On-Site Domestic Wastewater Treatment in India

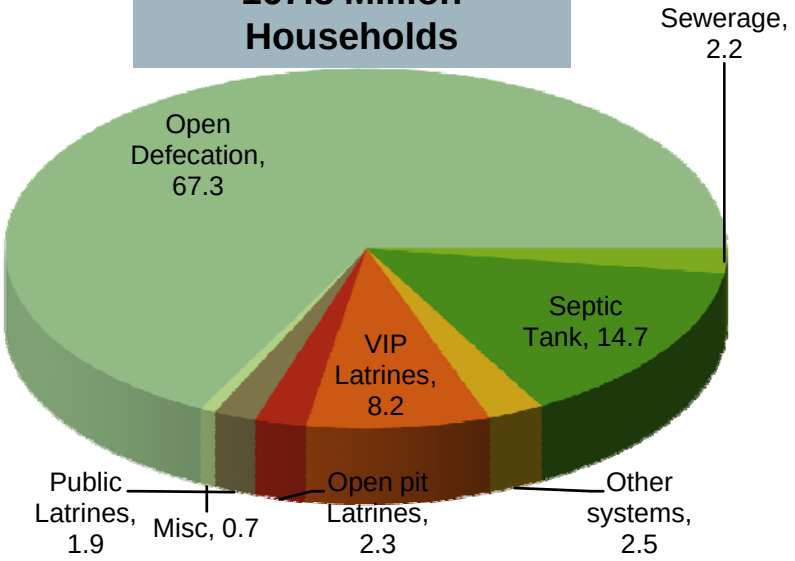
A. A. KAZMI

DEPARTMENT OF CIVIL ENGINEERING

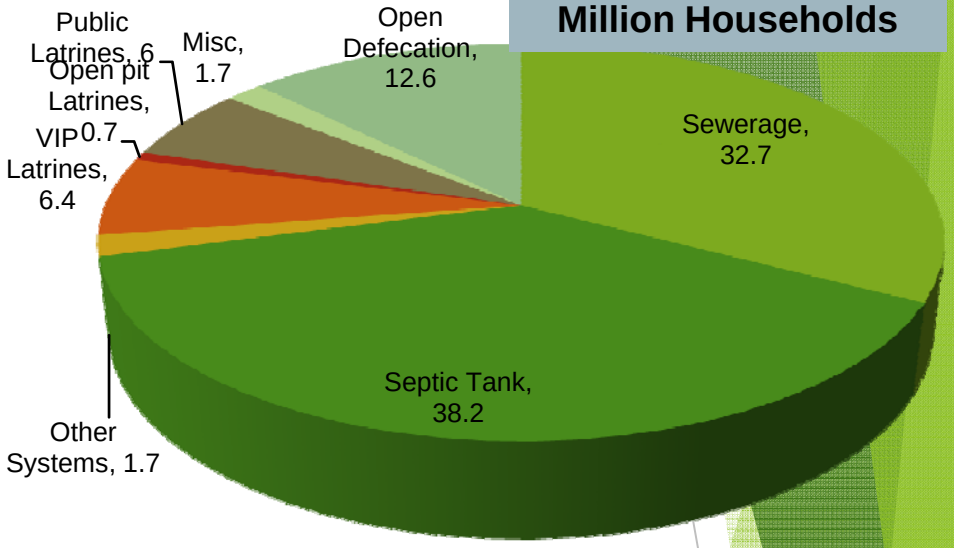
IIT ROORKEE

AVAILABILITY & TYPE OF TOILETS-2011 (%)

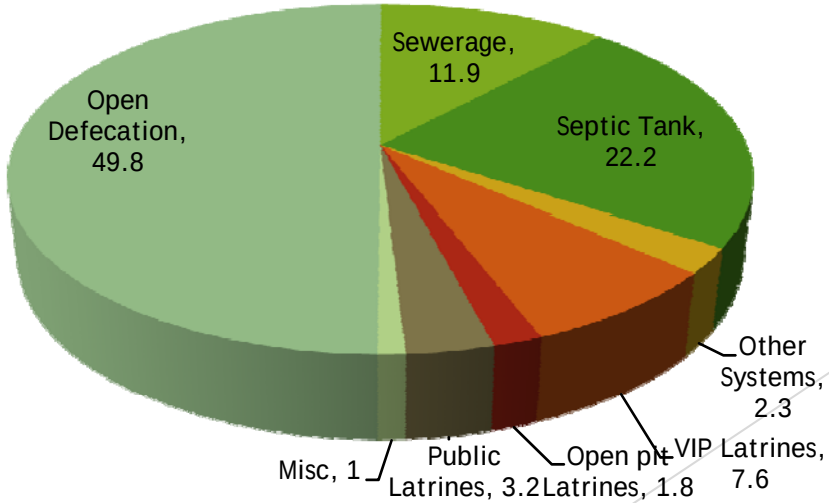
RURAL INDIA
167.8 Million Households



URBAN INDIA-78.8 Million Households



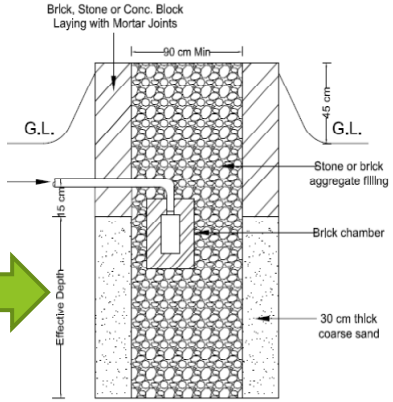
ALL INDIA
246.7 Million Households



www.censusindia.gov.in/2011census/hlo/Data_sheet/India/Latrine.pdf

FLUSH TOILET + SEPTIC TANKSFLUSH TOILET + TWIN PIT LATRINES

Discharge to Soakage Pit



Septic Tanks

Discharge to Stormwater Drain

Pit-1

Pit-2

http://sulabhinternational.org

SEPTIC TANK EFFLUENT DISCHARGE

Effluent Quality of Septic Tank -60-80 LPCD Water Supply : COD- 849-112 mg/L, BOD 653-912 mg/L, TSS 389-530 mg/L

SURFACE WATER POLLUTION

Moti Jheel- Lucknow

Phutala Lake- Nagpur

Pond outskirt of Village

GROUND WATER POLLUTION:

Coimbatore- CPHEEO & NEERI- 2005

Total Coliforms (CFU/100 ml)	Post Monsoon	1080	1100	1500	1600	900	620
	Winter	1150	1440	1660	1750	tnc	730
	Summer	TNC	TNC	TNC	TNC	TNC	520
	Monsoon	1100	1500	700	1000	1100	630
Faecal Coliforms (CFU/100 ml)	Post Monsoon	840	1102	590	780	860	400
	Winter	910	1000	600	840	TNC	420
	Summer	TNC	216	230	450	TNC	140
	Monsoon	940	1100	570	800	890	410

