

Waste Plastic Bottles Offering Innovative Material with Sustainable Application in Safe Guard Tree

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ABSTRACT: Due to growth of population and industrial sector rapidly there is increase in plastic pollution. On the weight basis about 5.6 million tonnes of plastic waste is generated in India per year (year 2014) When travelling comes there is need of food & water. Generally water is carried in PET bottles (Polyethylene Terephthalate) which when used are thrown away in environment. It is estimated that 1 out of 5 bottles are sent to recycle bin, rest of which is thrown away which creates pollution. We in our project are reusing waste PET bottles by innovative method in which it acts as a multipurpose safe guard tree which includes its safety and self sustainability. As far as self sustainability concern, it will be able to collect the rain water & store it near its root zone, which will ultimately increase the ground water table near the root zone of a particular tree. It's easy to plant a tree but it is very difficult to grow it up. So our objective is to provide safety & side by side help it to become self sustainable.

KEYWORDS: Polyethylene Terephthalate, Innovative safe guard tree construction, brick-mud cocks, root zone, self sustainable.

I. INTRODUCTION

Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant. When the society gets affected, then it will be uneconomical for the nation to create sustainable development.

With population growth in today's world, the need to the building has increased and to respond to this demand, the countries tend to use the industrial building materials and decline the use of indigenous and traditional materials. These factors in spite of increasing the energy consumption in the industry section, they can also raise the cost of homes and are considered as the barrier for users to obtain the basic needs of the life.

In the past, the glass was common in packing some foods such as milk and etc. They could be returned to the factory for using again for the same purpose. But now by changing the human's disposal culture, glass bottles have been replaced by plastic bottles, as they have increasingly become one of the substances of destruction of the landfills because they decompose in a long time. Two alternative solutions against the plastic bottle disposal are recycling and reusing process.

Recycling needs additional energy to treat the materials for producing something usable. Moreover, the recycling process produces wastewater and air pollutants. So the best solution is reusing for which no additional energy is required and does not contribute to pollution. Indeed, when we reuse junk, we are helping to save the obtained energy which would otherwise be wasted. It is focused on not only the financial aspect but also the environmental aspect.

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II. LITERATURE SURVEY

Mojtaba et.al, The author intends to investigate in this paper that the application of plastic bottles as one of the urban wastage in building construction & that how it can lead to sustainable development. It also mentions some ways for self standing and insulating them in thermal & sound points of views & some positive points which this material have versus others. At the end it concluded that in different factors such as time of execution, cost, load capacity, flexibility reducing waste and energy efficiency, plastic bottles can be more effective compared to conventional building materials such as brick, concrete and ceramic blocks etc.

Miss Idalia et.al, The author concluded that bio-degradation is the natural break-down of organic substances. Plastic does not bio-degrade. Nature does not know how to break down plastic because of what plastic is made of photo-degradation is the break-up of materials by the sun. In large periods of time, plastics break down into very small pieces of plastic that float around. Each year, tons of plastics and other litter are tossed into rivers, left on beaches, or dumped overboard from recreational and commercial vessels. Litter not only looks bad, but can put people and wildlife in danger. Plastic particles are now being found in the stomachs of birds in the antarctic and sub-antarctic. This is a signal that our plastic pollution is increasing because these areas were considered to be untouched by pollution. Fish and marine mammals wounded by plastic rings or ropes may develop infections in their open wounds. Turtles that get trapped in plastic rings eventually grow around them, causing their bodies to be deformed and their organs to not develop properly. Plastic pollution blocks the sunlight that is essential for the survival of corals.

III. OBJECTIVES

1. To find new method to reuse waste plastic bottles.
2. To find economic alternative for traditional materials used in safe guard tree.
3. To construct safe guard tree using waste plastic bottles & detail study about its working.
4. The overall objective is to reduce waste being thrown out in natural areas.
5. Reducing the environmental destruction by reusing plastic bottles.

