WASTE WATER TREATMENT, RECYCLING AND REUSE

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Plenary Session II on Waste water treatment, recycling and reuse

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Energy and Environment Foundation

WHAT WE ARE GOING TO DISCUSS TODAY

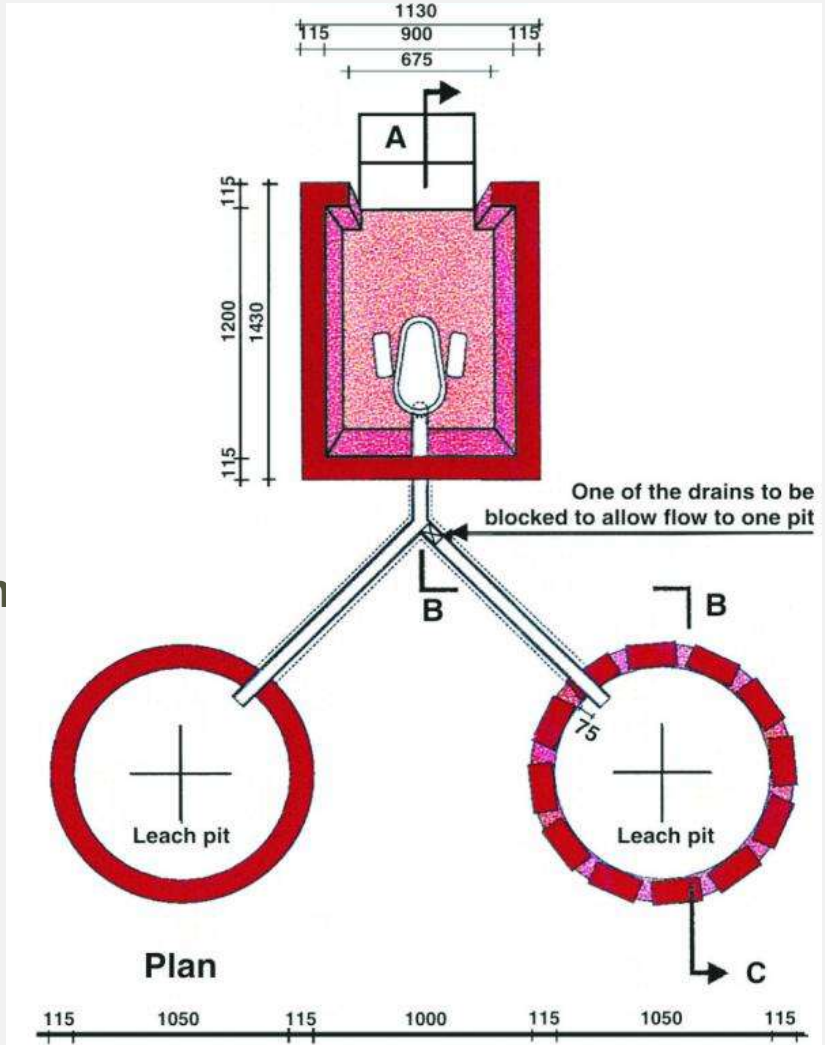
- We are fortunate to have five distinguished speakers in this session
- We will discuss one of the most crucial issues of our times – waste water management, which is closely related to water
- It has a wide variation – from on-site sanitation to centralized sewerage system
- However, the common objective is – health and hygiene, saving money and precious water
- Waste water is important on two counts – (a) its appropriate treatment and disposal is essential for our health and environment and (b) If treated properly, waste water can become a resource for secondary water use

