ENVIRONMENTAL AND ECONOMIC ASSESSMENT OF CONVENTIONAL VS ONSITE TREATMENT PLANT

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Abstract: Sewage treatment plants helps to minimize the negative impact on the environment by improving the quality of effluent. Generally, two forms of STP's existing centralized and decentralized. One of the tasks is to find the most environmentally sound option, taking into account the use of resources, energy, cost, etc. The main difference between the two is the conveyance structure. One of the main parameters taken into consideration while designing the STP is cost. LCCA is a part of LCA that compares the cost and helps to choose an appropriate alternative that fulfills the same performance requirement based on cost analysis. Cost mainly includes construction cost, operation, and maintenance cost, etc. This study aims to compare a centralized (ASTS) and decentralized (DOSIWAM) STP designed for the same population equivalent i.e. 640 people based on LCA of 30 years. The LCCA would be comprehensive with the consideration of the Capex and Opex of the respective plant configuration.

Index Terms - STP, DOSIWAM, ASTS, LCA, LCCA.

1. INTRODUCTION

Conventional Sewage Treatment is widely practiced in developed and developing countries which involve transporting sewage from large urban areas to a large capacity plant using a sewerage network, whereas decentralization is the concept of sewage collection, treatment and reuse at or near its point of generation. Smaller decentralized plants can optimize the energy required for the pumping of sewage, before and after treatment, for reuse applications if any with modularized expansion flexibility.

For a gigantic country like India, the Centralized development may need more time for the total implementation in one go. Instead, the decentralized sewage treatment plant may help us for immediate startup of projects, with lesser dependency on one central facility.

Many communities are considering decentralized systems over centralized because of the economic and environmental advantages the system offers. Today, decentralized treatment can provide the safety and reliability over conventional large-scale treatment system and can also offer many additional benefits to the communities.

In this paper LCCA of two Sewage Treatment Plants, Decentralized on Site Sewage Treatment Plant and Extended Aeration Activated Sludge treatment system has been carried out. Both systems are designed for population capacities of 640 people. The goal is to compare the most cost-effective system appropriate for treating sewage water.

2. MATERIAL AND METHODS

The object under study are two different STPS. One designed as Centralized (ASTS) while the other designed as Decentralized (DOSIWAM). Both the STPS are designed for same population equivalent. For both the system construction and operation and maintenance cost are taken into consideration. The study includes cost analysis of the sewage treatment plants.

The conventional (ASTS) sewage treatment plant (fig 1), is the modification of activated sludge process. It is used when the volume of water to be treated is less. This system has mechanical, chemical and biological treatment phases with extended aeration. In this plant usually primary sedimentation tank are not designed but employ an extended aeration period for the purpose of aerobically digesting. In this system a part of sludge is recirculated and excess sludge is stored in sludge holding tank.

In onsite (DOSIWAM) sewage treatment plant (Fig 2), human night soil is led separately to a biogas plant. The gas from the biogas plant is taken to kitchen. The effluent from biogas plant is combined with sullage from bathrooms, kitchens etc. The total effluent is then passed through grease trap or intercepting tank. From there, the effluent is led to multi-chambered stabilizing tank. The water coming out from this tank has very low BOD, so that the water becomes suitable for reuse in gardening and for irrigation. The solid waste is sorted out in biodegradable and non-biodegradable components. Non-biodegradable component goes for recycling, and biodegradable component goes for vermicomposting. The recovered manure is used on the same land where the garden has been established. Thus, with this system, all the waste is taken care of and fully recycled and reused.

