Comparative Study of Magic Soak Pit and Alternative Materials

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***Abstract*—The rising demand for decentralized and sustainable wastewater solutions has brought increased attention to Magic Soak Pits—an innovative alternative suited for rural and peri-urban areas. Unlike conventional soak pits, the Magic Soak Pit incorporates layers of brickbats, charcoal, sand, and lime, which help in the partial filtration and purification of greywater before it seeps into the ground. This low-cost yet efficient system not only prevents waterlogging and the spread of disease but also aids groundwater recharge, making it an eco-sensitive and community-friendly approach to sanitation.**

***Index Terms*—Magic Soak Pit, Greywater Management, Wastewater Treatmen.**

I. INTRODUCTION

A soak pit, also known as a soak away or leach pit, is a covered, porous-walled chamber that allows water to slowly soak into the ground. Pre-settled effluent from a Collection and Storage/Treatment or (Semi-) Centralized Treatment technology is discharged to the underground chamber from which it infiltrates into the surrounding soil.
As wastewater (grey water or black water after primary treatment) percolates through the soil from the soak pit, small particles are filtered out by the soil matrix and organics are digested by microorganisms. Thus, soak pits are best suited for soil with good absorptive properties; clay, hard packed or rocky soil is not appropriate. Soak pit is actually a tank for recharging ground water (or underground water) and increasing ground water level using waste water which cannot be used and it can be constructed with most of the available household and some simple hardware.

OBJECTIVES

- Study of sanitary situation process in rural area.
- To study the advancement the design of soak pit. (Magic Sock Pit.)
- Provision of alternative material of magic soak pit.

Implementation and use of Soak Pit can help in optimizing your local water management and sanitation system and make it more sustainable by:

- Offering a cost-efficient opportunity for a partial wastewater treatment
- Providing a relatively safe way of discharging pre-treated wastewater into the environment
- Recharging groundwater bodies

II. METODOLOGY

After studied construction procedure of magic soak pit we have collected information about materials and site condition. We found that size of tank us depend upon the discharge of waste water coming from source.
Current Drainage System: There is no proper drainage system available hence whole wastage water dispose in open land and produce bad odor and mosquitos.

For deciding discharge of waste water coming from sources which we have already selected for a family is depend upon these member who's used water daily life including peak hour used and only consider domestic waste like water used for bath, washing, gardening etc.

- Design of Magic Soak Pit For Commercial and Three Houses
- ESTIMATION OF WASTE FLOW:

Required water per person – 75 l/day

For bath- 55 l/day
For cloth washing – 20
For using shops-315/day
No of member in house – 10 with 4 commercial shops
Total flow – 10*75+4*315 = 2000/day

- TANK SIZE:

Volume of tank – 50000 lit(cu.m)
Assume 1805mm dia. of tank
Area= 5m^3
Height = 1905mm

III. TESTS ON MATERIALS

- WATER ABSORPTION TEST:

IS: 3495 (Part-2)-1992, RA 2011
Calculation:
Water absorption, percent by mass after 24 hours immersion in cold water is given by the following formula

$$\text{Water absorption} = \frac{M_2 - M_1}{M_1} \times 100$$

Fig.1 Water absorption test

Table No1: Observation Table for Water Absorption Test 'Red Brick'

SR NO.	NO OF BRICKS	DRY WT. %	WET WT. %	RESULT %	AVERAGE %
1	RB 1	2.326	2.821	21.28	21.35
2	RB 2	2.588	3.087	19.28	
3	RB 3	2.323	2.869	23.50	

Table No 2. Observation Table for Water Absorption Test 'Super X bricks'

SR NO.	NO OF BRICKS	DRY WT. %	WET WT. %	RESULT %	AVERAGE %
1	XB 1	0.954	1.326	38.99	36.60
2	XB 2	0.940	1.270	35.10	
3	XB 3	0.834	1.132	35.73	

- Compressive Strength Test:

IS: 3495 – P (1)-1992-Methods of tests of burnt clay building bricks (Determination of compressive strength)

- Calculation:

$$\text{Compressive strength}(N/mm^2) = \frac{\text{Maximum loadat failure in N}}{\text{Avg. area of the bed faces in } mm^2}$$

Table No 3: Observation Table for compression test on red brick

SR. NO	N.	LOAD KN	AREA OF BRICK MM	COMPRESSIVE STRENGTH N/M
1	RB1	52.70	225*75	7.027
2	RB2	106.15	225*75	14.15
3	RB3	86.15	225*75	11.48

Table No 4: Observation Table for compression test on super x brick

SR. NO	N.	LOAD KN	AREA OF BRICK MM	COMPRESSIVE STRENGTH N/M
1	XB1	44.40	200*75	5.92
2	XB2	46.40	200*75	6.20
3	XB3	48.70	200*75	6.49

Fig.2 Compression Test on (UTM)

Fig.3 Compression Test on (UTM)

- Survey

Table No 5: Survey

SR. NO	MATERIALS	RATE
1	PIPES 1	230 PER FT.
2	RED BRICKS	3000RS/BRASS (BROKEN)

- Test on Waste water

➢ PH Value Test:

Materials Required: Waste water collected from source, Acetate buffer (pH = 4), minimum buffer (pH = 10), pH meter Tissue paper.