ON-SITE SANITATION FOR SAVING RESOURCES

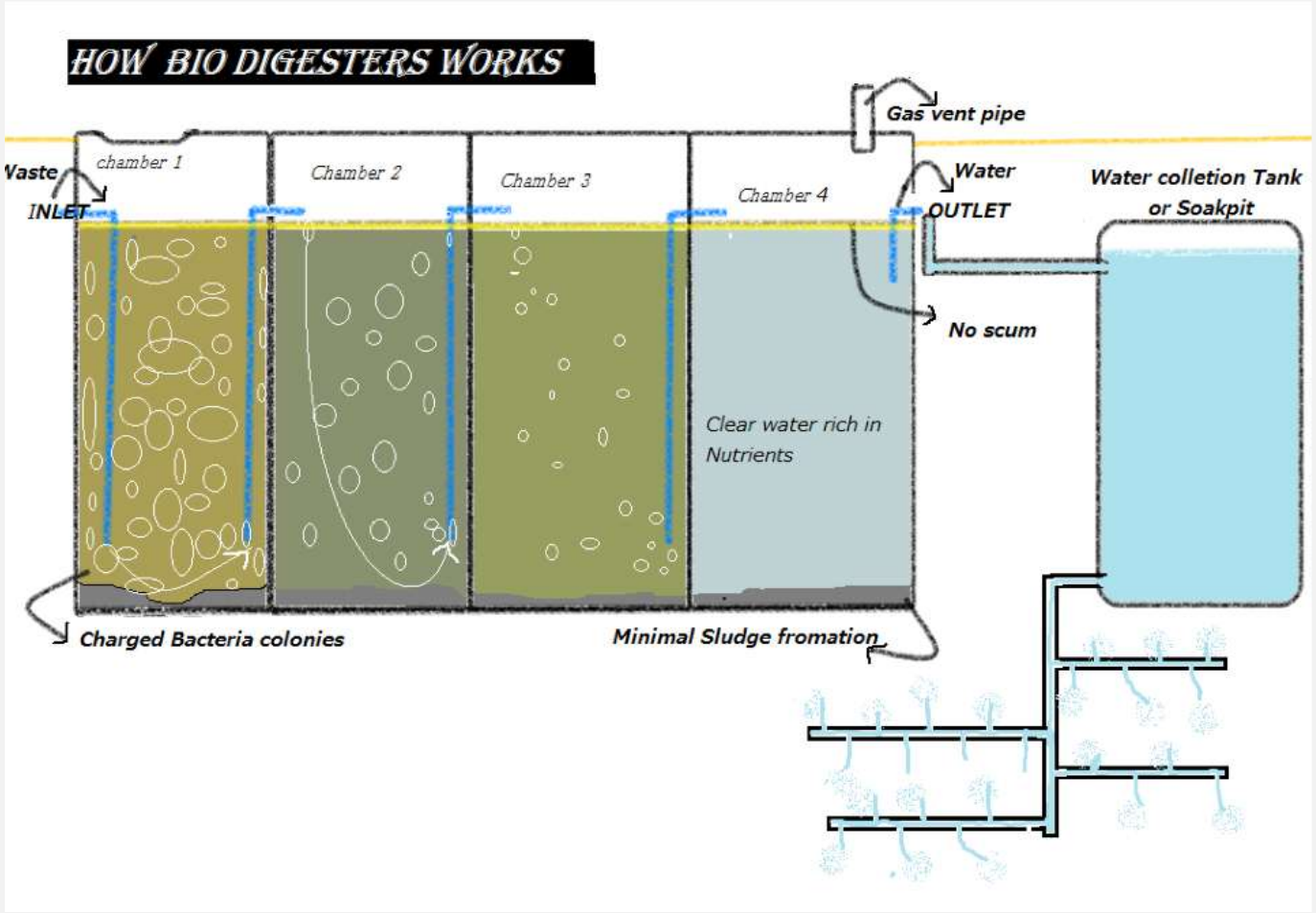
- Wherever applicable, on-site sanitation systems have a couple of advantages**:** less overall cost, less requirement of water, prospect of use of residual nutrients and direct control of the users over the system
- Some popular systems are –
  - **Twin pit toilets**
  - **Septic tanks**
  - **VIP and DVIP (ventilated / double ventilated improved pit)**
  - **Biosan toilets**
  - **Bio-toilets (e.g. developed by DRDO in India)**