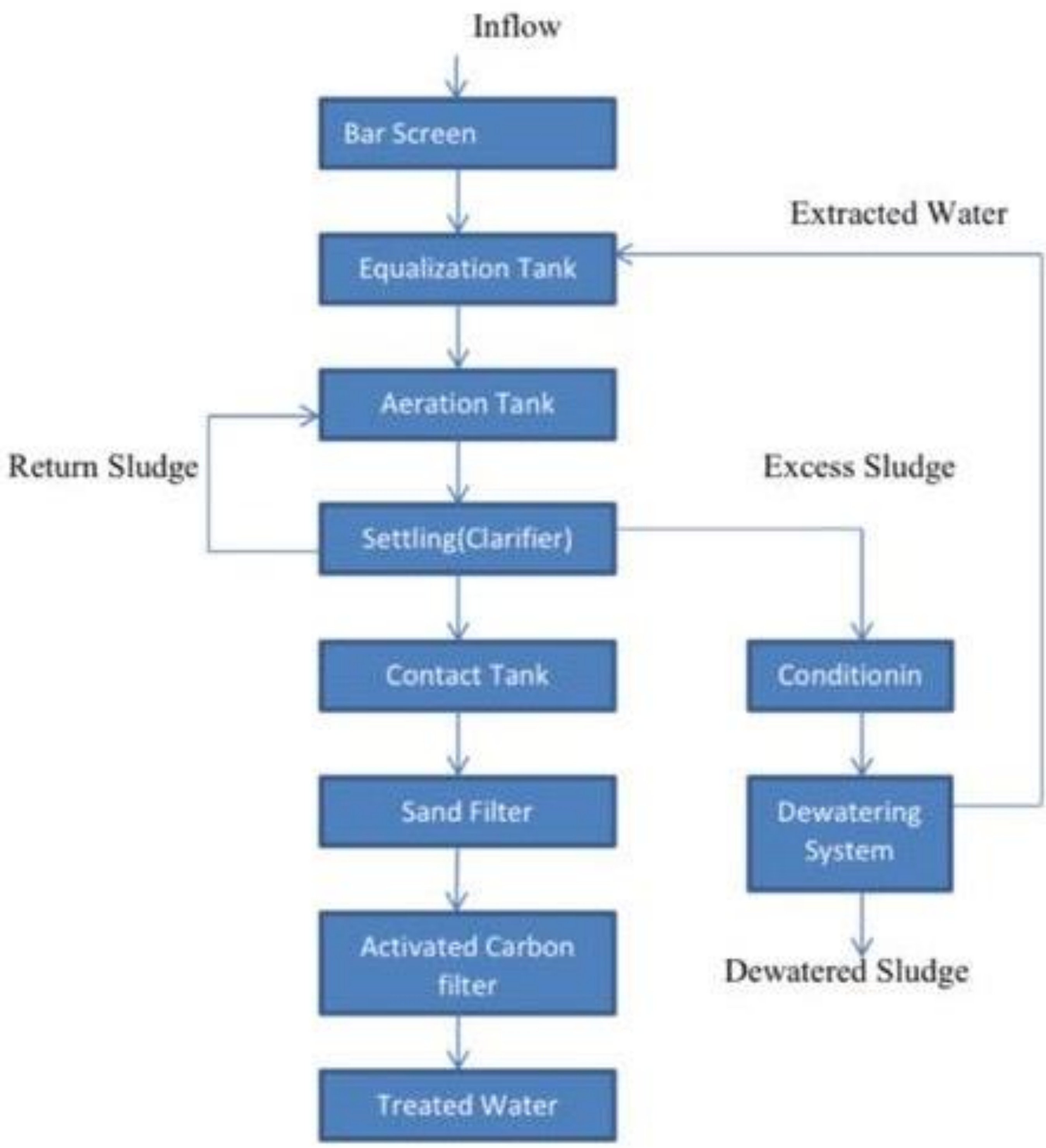

Fig 2.1: Process Scheme of Extended Aeration Activated Sludge Process

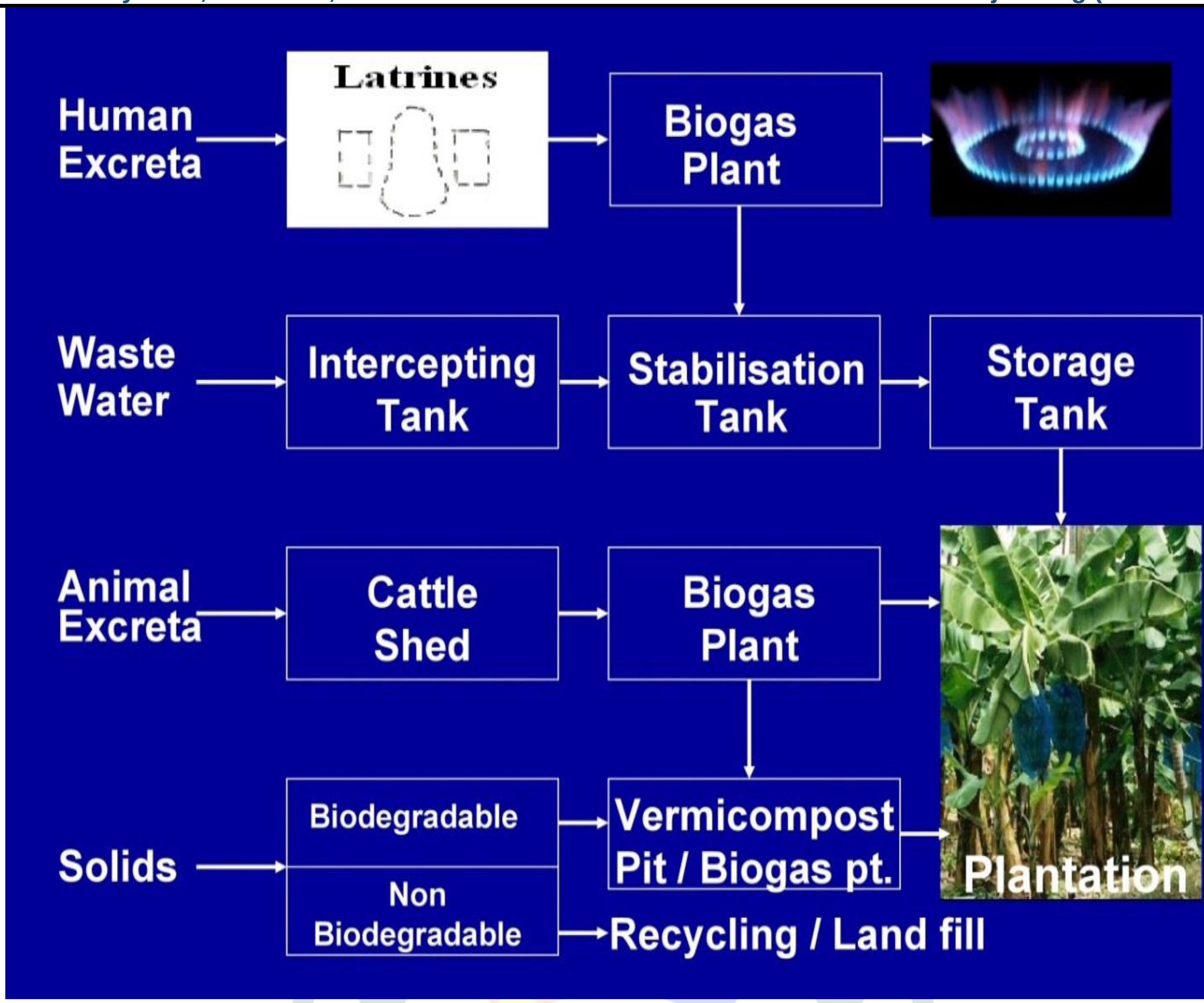

Fig 2.2: Process Scheme of Decentralized Onsite Sewage Treatment Plant

3. INPUTS OF LCCA

3.1. Operation Cost of Extended Aeration Activated Sludge Process:

Table No.3.1.1: Operation Cost of Extended Aeration Activated Sludge Process

SR. NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
PART APRIMARY TREATENT					
1	Bar Screen SS304	Set	2	20,000	40,000
2	Raw Sewage Pumps	Set	4	20,000	80,000
3	Coarse Bubble Diffusers	Lot	8	2400	19,200
4	Air Blower	Set	4	53,000	2,12,000
5	Air Flow Meter		1	68,000	68,000
6	Sludge Pumps	Set	4	13,330	53,320
7	Tube Settler Media	Set	5	8436	42,180
PART B- SECONDARY & TERTIARY TREATMENT					
1	Filter Feed Pump	Set	4	11,792	47,168

2	Pressure Sand Filter	Set	2	50,000	1,00,000
3	Activated Carbon Filter	Set	2	50,000	1,00,000
