter separation and turbidity balance is completed in filter1, removal of any microbial contamination (mainly coliform, *E. coli*) and remaining fecal matter separation is completed in filter2 and finally in filter3, total hardness ratio, metal ion removal and TDS is balanced. The final collection of purified water is done in the main storage tank from where water can be used directly.

Annual maintenance:

In every year before rainy season, drain out the remaining water from the bottom of the tank by opening the plug of drain pipe. During this operation, two washes is recommended of the filters too and if possible replace the materials by new. On completion of cleaning of tank, the drain pipe has to be closed with the plug carefully and if any gap remains other contaminants may enter. Clean all the pipes, and the catchment area before collection of rainwater. The utmost hygienic care has to be taken during all cleaning operations and harvesting rain water.

Cautions:

The treated rainwater is now safe for drinking and other household purposes. No other purification or use of filter is needed for drinking this treated water. You have to take precaution so that no other contaminated water, microbes, animals, insects enters into the tank. All open mouth of PVC pipes has to be covered with mosquito net. You are free to take any precautions to make it saferas potable water and recommended dose of any sort of bleaching may apply time to time or zeoline also be used. If doubt comes, one may also get the harvested rain water tested from any reputed laboratories before drinking.

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