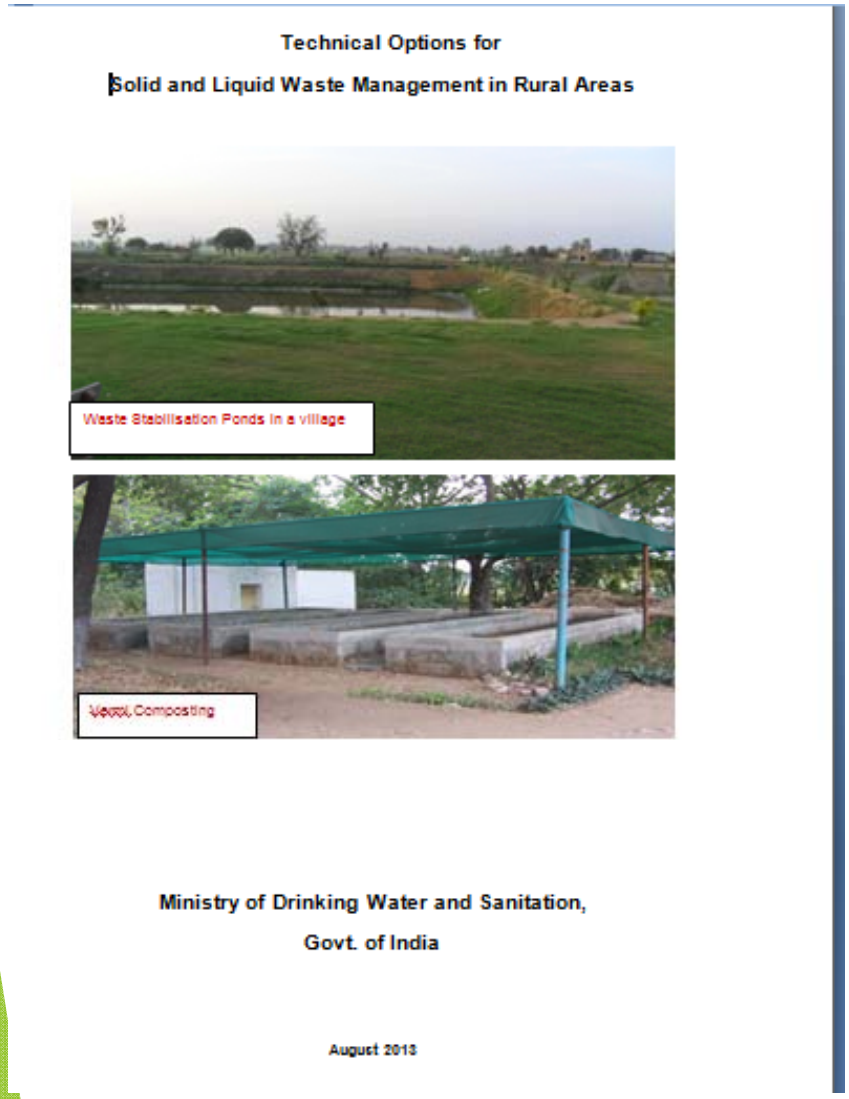
RECENT INITIATIVES BY THE GOVERNMENT ON ADVANCED ON-SITE SYSTEMS AND SEPTAGE MANAGEMENT

GOVT. OF INDIA
MINISTRY OF DRINKING WATER SUPPLY & SANITATION
INITIATIVES

NIRMAL BHARAT ABHIYAN- TOTAL SANITATON COMPAIGN

- Complete rural sanitation upto 2002 ensure sanitation facilities in rural areas with broader goal to eradicate the practice of open defecation: it includes
  - Information, communication and education IEC Activities ,Capacity Building
  - Construction of Individual Household Latrines ,Rural Sanitary Marts and Production Centers
  - Provision of Revolving Fund in the District
  - Community Sanitary Complex ,Institutional Toilets- School and Anganwadi toilets
  - Solid and Liquid Waste Management
  - Maintenance of facilities created under NBA ,Administrative Charges
- Under solid liquid waste management plan
  - About Rs 700,000 (About US$ 11000) for village having up to 150 households
  - About Rs 1,200,000 (About US$ 20,000) for village having up to 300 households
  - About Rs 1,500,000 (About US$ 24,000) for village having up to 500 households
  - About Rs 2,000,000 (About US$ 32,000) for village > 500 households
  - Central Government 70 % & State Government 30 %

http://tsc.gov.in/TSC/NBA/AboutNBA.aspx



Technical Handbook- With coverage of advanced on-site sanitation

RELATED CHAPTERS IN THE BOOK

2.5 On-site waste water treatment systems

2.5.1 Septic tanks

2.5.2 Advanced on-site systems

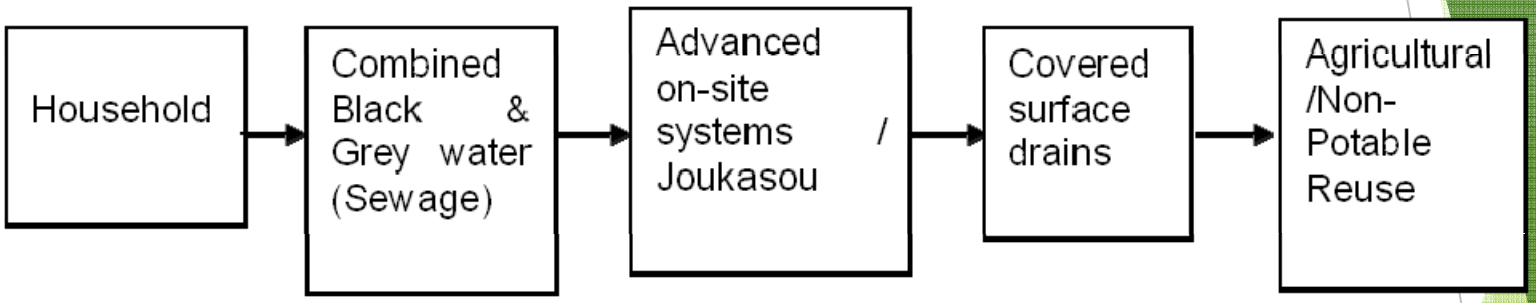
2.5.2.1 Package type anaerobic filter system

