

## Use of Eco-Sanitation Process in Rural Areas of Punjab (India)

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**Abstract:** An attempt has been made in the present study to investigate out for the reduction in the volume of water which is reaching the pond, separation of wastewater i.e. blackwater and greywater can be done by providing ecosan diverging toilets carried out in two different villages of Punjab state. It was carried out in two selected rural areas located in a radius of about 30 kilometres of Nawashahr district. Eco-sanitation Technology was used to sample out the organic content from the wastewater. Wet Ecosan type is used in this technique to treat the blackwater. Construction details, sizing of ecosan vaults and cost of the toilets were made according to materials required.

**Keywords:** wastewater treatment, ecosan Technology, blackwater, greywater

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### I. Introduction

The conditions of village ponds in the state of Punjab, India are very worst and unhygienic. From the presently conditions the village ponds are either very silted, encroached upon or it is being used for disposing village wastewater. These worst conditions of village ponds are further polluting down the groundwater in the nearby areas. These wastewaters flow from the open drains and it overflows and ultimately it all disposed off in the ponds of village. Very Less percent of Domestic household in Punjab have the proper closed drainage system and in very large percent the wastewater is being dumped or disposed off though the open drains to the village ponds, which also leads to various health issues and this increasing day by day and becoming a big health issue. (Census GOI 2001).

Researchers have found that whether it is a greywater alone or combined total sewage (black and greywater) mixed together the conventional sanitary engineering has maintained that "sewage is sewage". There is one reasonable argument for this perspective that if greywater is left untouched or untreated for a few days, it will behave like the combined total sewage. Both untreated as well as combined will become anaerobic, and also will contain a large number of bacteria [1]. These observations have given rise to regulations that do not differentiate among the various sources of pollution and therefore prefer the same treatment technologies for all these kind of wastewaters.

These grey water samples could contain up to 911 different xenobiotic organic compounds, depending on the products used at home for the cleaning and other usage [2]. Also, in there is range of coli forms (faecal and total) occupied by both children and adults than occupied by adults only. Ecological Sanitation toilets are a urine diversion dehydrating toilet based on the idea that urine, faeces & water is a part of Ecological loop resources [3]. Human urines are contained different types of impurities with high concentration proportions of Potash (51%-55%), Phosphorus (46%-50%) and Nitrogen (76%- 86%). Also, human faces contain Potash 12%, Phosphorus 40% and Nitrogen 10%. Users apply 80% of these resources in their field. Similarly, due to different problems or due to less availability of agricultural land, once the urine collection tanks are full almost 12% of neighbours shared with each while the remaining percent 8% throw it down the drain.

The objective of this study was to separate out the grey and blackwater by using the concept ecosanitation in the rural areas so as to reduce the organic strength and pathogenic organisms going into the pond. The importance of the work also lies in the fact that domestic wastewater from the major source of water entering the pond contains blackwater and greywater. Different treatment required for both these type of wastewater to treat as well as utilize the pond water in a beneficial way. Therefore, this study which has been proposed for rural areas pond and its wastewater collection system to become a stepping stone for the integrated water resources management in rural areas by planning effective treatment.

### II. Materials And Methods

#### 2.1 Description of the rural areas

Two different villages were identified and selected in the radius of around thirty kilometres in Doaba region of Punjab namely Sodhian and Kultham as shown in Fig.1 below state for the present study. The two catchments represent a wide range of population sizes, land uses and catchment area of ponds. The existing condition of the village pond and its surroundings were examined. Sodhian (Nawashahr) is a midsized village

with only one pond for collection of almost whole of the storm water generated in the catchment. Kultham (Nawashahr) is a multiple outlet village, but the studied area of the pond is small and quite bad in condition. The information on the village catchments was obtained through the survey maps provided by the Department of Water Supply and Sanitation, Government of Punjab and physical survey visits. The location of the study areas and the catchments areas are shown in Figure 1 & Figure 2 (A) to (B) respectively.