4	Backwash Pump	Set	4	11,792	47,168
5	Chlorine Doser	Set	1	21,000	21,000
6	Electromagnetic Flow Meter	Nos.	1	30,000	30,000
7	Drain valve	Nos.	1	1750	1750
8	Suction valve	Nos.	1	1000	1000
9	Discharge valve	Nos.	1	555	555
10	Check valve	Nos.	1	1300	1300
11	Isolation valve	Nos.	1	580	580
12	Control valve	Nos.	1	6000	6000
13	Butterfly valve	Nos.	1	5000	5000
14	Pressure relief valve	Nos.	1	6000	6000
PART C- OTHERS					
1	MCC Panel	Nos.	1	1,70,000	1,70,000
2	Supplying, installation and commissioning of power cables	Lot	1	1,07,000	1,07,000
3	Supply, installation, testing and commissioning of Cable Tray	Lot	1	90,000	90,000
4	Piping and Fitting a) Supply and laying GI pipes b) Supply and laying of UPVC 40 schedule piping and fitting material for Air Line in Equalization tank & Sludge Holding tank		1 1	50,000 40,000	50,000 40,000
1	Sludge Centrifuge (with centrifuge feed pump) (OPTIONAL)	Nos.	1	1,00,000	1,00,000
	TOTAL				14,39,221.