IV. METHODOLOGY

1. In this study we firstly collected waste plastic bottles, cycle rims, waste steel rods of size 42 inches approximate & waste rubber strips from junk yards.
2. Then construction of frame with 4 rims placed one above other at specified distance supporting them with 8 steel rods. Spot welding is done, & ensured that the specified symmetry is achieved & then final welding is done.
3. In this way frame is constructed. Then a series of 5 bottles is interconnected by making hole in bottom part of bottle of diameter such that the mouth of bottle is inserted into that hole & gets interconnected.
4. Adhesive is applied to ensure that there is no leakage between bottles. In this way 27 series are made & arranged around the circumference of the frame. These bottles are held in position with help of 5 to 6 rubber strips & steel wire to hold on the weight of bottles when filled with water at its maximum level.
5. These are then placed at equal distance from each other. Note that that the bottom most layers of bottles is fitted with the brick mud cock which ensures the low rate of seepage through bottles, when water is poured from top most bottle, it directly travels through the bottles & gets percolated in the ground.
6. Its storage capacity, shape, materials used can be modified as per persons needs. Fertilizers also can be introduced through the bottles which may be useful in agricultural sector.

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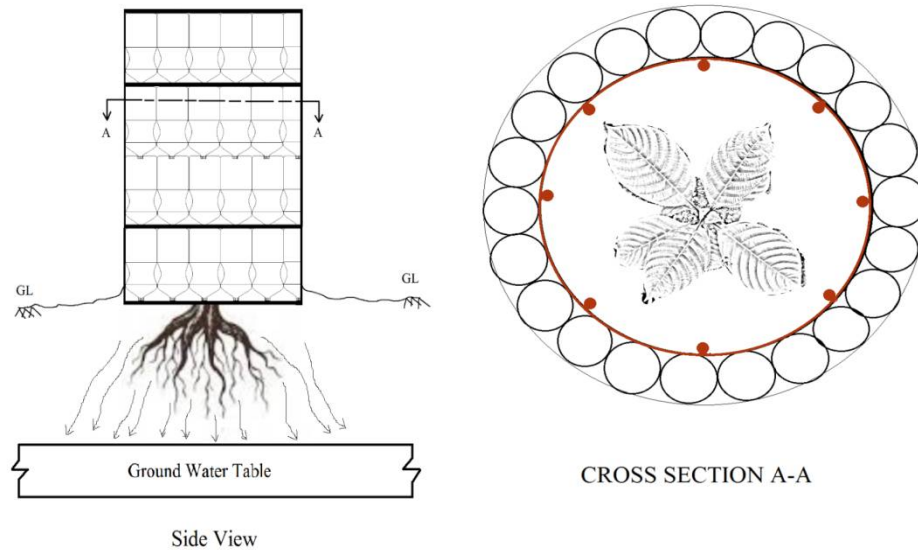


Figure 1: Design of Safe Guard Tree.

1. Design of Safe Guard Tree-

The typical layout of plastic bottled safe guard tree which shows a side view & cross-section through which we can understand the working of safe guard tree. Side view shows the roots of tree which are spread in vertically downward direction in search of water. The cross-section shows the top view of safe guard tree.

V. EXPERIMENTAL WORK



Figure 2: Construction of Frame.

2. Construction of Frame-

Construction of frame is done with cycle rims & steel rods, which forms a proper drum shape where bottles can be attached to the circumference of the frame with help of rubber tube strips & a metal string.

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Figure 3: Application of Red Oxide Coating on Frame.

3. Application of Red Oxide Coating on Frame-

Application of red oxide paint was done in case to avoid rusting of frame in moisture conditions & for good appearance.



Figure 4: Interconnection between Bottles.

4. Interconnection between Bottles-

Interconnecting bottles by making hole at bottom of bottle and inserting another bottle into it, in this way a series of 5 bottles were made. Such 27 series were made to ensure the requirement. Side by side the upper portion of upper layer of bottle is cut down horizontally which makes path to enter rainwater as well as through conventional means. By changing the capacity of bottles (500 ml, 1litre, 2 liters etc) or by modifying the numbers of bottles attached to frame, the total water carrying capacity of safe guard tree can be modified.



Figure 5: Construction of Brick-Mud Cocks

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5. Construction of Brick-Mud Cocks-

By taking raw brick mud such cylindrical shaped cocks were made & let them bake at 950°C for 24 hours. After drying it was then inserted into a last bottle of series & made it water tight by applying adhesive. Here after water is filled in bottles its percolation rate will be decreased due to low porosity of mud cocks.



Figure 6: Actual Photograph showing Mud-Cocks Inserted in Bottles.

6. Actual Photograph showing Mud-Cocks Inserted in Bottles-

After inserting these mud-cocks the percolation rate was calculated as 1.33 lit/hr which is more than sufficient to water a tree for 8 to 10 days. This atomization helps us to just fill these bottles once in 8 to 10 days.