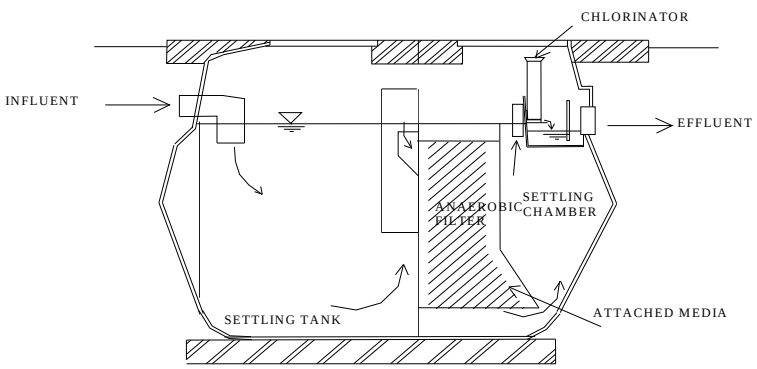
2.5.2.2 Package contact aeration system

2.5.2.3 Package anaerobic filter contact aeration system

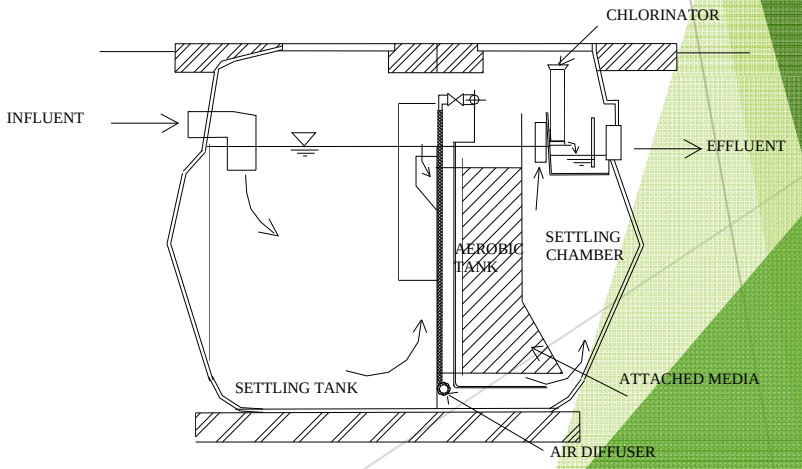
RELATED CONTENTS & FIGURES

Option-3 (Safe on-site sanitation) scheme





Prefabricated septic-tank anaerobic filter type systems



Typical cross-sectional drawings of package contact aeration system

GOVT. OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS INITIATIVES

MINISTRY OF ENV. & FORESTS RULES & REGULATION

For any new construction projects as per **State Environmental Impact Assessment Authority (SEIAA)** Clearance

Sewage Can be disposed off as below:

- By Septic tank & soak pit during the construction phase.
- By Package Sewage treatment plant in operational phase if the project don't fall under Central Sewage treatment plant.

GOVT. OF INDIA
MINISTRY OF URBAN DEVELOPMENT INITIATIVES

Technology Options for Urban Sanitation in India

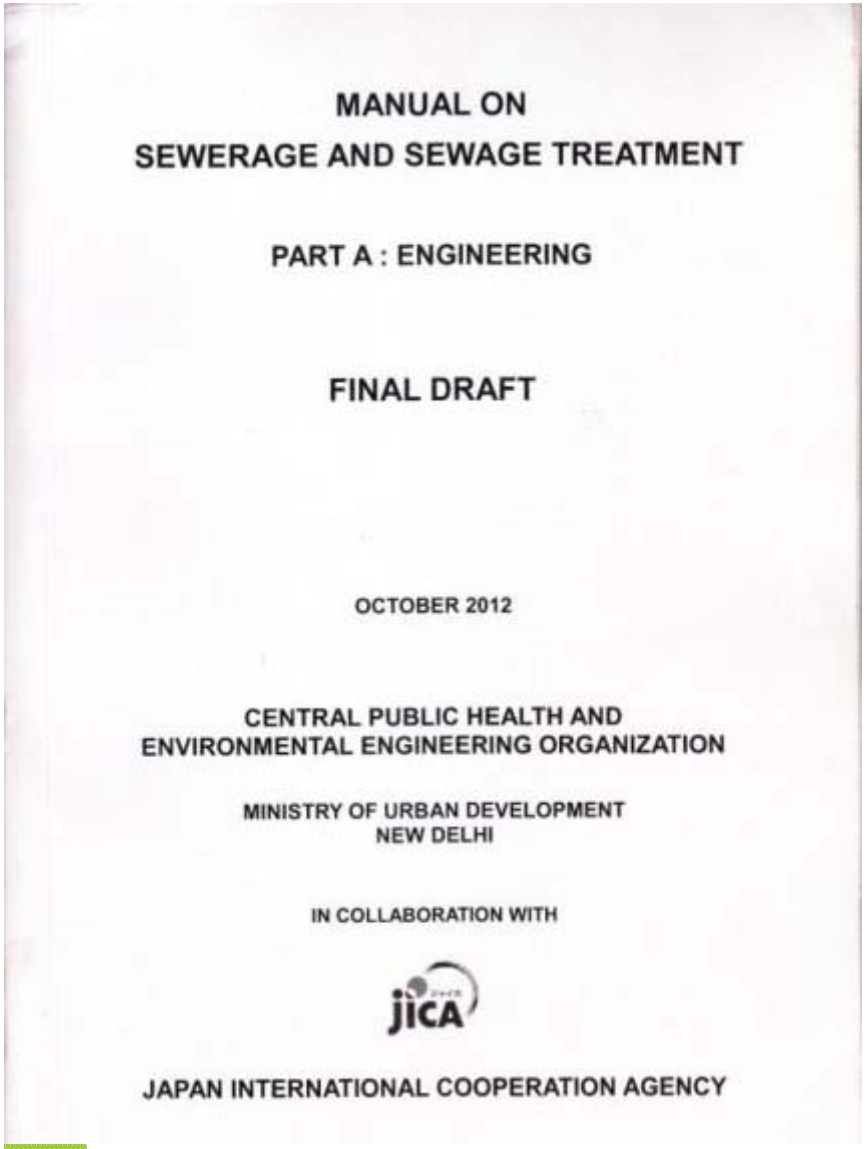
सत्यमेव जयते
Government of India

Sanitation Options for Different Residential Settlement Types

	Settlement characteristics	Typical existing sanitation services	Key Issues	Options for Upgrading	
				On-Site	Off-site
High Income Residential,	Low-density development with large plots and ample open space.	Most properties have septic tanks with or without a soakaway. In some cases there are sewer connections.	Septic tanks are often poorly maintained, and partially treated wastewater is discharged into open drains, creating a public health risk. Demand for water for irrigation of	Promote or enforce improved septic tank maintenance, including periodic emptying of pits. Addition of tertiary treatment at household level (anaerobic filter or reed bed).	Off-site treatment and disposal of septage. Sewerage combined with off-site wastewater.

	Settlement characteristics	Typical existing sanitation services	Key Issues	Options for Upgrading	
				On-Site	Off-site
Multistorey residential apartments	High-density, medium-low income.	Either connected to sewerage or have shared septic tanks.	Malfunction of septic tanks and soak pits.	Shared septic tank followed by: a) anaerobic filter and reed bed prior to discharge into surface water; or b) discharge to small bore sewerage system.	Septage transportation and off-site treatment. Sewerage combined with off-site wastewater
Urban village, former rural village overtaken by urban spread	Medium-high density, mixed income.	Coverage variable; existing toilets mostly have septic tanks or leach pits discharging into open drains or	Poor maintenance of toilets, inadequate services for fecal sludge collection and treatment. Open defecation may be	Promote/enforce improved O&M, including periodic emptying of pits. Simplified sewerage in denser areas, with on-site treatment.	Septage transportation and treatment. Reuse of wastewater or sale of fish or animal feed.