3.2 Construction Cost of Extended Aeration Activated Sludge Process

Table No.3.2.1: Construction Cost of Extended Aeration Activated Sludge Process

SR. No.	PARTICULARS	QTY.	UNIT	RATE	AMOUNT
1	**EXCAVATION**	1305	CUM.	750	978750
	25M X12M X 4.35M				
	TOTAL FOR EXCAVATION				**978750**
2	**150MM THK.P.C.C. (M-20) FOR RAFT**	37.013	CUM.		

	CEMENT (WITH 5% WASTAGE)	272	BAGS	350	95215
	CR. SAND	816	CFT.	35	28564
	METAL 20MM	1156	CFT.	32	36998
	LABOUR CHARGES	37.01	CUM.	1500	55519
	TOTAL FOR P.C.C. (M-20) GRADE				**216295**
3	**R.C.C. FOR RAFT 300MMTHK.WITH (M-20) GRADE**	67.419	CUM.		
	REINFORCEMENT	6047.5	KGS.	57	344707
	CEMENT	496	BAGS	350	173435
	CR. SAND	1487	CFT.	35	52031
	METAL 20MM.	2106	CFT.	32	67392
	R.C.C. LABOUR CHARGES	2418.99	SQFT.	160	387039
	TOTAL FOR R.C.C. OF RAFT (M-20) GRADE				**1024604**
4	**R.C.C. WALL FOR STP CONSIDERING 300MM THK**	96.831	CUM.		
	IN BOTTOM & 230MM IN TOP				
	REINFORCEMENT	9832.9	KGS.	57	560476
	CEMENT	678	BAGS	350	237236
	CR. SAND	2033.5	CFT.	35	71171
	METAL 20MM.	2880.7	CFT.	32	92183
	R.C.C. LABOUR CHARGES	3933.17	SQFT.	160	629306
	TOTAL FOR R.C.C. OF WALL (M-20) GRADE				**1590372**
5	**R.C.C. TOP SLAB 300MM THK.WITH (M-20) GRADE**	67.419	CUM.		
	REINFORCEMENT	6047.5	KGS.	57	344707
	CEMENT	496	BAGS	350	173435
	CR. SAND	1487	CFT.	35	52031
	METAL 20MM.	2106	CFT.	32	67392
	R.C.C. LABOUR CHARGES	2418.99	SQFT.	160	387039
	TOTAL FOR R.C.C. OF TOP SLAB (M-20) GRADE				**1024604**
6	**TOTAL FOR R.C.C. OF S.T.P. AS PER THE DRAWING**				**4834625**

3.3 Construction Cost of Dosiwam

Table No.3.3.1: Quantity of Concrete in Refuge Floor Tanks Grade M25

DESCRIPTION	NO. OF TANKS	THICKNESS	LF	BF	DF	QUANTITY
Stabilization Tank	4	0.2	5	2.9	1.83	1397.78155
Malaprabha Digester	3	0.5	7.68	7.68	2.1	1509.7138
Storage Tank	3	0.4	4.24	4.24	1.5	329.416855
Total						10374.19841

Table No.3.3.2: Calculation of (Stabilization Tank, Malaprabha Digester, Storage Tank) in Common

Volume of Cement	**889.1615141**
Cement in Kg	1656594.267
No. of Bags	33131.88533
Cost of One Bag	300
[1] Total Cost	9939565.599
Volume of Sand	**889.161525**
Sand in Brass	3368.17249
Cost of Brass	1460
[2] Total Cost	4917531.835
Volume of Aggregate	**1518.211299**
Aggregate in Brass	4628.26688
Cost of Brass	2700
[3] Total Cost	12496320.58
[1] + [2] + [3] Total Cost	27353417.97

Table No.3.3.3: Quantity of Concrete in Under Ground Tanks Grade M25

DESCRIPTION	NO. OF TANKS	THICKNESS	LF	BF	DF	QUANTITY
Stabilization Tank	2	0.2	12	4	1.83	279.6727
Malaprabha Digester	4	0.2	8.8	8.8	2.1	593.21383
Storage Tank	4	0.2	4.89	4.89	1.5	167.4128
						1040.29933