➢ Test results:

- Average value of PH of Raw sample is 2.75
- Average value of Treated Sample is 3.91

Table No 6: PH value Observation

SR NO	SAMPLES	1	2	3
1	RAW SAMPLE	2.5	2.85	2.90
2	TREATED SAMPLE	3.27	3.97	4.50

- Turbidity Test

Apparatus:

W.H.O Nephelometric turbidity meter for maize solution of the sample by multiplying the scale reading by 0.9 N.T.U, 9 N.T.U, 99 N.T.U, test tubes and water samples.

- Result:

- Turbidity of waste water coming from sources which disposing in to the Magic soak pit is 130.20 mg/lit.
- Turbidity of waste water influent which collects after infiltrated from magic pit is 45 mg/lit.

IV. COST COMPARISON

- ESTIMATION FOR MAGIC SOAK PIT WITH ALTERNATE MATERIALS

Table No 7: Quantity of soak pit

SR. NO	PARTICULARS OF ITEMS AND DETAILS	NO	LENGTH	BREADTH	HEIGHT	QUANTITY	TOTAL QUANTITY
1	EXCAVATION WORK AND SITE CLEARANCE.	1	8FT	7FT	6.5FT	1	1
2	PVC PIPE	1	10FT			1	2
3	PLASTIC TANK	-				-	-
4	RED BRICKS (BROKEN)	-				2BRASS	BRASS

- Total Estimation of magic soak pit with regular materials
- Note: Cost of construction of magic soak pit with regular materials is more than Magic soak pit with its alternative materials.

We are using red broken bricks which are available in cheap rate somewhere we can get without cost, these bricks has high water absorption capacity than super x bricks and its quite tough and has optimum compressive strength so it is suitable material.

The reason we don't use Super X bricks is because it floats on water.

- Note: we can used burn bricks (broken bricks) if it available at lowest cost.

We did not need to supply any RCC or plastic tank as RCC bank was already built underground a few years ago.

- Total Estimation of magic soak pit with regular materials

Table No 8: Total Estimation at construction site

SR. NO.	DESCRIPTION OF ITEMS	UNIT	RS/UNIT	TOTAL COST
1.	EXCAVATION	3BRASS	733/BRASS	2200
2.	RUBBER BED	LUMP SUM	500	500
3.	RED BRICKS LAYER	2BRASS	2500	5000
4.	PUC PIPES	10FT	230	2300
5.	PIPE FITTING	LUMP SUM	200	200
6.	BACKFILLING	0.25BRASS	400	400
7.	PCC WITH MIRROR FINISH	4INCH (7FT×8FT)	3500	3500
8.	AGGREGATE	0.5BRASS	-	1000
9.	CEMENT BAGS	3	350	1050
	DUST	0.5BRASS	-	1000
10.	LIFTING OF WASTE MATERIALS	-	-	2500
11.	LABOURS	500	-	4500
TOTAL COST: -				₹24150.

- ✓ TEST RESULT & DISCUSSIONS: While we are studying both types of materials used in construction of magic pit we consider different parameters like quality of influent infiltrate from pit should be treat as quality of water increase. We comparing between two materials and methods on the basis of coat and quality of waste influent.

- ✓ Characteristic of waste water

Table No. 9: Tests Result

Sr No	Tests	Magic pit with regular materials		Magic pit with alternative materials		Remark
		Raw Waste	Treated	Raw waste	Treated	
1	PH	2.5	3.37	2.9	3.97	PH value increased <
2	Turbidity (mg/lit)	130.8	45	137.9	38	Turbidity decreased

- ✓ Second consideration is economy of cost of construction of magic soak pit including labour for obtaining this we have preferred locally available material mentioned as above.
- ▪ Note: In case of maintains of magic soak pit with alternative materials and equipment's is less as compare to regular soak pit. It requires 2 to 3 years for clean the solid which are collect in tank and simple methods used for this.

V. CONCLUSION

Following are some important concluding points on basis of above experiment and study:

- In rural areas there is no any special treatment plant for treated waste water due to insufficient funds, hence people dispose the domestic waste water through 'Nalah's in rainy season due to high flood it mix with natural drainage which caused water pollution.
- This is method is effective worked in such situation where no possible to treat waste water, due to its economy it can afford any common family for constructing magic pit in his house. It doesn't require more space for construction and also required less materials and equipment's.
- We treated waste water for reducing characteristic of waste water which produces bad effect to human being as well as animal and courses water pollution. Through the magic pit we can also improve the parameter of waste water and increased quality of water, if we mix the influent in natural water or ground water it will not affect the quality of water it may dilute with water.
- We using local materials for constructing magic pit and used waste plastic tank or any type of container for collecting waste water in pit, and we can use plywood or steel plate instead of concrete flooring then it will economical.
- It cost a lot of money to build a soak pit at that place because there were four commercial shops near that site or at that place and also the number of people living in that house was too much so we had to keep the depth and size of the pits big.
- It requires periodic maintenance about per years and it may take a little effort cleaning the tank and it has life around years 30-40 to years.
- ✓ Following are the important points which will consider in future expansion of design parameters of construction of magic pit:
- We can used burn brick for the materials instead of fly ash or boulder which can easily obtain and it will economical as extra burn brick normally present on brick kiln and it will not use in building construction and it is cheap.
- If we used this in construction of magic pit and it may effectively work then it will make more economic magic pit. Efficiency of magic soak pit is depended upon the soil present on site and its properties like grain size, coefficient of permeability, infiltration rate and stratification of soil bed etc.

REFERENCES

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