MANUAL ON SEWERAGE & SEWAGE TREATMENT- NEW CHAPTER ON ON-SITE SEWAGE TREATMENT



MANUAL ON

SEWERAGE AND SEWAGE TREATMENT

PART A : ENGINEERING

FINAL DRAFT

OCTOBER 2012

CENTRAL PUBLIC HEALTH AND
ENVIRONMENTAL ENGINEERING ORGANIZATION

MINISTRY OF URBAN DEVELOPMENT
NEW DELHI

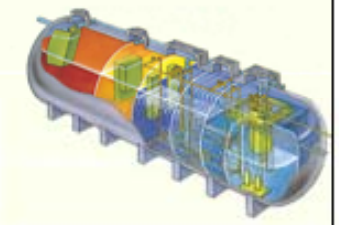
IN COLLABORATION WITH

JICA

JAPAN INTERNATIONAL COOPERATION AGENCY

INTRODUCTION AND DESIGN FEATURES OF ADVANCED ON-SITE SYSTEMS

Table 9.9 Classification according to treatment capacity (Example of Japan)

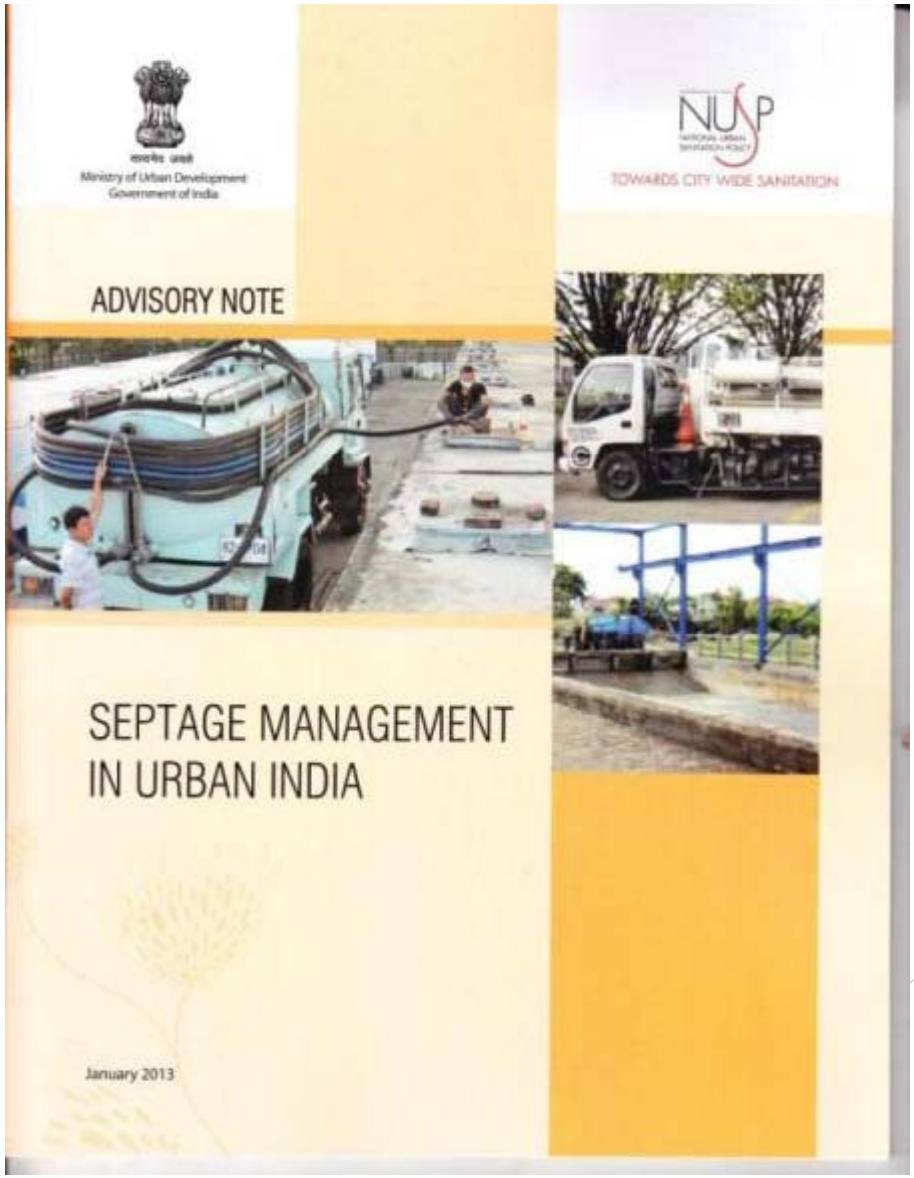
Package-type			On-site construction-type
Small-scale	Medium-scale	Large-scale	Medium/Large-scale
(About 5 to 50 people)	(About 51 to 500 people)	(Approx. 500 to 5,000 people)	(More than 500 people)
			

ii. Performance

Treatment processes are classified into three kinds according to performance: a proce
that mainly removes BOD-related contaminants, a process that removes BOD-relat
contaminants and nitrogen, and a process that removes BOD-related contaminan
nitrogen, and phosphorus.

SEPTAGE MANAGEMENT

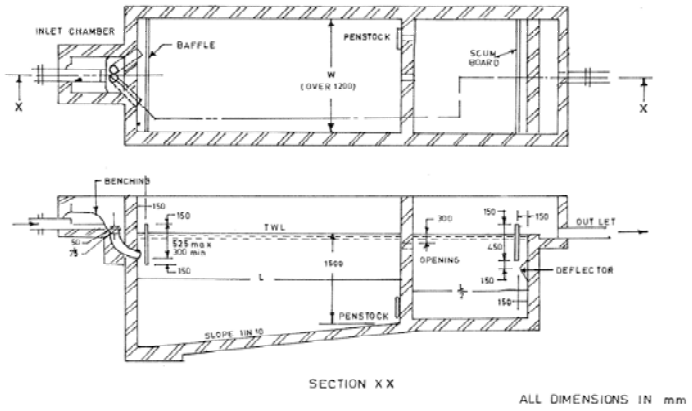
ADVISORY NOTE ON SEPTAGE MANAGEMENT



OPTIONS FOR SEPTAGE MANAGEMENT

- Pretreatment ----- lime stabilization (optional)-------- Pumping------- Sludge Drying beds (FRP covered in regions of high rainfall) --------Dewatered & Dried Sludge---- Composting----- Reuse as Organic Fertilizer;
- Pre-treatment----- lime stabilization (optional)-------- Pumping------- Mechanical Sludge dewatering system---------- -Dewatered sludge ------- Solar drying or/ and Composting----- Reuse as Organic Fertilizer;