Figure 7: Actual Photographs of Model

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7. Actual Photographs of Model-

The last layer of bottles is inserted into ground about 10 to 12 cm to ensure that the water seeps through vertical direction only which in turn results in increase in ground water table.



Figure 8: Bottles Full of Water

8. Bottles Full of Water

After proper bonding & drying of adhesives, it is ensured that there is no leakage between the connections. The above photograph shows the bottles full of water & ensures the leak proof connection. This safe guard tree was then tested & results were obtained as given below in conclusion.

VI. ADVANTAGES

1. Shape of the frame can be modified into square, rectangular, hexagonal etc.
2. Water carrying capacity of our model can be modified by just making minor changes in design i.e. by adding or removing bottles in frame.
3. Fertilizers can be introduced to plants into just by adding them in bottles.
4. Temperature can be maintained up to some extent in summer season.
5. For fully grown trees (whose diameter is large and conventional safe guard cannot be used) our safe guard tree can be implemented by modifying its frame i.e. adding clip & hinge system to it.
6. Seepage rate can be modified as per requirement by adding water in units of bottles or by modifying the material used in lower most layers of bottles. (by adding bottle caps with small holes in it)
7. As plastic bottles are used, it is eco-friendly & can help to reduce plastic pollution.
8. Cost of construction is low as compared to conventional safe guard tree.

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VII. COSTING & COMPARISON

Table 1: Costing of plastic bottle safe guard tree

Sr. No.	Material	Rate/Unit (Rs)	Total
1	Steel Rods 8mm ϕ 42 Inch-8 No. (3.37 Kg)	25/Kg	Rs.85
2	Plastic Bottles- 150 No.	0.50 / Bottle	Rs.75
3	Cycle Rim- 4 No.	20 / Rim	Rs.80
4	Rubber Packing -10 No.	6	Rs.60
5	Adhesive 500gm- 1No.	100	Rs.100
6	Red Oxide Paint, 500 ml – 1 No.	90	Rs.90
Total cost of designed unit			Rs.490=00

Table 2: Cost Comparison (different materials used)

Sr. No.	Type of tree guard	Cost Per Unit	Remark
1	M. S. (Mild Steel)	Rs. 1500	Manufacturing cost is more, more corrosion possible, life span up to 10 years.
2	Brick	Rs. 1200	Manufacturing cost is more and more utilization of other natural resources; load per unit area is more, life span up to 5 years.
3	Sun Shade Cloth	Rs. 350	Manufacturing cost is minimum but life span is less than 1 year.
4	Safe guard tree	Rs. 490	Manufacturing cost is less, life span more than 15 years; cost can be reduced by modifications.

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Table 3: Comparison (different methods)

Sr. No.	Water Supply System	Cost /Unit (Rs.)	Remark
1	Sprinkler	2500	Operating and maintenance cost is more, water evaporation is maximum, life span is up to 5years but more cost, covers maximum area.
2	Drip	2050	Operating and maintenance cost is more, evaporation is minimum, life span up to 15 years but more cost, covers maximum area.
3	Manual	1000	Requires more no's of labors & other equipments. (Including Wages and salaries of workers)
4	Safe guard tree	490	Operating and maintenance cost is much more less than conventional systems, life span more than 5 year's.

The costing of Safe Guard Tree is excluding the fabrication & man power cost.

VIII. APPLICATIONS

1. Newly planted road side trees which require safety from animals, humans etc & requires ample amount of water for its survival.
2. Highway side planted trees which require watering at least once in a 2-3 days which is not possible to transportation department and this time can be extended till one week after installation of plastic bottle safe guard tree.
3. It can be used in agricultural sector.
4. It can be used in residential as well as commercial landscaping which serves multipurpose use i.e. safe guarding & self sufficient against watering.

IX. RESULTS & CONCLUSION

1. The shape of frame can be modified into any shape i.e. square, rectangular etc, number of bottles can be increased or decreased as per our requirements to design so ultimately the capacity of model increases or decreases.
2. Seepage through one bottle per hour is about 70 to 110 ml. The number of bottles around the periphery is 27 so per hour there will be seepage of 2.43 liters. That is for 24 hours seepage rate is 58.32 liters. For this particular model it takes about 55 hours i.e. two and half day to empty all the water from bottles. This time can be extended by modifying the mechanism used for seepage at the lower layer of bottles. Modifying the material used at bottom most part can help to delay the seepage period i.e. by installing drippers seepage period can be extended.

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