Table No.3.3.4: Calculation of (Stabilization Tank, Malaprabha Digester, Storage Tank) in Common

Volume of Cement	**622.5842834**
Cement in Kg	889632.4792
No. of Bags	16241.538472
Cost of One Bag	300
[1] Total Cost	4872461.542
Volume of Sand	**622.5842834**
Sand in Brass	1643.235993
Cost of Brass	1460
[2] Total Cost	2399124.55
Volume of Aggregate	**1244.157456**

Aggregate in Brass	2855.35187
Cost of Brass	2700
[3] Total Cost	7709450.049
[1] + [2] + [3] Total Cost	14981036.14

4. RESULT AND ANALYSIS

Table No3.4.1: Comparative Cost Analysis

SR NO	REMARK	ASP Cost in Rs	DOSIWAM Cost in RS
1	Construction	4834625	40548835
2	Operation	1439221	47896
3	Maintenance	1800000(60,000/year)	00
4	Electricity	8322480	79716
5	Manpower	14040000(4,68,000/year)	00

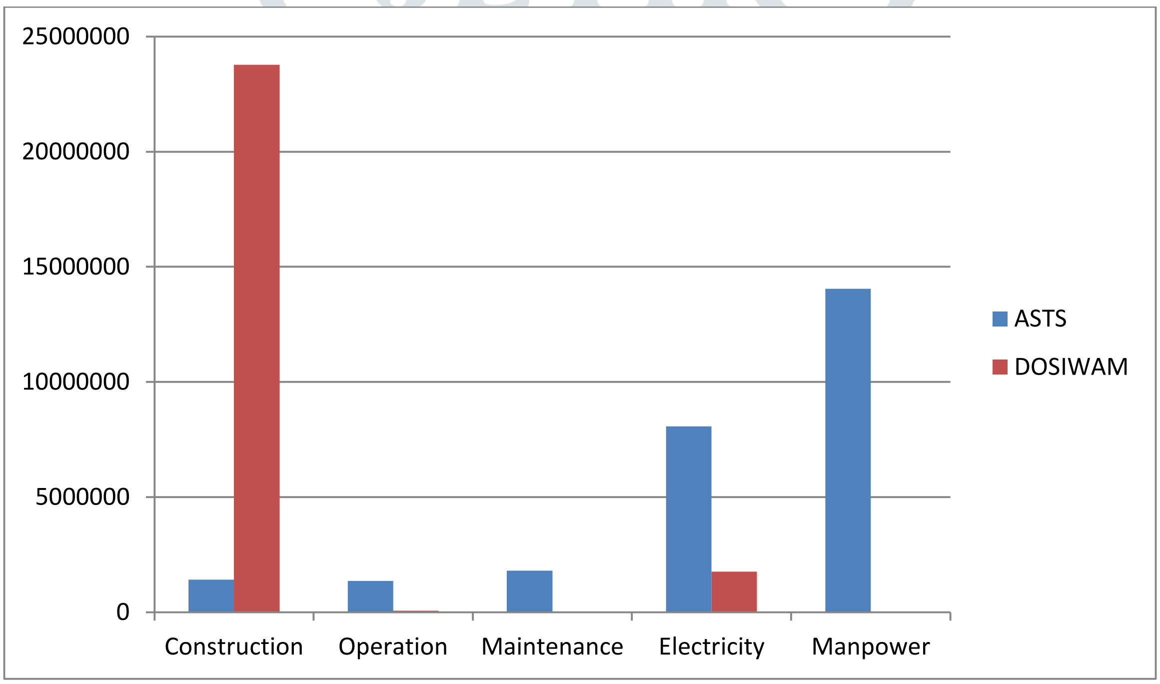

Fig 4.1: Comparative Cost Analysis

5. CONCLUSIONS

The results show that the decentralized STP (DOSIWAM) is comparatively more costly than centralized STP (ASTS) in case of construction cost. The system proved to be economical in all other parameters taken into account like operation cost, maintenance cost, manpower cost etc.All other costs are almost negliglible compared to centralized STP. The main advantage of this system is that labour and maintenance cost is nil.

The centralized STP proved to be economical only when taken into account the construction cost. When considering other parameters decentalized STP Proved to be more economical.

6. REFERENCES

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