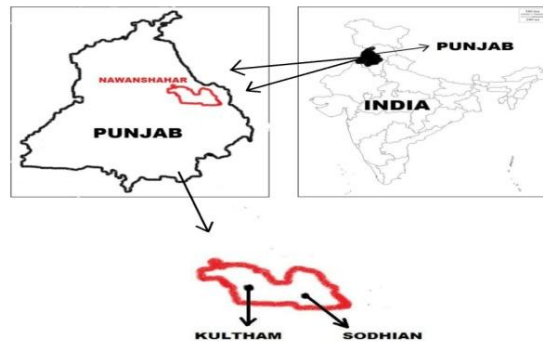


Fig.1 Location of Selected Areas on India Map

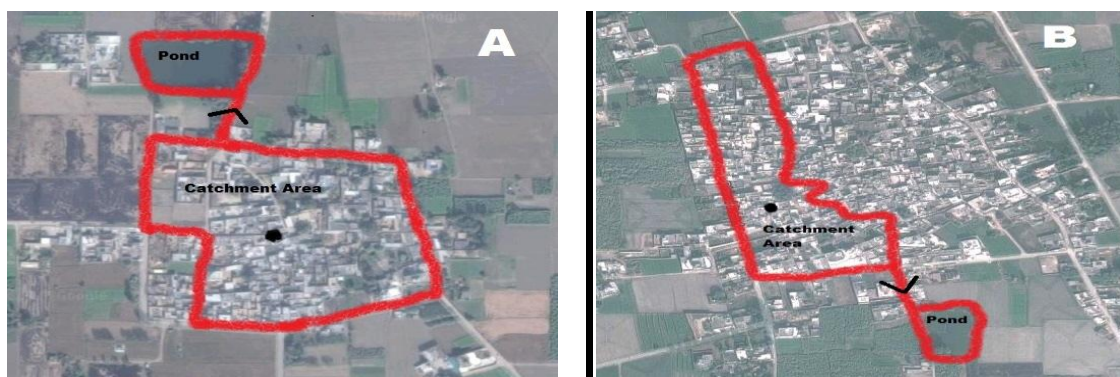


Fig.2 Maps View of (A) Sodhian (B) Kultham

## 2.2 Methodology Adopted

For the purpose of blackwater treatment and greywater treatment, three different treatment systems are designed:

**2.2.1 For Black water Treatment - Ecosan Toilets:** Blackwater Coming from bathroom toilets gets mixed with greywater coming from wash basins, kitchens, showers and for this these both type of wastewater needs to be separately treated without mixing each other. For this purpose it led to a Wet Ecosan double chamber Toilet treatment system. Wet Ecosan is suitable Ecosan system than dry ecosan latrines due to the reason it is similar to common type of toilets that are used now days, also there is no case of handling the faeces regularly, and it may be socially more acceptable than the dry ecosan. A Wet Ecosan toilets is a toilet which separates faeces & urine but as common toilets. It functions similar to offset pit latrines UD facilities in pan. The urine is collected separately for instant use and the faeces are flushed with minimum water to store in pits. The basic feature of the toilet is same as that of pour flush toilets except urine collection facilities. There are two separate pits made of concrete rings connected with distribution chamber. Only the difference in this type of toilets is the design of pan. A special pan with two separate holes for urine and faeces has been used in this toilet. The urine from the urine hole is diverted to urine collection tank and the faeces with water are stored in pit in operation. The major advantages of this type over the dry toilet are that in this type one can use water for bottom cleaning and flushing. The pits are made shallow, they are only four and half feet deep, and the volume of urine tank varies between 20 to 30 litres. The double vault/chambers are used in alternately of interval period of 6 months each.

### 2.2.2 in Double Vault Chamber

Double Vault Toilets is designed to operate in batches. Storage and Collection of faeces is done in dual or twin pit compartments which are used alternately. When the first respective compartment is "full" then the second compartment is put in use, while the first one is sealed off. At least after almost one year time of storage is counted or noted down from the date of the last faecal matter contribution to a compartment.

While about studying & designing an Ecosan system is about urine, whether to mix the urine or divert it. If ongoing approach is taken, requirement of effective processing will be needed. Thus the two basic options are either: divert the urine; or mix it (urine & faeces).

### 2.2.3 Diverting Urine

Firstly and important reason that the urine collected down remains basically free from the pathogenic organisms. By Opting or Doing this it reduces the strength & volume of potentially material upto certain extent. On treatment basis both the faeces & urine requires different treatments process. By diverting urine it reduces down the problem of odour also urine without mixed with faeces is an excellent fertilizer.

### 2.2.4 Mixing of faeces & urine

A system on separations of liquids does not need a special type of squatting plate. In some ecosan technology a very little amount of liquid proportion, goes in the same hole of the Toilet. In liquid separation systems one of the important points that must be required is that, liquids which are with the faeces contact, firstly they must be treated, evaporated or sterilized before it can be reused as a soil conditioner or fertilizer. In rural areas, common toilets in dry and warm it is possible to process faeces and urine together. Faeces & urine both go down the same hole.

Inside the Processing Vault, the excreta present are made to be dehydrated or soaked with the presence of proper ventilation inside the vault, natural evaporation and sun. The moisture present in the excreta/faeces is removed. With the removal of moisture, volume of faeces will be reduced down to about 72-76%. Also, there is significant reduction in the pathogens amount present in faeces. Due to high level or proportion of pathogens found in faeces, faeces should be treated well before using it as soil conditioner or on fields. Heat treatment is one of the effective ways of reducing the pathogens for e.g. sewage sludge treatment. Another treatment to reduce the pathogens is the addition of lime or wood ashes. This will help to raise the pH level thus by accelerating pathogens inactivation. It also reduces the smell and act as cover material which reduces the risk of flies. Applications of faeces include as the material can be mixed with the soil or can be buried elsewhere (extended storage is another option if there is no requirement of material). It can be also used as fertilizer or as a soil conditioner.