TYPICAL ON-SITE SYSTEMS IN INDIA



Structure of a septic tank, Source: CPHEEO, 1993

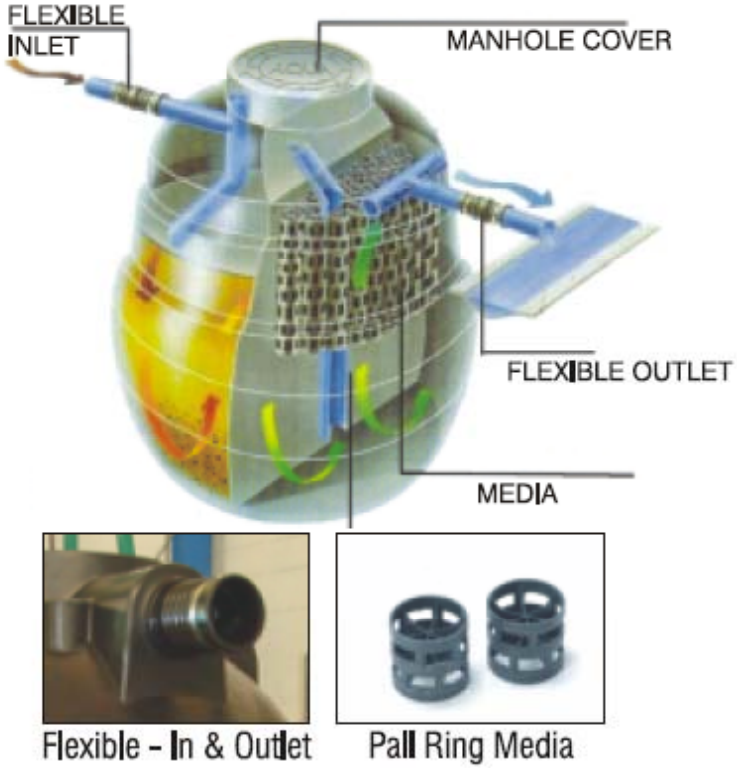
Precast Septic Tank

Vinayakashot Private Limited, Ltd

Prefab Polyethylene Cast Septic Tank

Sintex Pvt. Ltd

ADVANCED VERSIONS



SETTLER-ANAEROBIC FILTER

- The capacity ranges from 800 to 6000 l/d.
- Claims: Excellent performance through massive reduction of BOD around 70-80%

SETTLER- CONTACT AERATION

- The capacity ranges from 800 to 6000 l/d.
- Effluent can be used for irrigation, gardening.

Source: Sintex Pvt. Ltd

PERFORMANCE EVALUATION

MODIFIED SETTLER-ANAEROBIC FILTER COMBINED SINGLE HOUSEHOLD WASTEWATER TREATMENT

Background: Where ground conditions do not permit infiltration of treated wastewater, additional treatment in the form of a constructed wetland or anaerobic filter could be provided prior to discharge into a drain or watercourse. This option should only be considered if management systems for the treatment facilities can be guaranteed, a condition that very often cannot be met.
Technology Option for Urban Sanitation in India

BACKGROUND INFORMATION

- **Single Household: Middle Class**
- **Water Supply – 135 Litre/Cap.day**
- **Members: 5**
- **Size of Tank – 1200 L**
- **Materail : Polyethylene**
- **Media of Anaerobic Filter: Poly-ethylene**
- **Specie Surface Area of Media - 100 m2/m3**