APPROPRIATE TECHNOLOGY – TWO PIT POUR FLUSH COMPOST TOILET

- In Sulabh Two Pit Pour Flush Compost Toilet, there are two pits one of which is used at a time
- Excreta in the first pit turns into safe manure after two years
- Manure is odourless and pathogen free & can be used in fields and gardens
- Capacity of the pit can vary from 2 years to 40 years as per design
- More than 1.5 million Two Pit Pour Flush Compost Toilets installed in India by Sulabh alone. The Government of India has also got installed 54 million such toilets
- This design has been implemented in Asia, Africa and Latin America



BIO-TOILET (DRDO) WORKING LIKE BIO-DIGESTER



WASTE WATER MANAGEMENT: ESSENTIAL FOR CONTROLLING POLLUTION

- Waste water can be categorized into municipal / domestic and commercial / trade / industrial
- All of these need to be disposed of in scientific manner
- Waste water, from whatever source, can be a source of severe environmental pollution and a health hazard
- Appropriate disposal is very important
- My presentation focusses on municipal waste water

RECYCLING AND REUSE OF WASTE WATER

- The world of waste water management has moved a full cycle in about 100 years
- The journey started with the ubiquitous septic tank in 1860, moved up to increasingly centralized and large sewerage system and then it was realised that more water and more energy was being consumed in the process
- The kind of planning and executing capability required to construct hundreds of kilometres of sewer lines and maintain them for 3-4 decades is not happening in developing countries

TREATMENT TECHNOLOGIES

- Treatment of sewage is broadly categorized into primary and secondary
- Tertiary treatment systems have also been developed long back but but rarely used
- Primary treatment is screening using suitable screens like bar screen for removal of coarse materials, such as, grits
- Secondary treatment is the main part of sewage treatment (examples in the next slide)
- Finally, disinfection of the treated effluent is carried out using Chlorine

TREATMENT TECHNOLOGIES

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- The famous book 'Sewage Treatment in Hot Climates' by Duncan Mara from the University of Dundee (1976) opened a new chapter
- Very fortunately, Duncan Mara had visited our facilities at Patna
- In this book Duncan Mara broached the subjects of **waste stabilization ponds**, **aerated lagoons**, **oxidation ditches**, **high rate biofiltration** and effluent reuse
- **Root zone technology** has further been added
- And the band wagon moved on to '**small bore sewer**' for decentralized application, especially for high density areas

TREATMENT TECHNOLOGIES

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Popular secondary treatment systems at present:

- **Activated Sludge Process (ASP)**
- **Trickling Filter**
- **Extended Aeration**
- **Up-flow Anaerobic Sludge Blanket Reactor (UASB)**
- **Sequential Batch Reactor (SBR)**
- **Moving Bed Biofilm Reactor (MBBR)**
- **Membrane Bio-reactor (MBR)**

- Combinations have been worked out for higher efficiency, e.g., UASB + ASP, UASB + Trickling Filter etc.

MUNICIPAL WASTE WATER

- In our high aspiration of having a sewerage system everywhere, we tend to forget the basic premises on which this system is based
- Minimum 100 lpcd water availability, proper plumbing, laying of the sewer drains for long stretches with proper leak proof fitting and gradient and finally constructing an appropriate sewage treatment plant (STP) – these are very real challenges
- Laying sewer drains as a ‘post script’ is another formidable challenge
- Then comes the issue of operation and maintenance for the sewer line as well as the STP

MUNICIPAL WASTE WATER .. CONTD.

- So, how do we deal with the situation?
- Fortunately it has been realized that reversing the trend from centralized to de-centralized may have the answers for specific situations
- At the same time there has been a shift towards reducing energy requirement by depending more on the biological processes
- Countries with predominantly tropical climate have an edge over the temperate ones for the biological processes

DEVELOPMENT OF DECENTRALIZED SYSTEMS

- The latest **‘Manual on Sewerage and Sewage Treatment Systems’** published by the Ministry of Urban Development, Government of India, 2013 has included a chapter on **‘Decentralized Sewerage System’**, Chapter 8 and **‘On-site Sanitation’**, Chapter 9

- This is of great significance although it takes a long time to get percolated into Government programs in departmental tenders
- Small bore sewer has been included
- Interestingly, public toilets have been described as ‘a further decentralization within decentralized sewerage’