## III. Results And Discussion

### 3.1 Wastewater Parameter Analyzed

TABLE 3.1:-Results of wastewater parameters analyzed of Village Kultham & Sodhian [7]

Parameter Analyzed	Kultham	Sodhian
pH	7.88	8.20
Nitrates (mg/l)	59.98	39.20
BOD (mg/l)	289.50	306
COD (mg/l)	744.16	657
Total Phosphorus (mg/l)	47.08	30.71
TDS (mg/l)	1193.66	1306.50
TSS (mg/l)	171.833	2615.83
E.Coli/100ml	3.52x10 <sup>5</sup>	5.84x10 <sup>5</sup>
Total Coli form/100ml	5.2x10 <sup>6</sup>	5.89x10 <sup>6</sup>

TABLE 3.2:- Results of greywater samples of villages Kultham & Sodhian

Parameter Analyzed	Kultham	Sodhian
pH	7.60	8.06
Nitrates (mg/l)	46.00	17.20
BOD (mg/l)	178	205
COD (mg/l)	490	450
Total Phosphorus (mg/l)	0	0
TDS (mg/l)	685.71	664.28
TSS (mg/l)	411.43	443.57
E.Coli/100ml	7/100	8/100
Total Coli form/100ml	183	186

By segregating the blank water from greywater, the polluttional parameters can be reduced to great extent as demonstrates in Table 3.2.

By using ecosan toilets the organic matter content of the wastewater can be lowered down as shown by low values of BOD & COD in table 3.2. It has also resulted in substantial decrease in the bacterial population of wastewater entering the village ponds. Nutrients Entry into the village pond can also be reduced by employing the eco-sanitation technology. Therefore it is important to use Ecosan toilets.

### 3.2 Sizing the Vaults

#### 3.2.1 Formula on Sizing the Vaults

$V = N (F+U)/1000$  where

V = Volume of the vault in m<sup>3</sup>

N = Number of users

F = Volume of faeces (in litres) produced per person within the retention time

U = Volume of urine (in litres) added per person per year

#### Design Example

Volume of Solid Excreta per Person per Year= 50 litres

Volume of Urine per Person per Year= 500 litres

Retention Time= 6 Months using double vault system

Number of household= 5 users

Volume of the vault (m<sup>3</sup>) =  $\frac{N (F+U)}{1000}$

$$\begin{aligned} \text{Volume} &= \frac{5 \times (50 + 500)}{1000} \\ &= \frac{2750}{1000} \\ &= 2.75\text{m}^3 \end{aligned}$$

Vault = 1.15 x 1.14 x 2.1m would be enough.

### 3.3 Cost of Ecosan Toilets

Estimating the cost or the overall cost of Ecosan toilets is more than simple latrines. However, Ecosan toilets are more than just a toilet; with toilet it is also a treatment technology. By taking these in mind, the price is significantly lower than the other types of toilets and treatment technologies.

**TABLE 3.3:-** Estimated Cost of Materials used in Ecosan Toilets

S.No.	Work Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1	Bricks	730	bag	4.50	3375
2	Sand	36	cuft	43	1505
3	Aggregate	15	cuft	40	600
4	Cement	5	cuft	550	2750
5	Pan	2	nos	300	600
6	MS bar	10	kg	52	520
7	Mason	4	nos	500	2000
8	Pipes and Fittings				
	3" Poly tee*	1	nos	65	65
	3" Poly bend	1	nos	60	60
	2" PVC tee	1	nos	88	88
	3" Poly pipe	4	Rft	22	88
	3" Poly cowl	1	nos	32	32
	2" PVC bend	3	nos	100	300
	2" PVC net cap	3	nos	20	60
	2" PVC pipe	1	rm	55	55
	1/2" GI nipple	2	nos	25	50
	1/2" GI socket	1	nos	21	21
	Tap ( Plastic)	1	nos	20	20
	100 liter plastic container	1	nos	750	750
	Total (Rs.)				12939

## IV. Conclusions

After examining the existing condition of village pond and surroundings of different villages namely Kultham and Sodhian of Doaba region of Punjab it was observed that people in villages do not have sewerage facility available, these villages had water supply systems. Due to the provision of water supply in these villages, the water use has increased and consequently the wastewater generation has also been increased. This

results in increased amount of wastewater reaching the pond which exceeds the self-purifying capacity of the ponds.

Due to improper knowledge and awareness cow dung mixture is put by the nearby dairy workers in the open drains which further jammed or choked the open drains due to this wastewater flow stops flowing and the waste flow get collected on the side roads. Open drains should be undergrounded properly & also should be connected with sewerage system. This would help to overall width of roads and also pollution would be control which is effecting the environment badly.

For Ecosan Toilets, Proper knowledge and Awareness generation among various users & activists are strong requirement needed as well as the maintenance & proper handling of faeces and urine containers. In the Ecosan Technology, Water saving parts of the system should be highlighted among the users also to research out best & effective way of sanitizing faeces as well as transportation of faeces also.

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