Package Plant

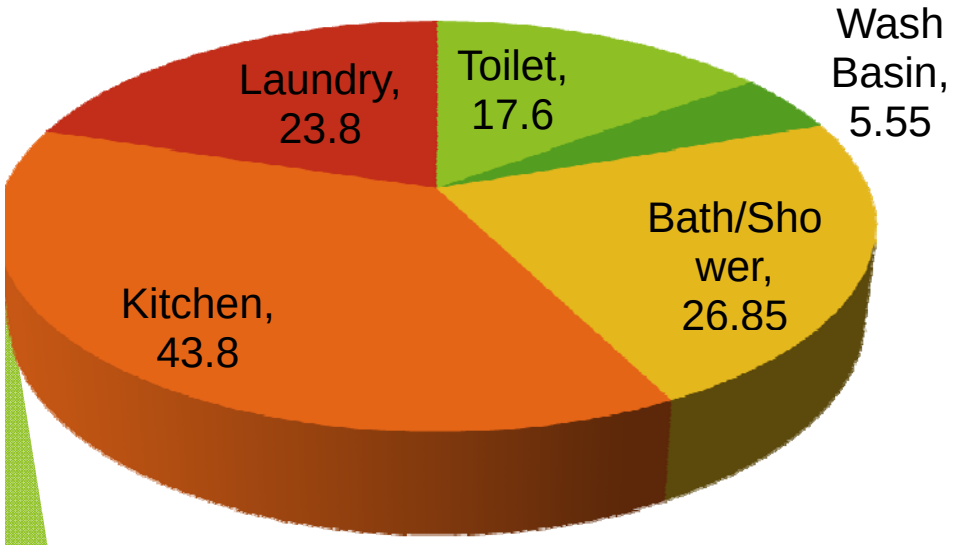
PLANT WITH INLET OUTLET CONNECTION

COVERED PLANT WITH MANHOLE

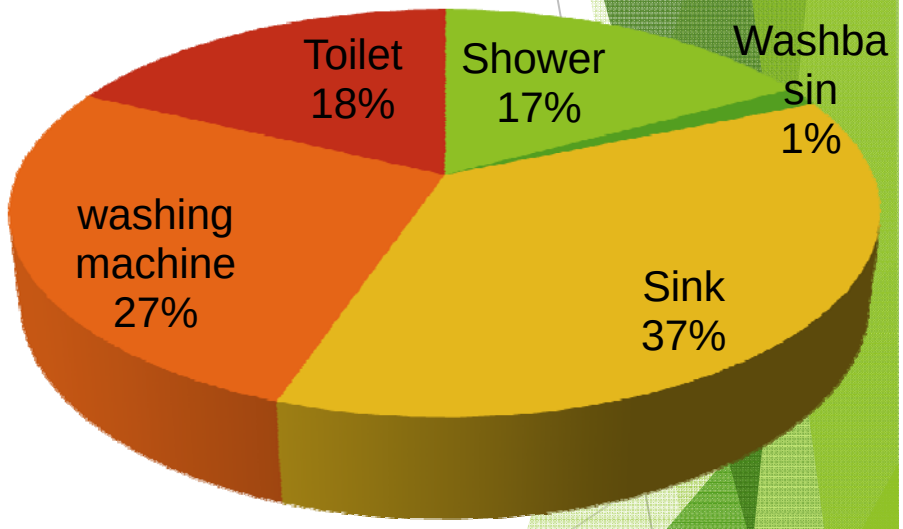
PLANT WITH WASTEWATER

WASTEWATER CHARACTERIZATION

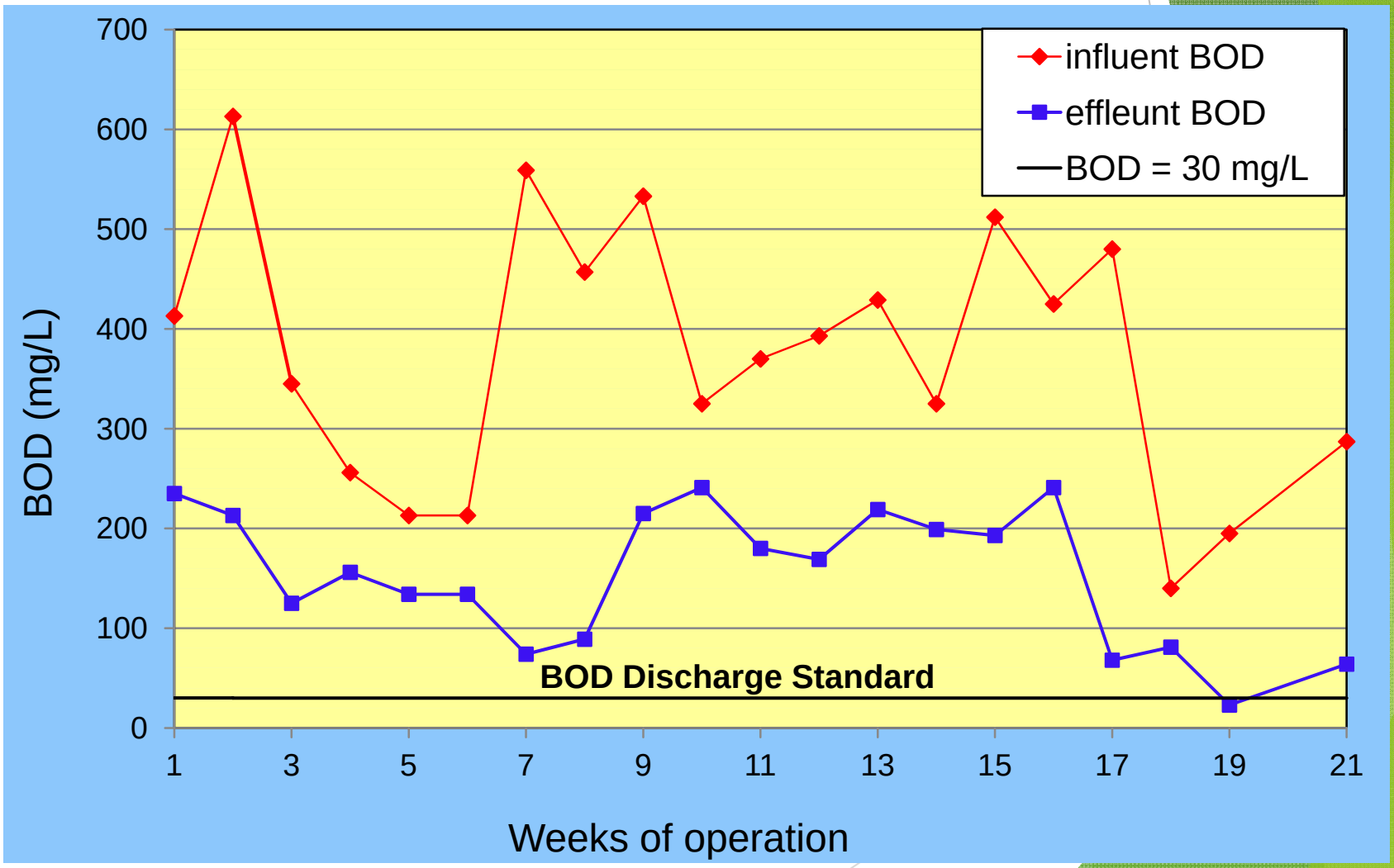
Wastewater Quantity (%)



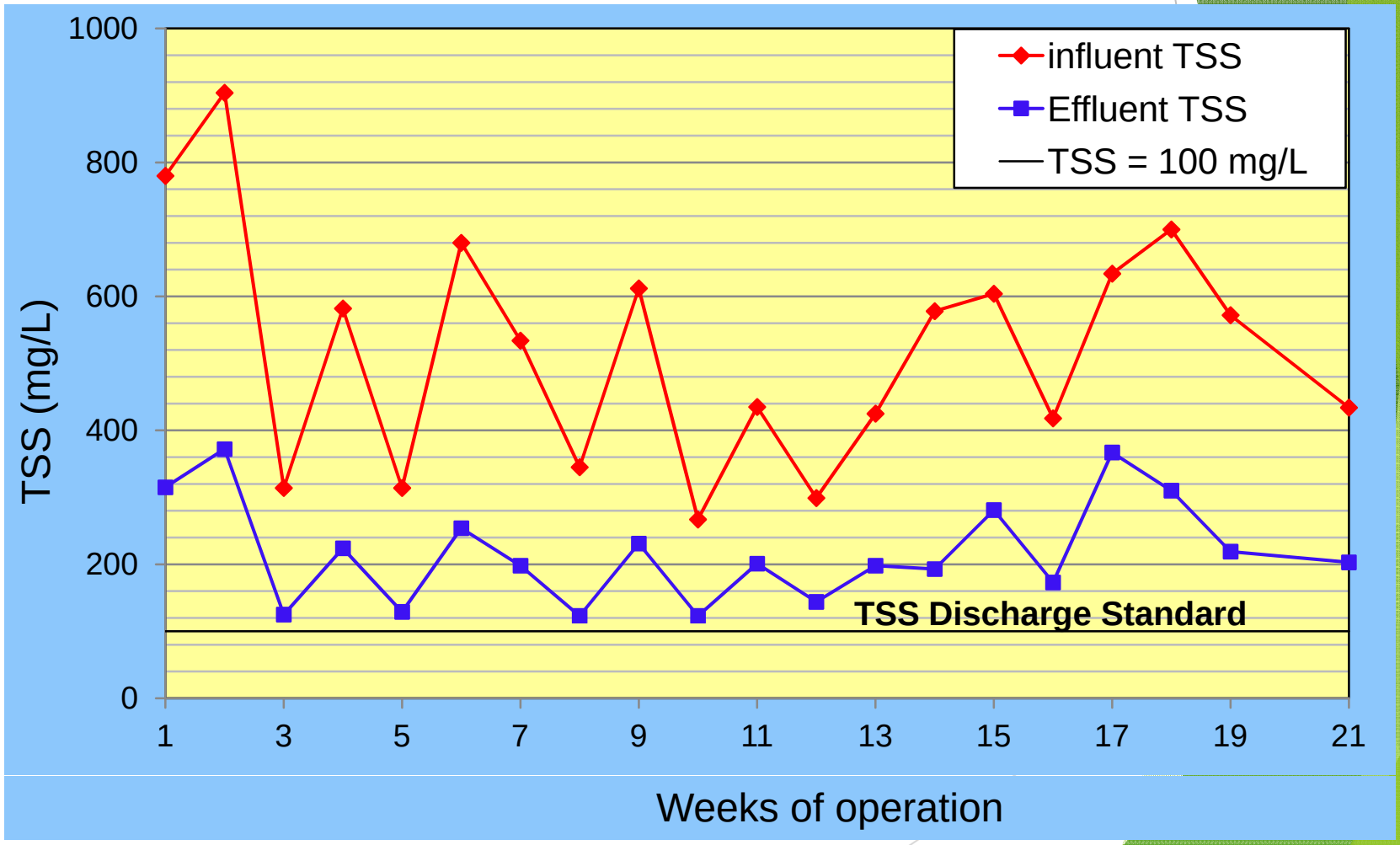
COD Load Generation %



BOD REMOVAL


700
600
500
400
300
200
100
0
BOD (mg/L)
1
3
5
7
9
11
13
15
17
19
21
Weeks of operation
influent BOD
effleunt BOD
BOD = 30 mg/L
BOD Discharge Standard