DEVELOPMENT OF DECENTRALIZED SYSTEMS .. CONTD

Some of the options for disposal of waste water are:

- **Septic tank** (the classic solution but with lots of limitations)
- **Biogas plant** (different scale application possible)
- **DEWATS** (decentralized waste water treatment system) baffled septic tank and anaerobic filter stand out as more plausible solutions of DEWATS; small bore sewer can be used for linkage with the toilets)
- **Soil Biotechnology** (SBT) developed by IIT, Bombay
- **Stabilization ponds** etc. (mentioned earlier)

LAND REQUIREMENT FOR VARIOUS SYSTEMS

Land and water availability are important determinants for choice of a system:

- Septic tank – 0.5 m^2 / m^3 daily flow
- Baffled Septic tank / Anaerobic filter – 1 m^2 / m^3 daily flow
- Constructed wetland - 30 m^2 / m^3 daily flow
- Anaerobic ponds – 4 m^2 / m^3 daily flow
- Facultative aerobic ponds – 25 m^2 / m^3 daily flow

- Human excreta recycled resulting in the production of biogas.
- Used for cooking, lighting, electricity generation & warming oneself in winter.
- 200 biogas plants of 35-60 cubic meter capacity constructed in different parts of India and 5 places in Afghanistan.

Public toilet linked to biogas plant with gas holder

USES OF BIOGAS

Her Royal Highness Princess Mathilde of Belgium, lighting the mantle lamp which uses biogas from the Sulabh Toilet Complex as the source of energy.

HUMAN EXCRETA BASED BIOGAS PLANT

His Excellency Timothy J. Roemer former, Ambassador of USA to India trying his hand in frying a papadam.

His Excellency Mr. Richard R. Verma, US Ambassador to India, watching an engine which ignites on battery to convert biogas into electricity

His Excellency Mr. Richard R. Verma, US Ambassador to India watching a demonstration of the Sulabh biogas being used as heating agent and warmer.

Sulabh Effluent Treatment Plant

- Biogas effluent treated through sedimentation tank, aeration tank, sand filter, activated charcoal followed by Ultra Violet (UV) rays.
- After the treatment the Biochemical Oxygen Demand (BOD) reduced to less than 10 milligram per litre.
- Treated effluent turns colourless, odourless and pathogen-free.

Can be used as liquid manure.

- Safe for aquaculture, agriculture, gardening & discharging into water body.

OUR EXPERIENCE WITH DEWATS

- We were the first organisation to get DEWATS in India (Sulabh International Institute of Technical Research and Training or SIITRAT) in association with the Bremen Overseas Research & Development Association (BORDA)
- The project was funded by the European Union (EU) and the participating organisations were:
  - BORDA, Germany
  - SIITRAT, New Delhi, India
  - GERES (Groupe Engineers Renouvelables et Environment), Marseilles France

OUR EXPERIENCE WITH DEWATS

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CONTD.

- – CEEIC (Chengdu Energy Environment International Corporation), China
- – HRIEE (Hangzhou Research Institute of Energy and Environment), Hangzhou, China
- – CSR (Centre for Scientific Research), Auroville, India
- – MDS (Malandu Development Society), Parathodu, Kerala, India
- Initially the product design was called ‘Low Maintenance Waste Water Treatment Systems’ or LOMWATS

OUR EXPERIENCE WITH DEWATS

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- Eight numbers of DEWATS facilities were designed and constructed by SIITRAT in Delhi and NCR
- The designs were simplified designs, consisting of pre-settlers, anaerobic filters and ponds
- Each design was especially tailored for the ground situation
- The results were quite encouraging
- BOD reduction was to the tune of 80-97.6 % in comparison to 43.2 % for a standard septic tank

WAY FORWARD

- There are two important issues for waste water management – availability of water and all-weather proper drainage
- Planning capability is the most important factor
- Planning capability for developing a sustainable plan for disposal of waste water followed by capability for preparing tenders and execution and ultimately, operation and maintenance on a long term basis are required
- All the stakeholders must be involved during the planning exercise as well as the execution period for long term success

THANK YOU