TSS REMOVAL

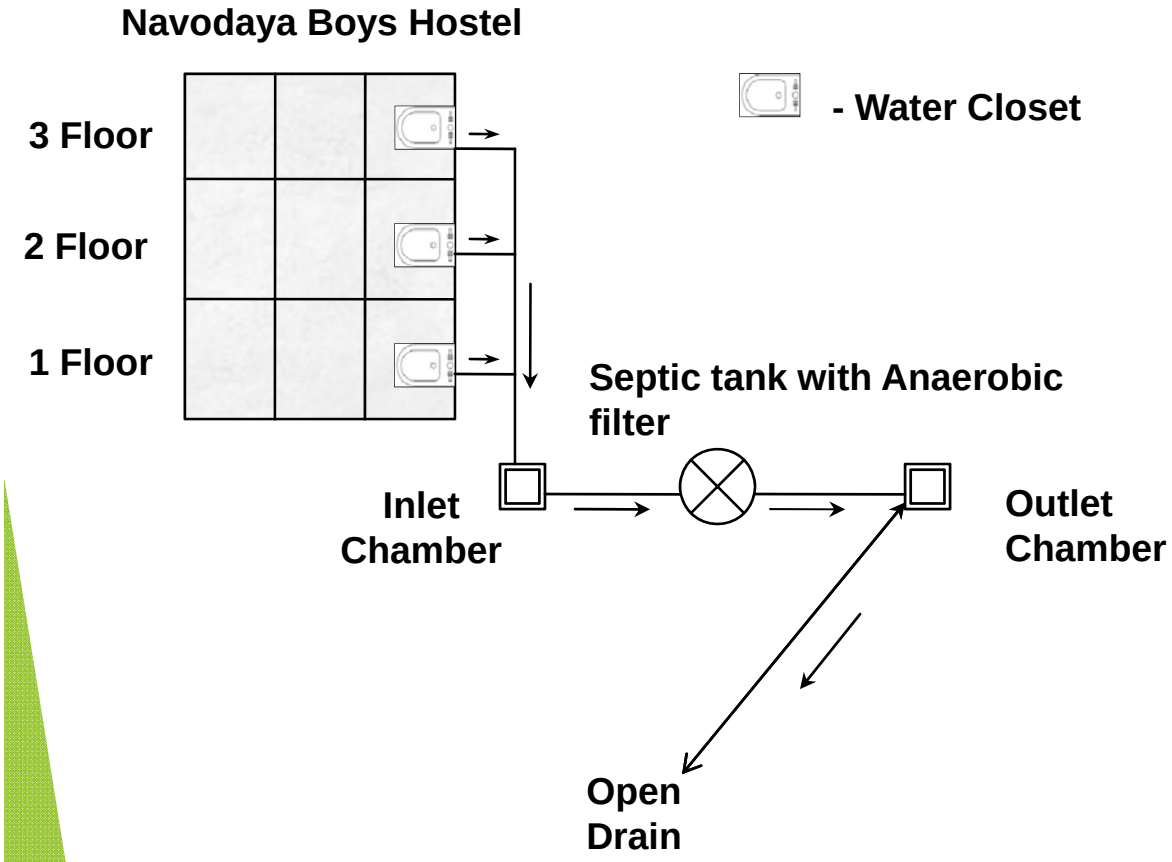

1000
800
600
400
200
0
TSS (mg/L)
influent TSS
Effluent TSS
TSS = 100 mg/L
TSS Discharge Standard
1
3
5
7
9
11
13
15
17
19
21
Weeks of operation

MODIFIED SETTLER-ANAEROBIC FILTER BLACKWATER TREATMENT- COMMUNITY SCHOOL

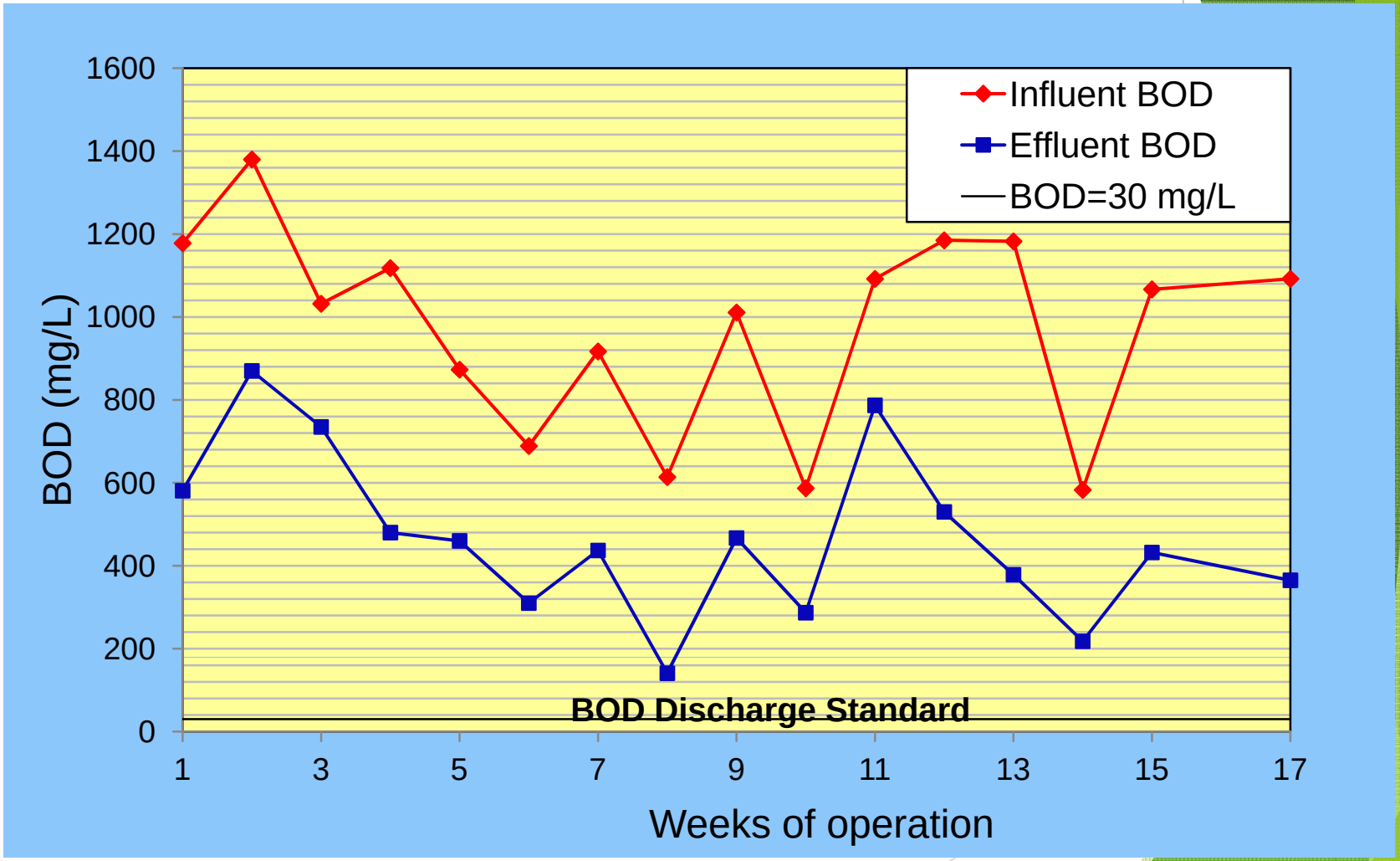
LAYOUT OF THE SYSTEM

– 130 STUDENTS

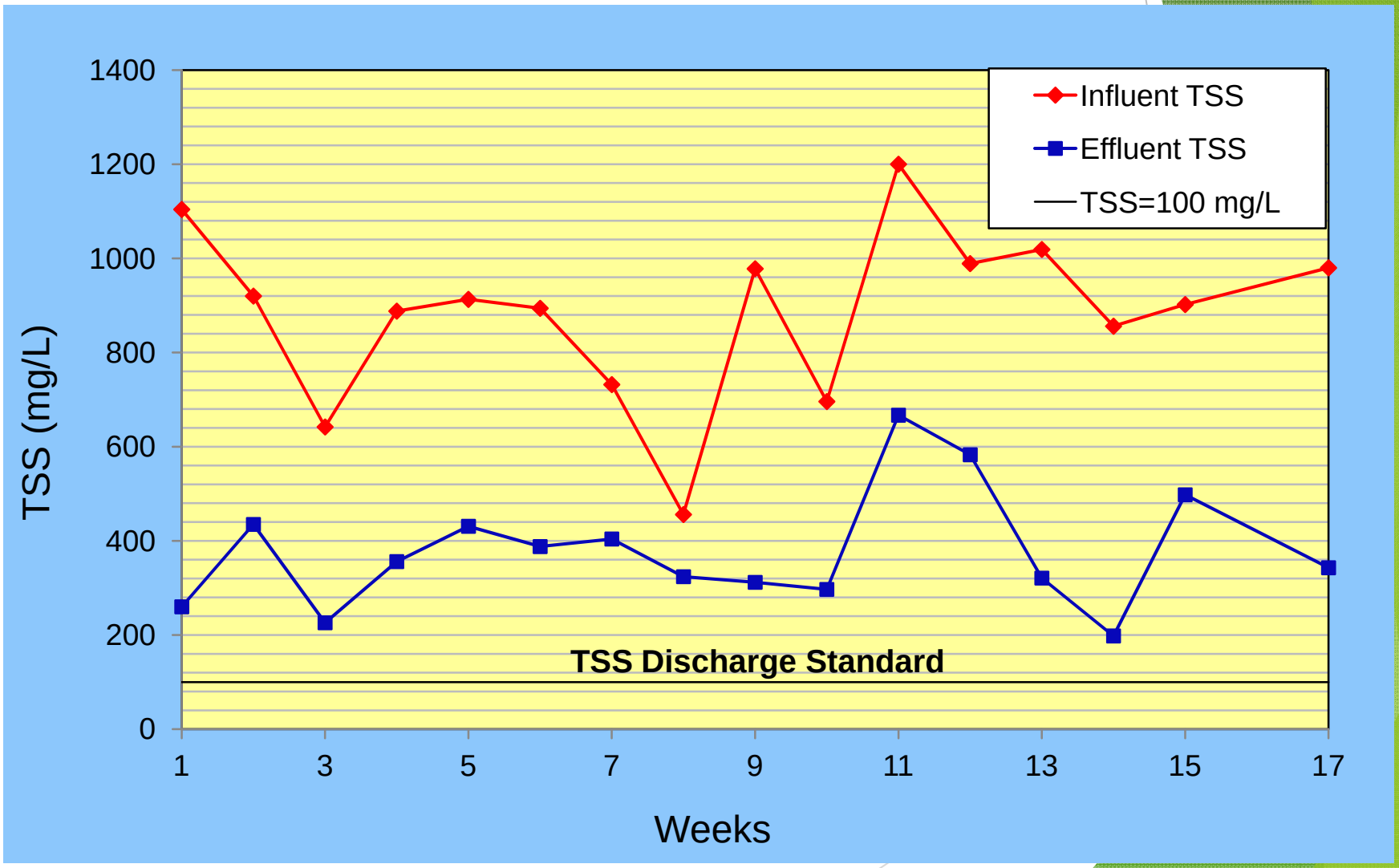
- 1000-1500 LITERS PER DAY



BOD REMOVAL


1600
1400
1200
1000
800
600
400
200
0
BOD (mg/L)
1
3
5
7
9
11
13
15
17
Weeks of operation
Influent BOD
Effluent BOD
BOD=30 mg/L
BOD Discharge Standard

TSS REMOVAL


1400
1200
1000
800
600
400
200
0
TSS (mg/L)
1
3
5
7
9
11
13
15
17
Weeks
Influent TSS
Effluent TSS
TSS=100 mg/L
TSS Discharge Standard

SEPTAGE CHARACTERIZATION

Constituents	Units	Combined Wastewater	Blackwater	EPA Design Values
BOD	mg/L	9,389	35,546	7,000
COD	mg/L	37,238	89,409	15,000
TSS	mg/L	19,322	39,945	15,000
VSS	mg/L	14,372	37,563	10,000
TKN	mg/L	738	1,015	700
NH_3-N	mg/L	172	243	150
TP	mg/L	197	294	250
Total Coliforms	MPN/100mL	1.50E+06	4.50E+09	10E+07- 10E+09
Fecal Coliforms	MPN/100mL	7.50E+05	2.30E+08	10E+06 - 10E+08
E.Coli	CFU/mL	4.30E+03	150E+05	10E+05 -10E+08
Salmonella	CFU/mL	2.50E+03	2.30E+04	1 - 10E+02

CONTACT AERATION TYPE SYSTEM

- **Capacity – 6000 L/day**
- **Type of Wastewater- Hotel**

Water Quality Parameter	Influent	Effluent
COD (mg/L)	**456-1009**	**86-574**
BOD (mg/L)	**104-306**	**32-76**
TSS (mg/L)	**350**	**89**
TKN (mg/L)	**120**	**62**
PO_4-P**(mg/L)**	8.3	3.7

PRESENT NEED:

- To develop a new generation of:
  - highly efficient,
  - compact,
  - user friendly
  - low priced treatment systems
- A new approach in design, fabrication and operation
- Rigorous septage management strategy- separate department in Government
- Subsidy from the Government
- Local Manufacturing of Blowers
- Capacity Building- Manpower Training
- Educational Programmes
- Mass production methods serve public:
  - reliable, effective.
  - robust and reasonably priced treatment plants