# BIOGAS and DEWATS, a perfect match?

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## Summary

BORDA's approach to DECENTRALISED WASTEWATER TREATMENT (DEWATS) foresees BIOGAS digesters as one treatment module. DEWATS linked BIOGAS digesters have shown significant benefits, increasing the overall sustainability of DEWATS linked sanitation projects, especially projects addressing sanitation infrastructure in low-income settlements and smaller institutions. The resources recovered from these BIOGAS digesters (gas for cooking, heating or lighting) when combined with adequate social interventions have resulted in increased acceptance of the installations by communities and institutions. Two case studies in Bangalore, India, exemplify BORDA's approach. A community based sanitation project (sanitation complex with toilets, bathing and laundry washing facility) at Ullalu, an urban slum, benefits through improved services provided by this sanitation complex (toilets, provision of hot water for bathing and gas for lighting) increasing the use of these installations. A hostel institution, Friends of Camphill, benefits from financial savings of gas for cooking which outweigh the initial added costs of biogas infrastructure and ensure the observance of maintenance intervals.

### BORDA's DEWATS linked BIOGAS units

Rapid urbanization, poor infrastructure, climate change and the big squeeze on water resources have created a global problem of adequate sanitation that is focused in the slums of big cities in the developing south. DEWATS was introduced in India as a technological solution that would both increase hygiene and recover the finite resources of water and nutrients. DEWATS is a biological treatment process where wastewater is treated by a combination of treatment modules such as the settler / biogas settler, imhoff tank, anaerobic baffle reactor, horizontal planted gravel filter and different ponds according to the wastewater and site specific requirements. DEWATS minimizes external energy inputs and maintenance requirements. Under the aegis of Community Based Sanitation projects and also for private organisations or individual owners, DEWATS forms a technical intervention adding to community sanitation the aspect of environmental sanitation. Collection and use of BIOGAS from these units have been added as a means of converting the gas waste stream to a resource for communities or owners.

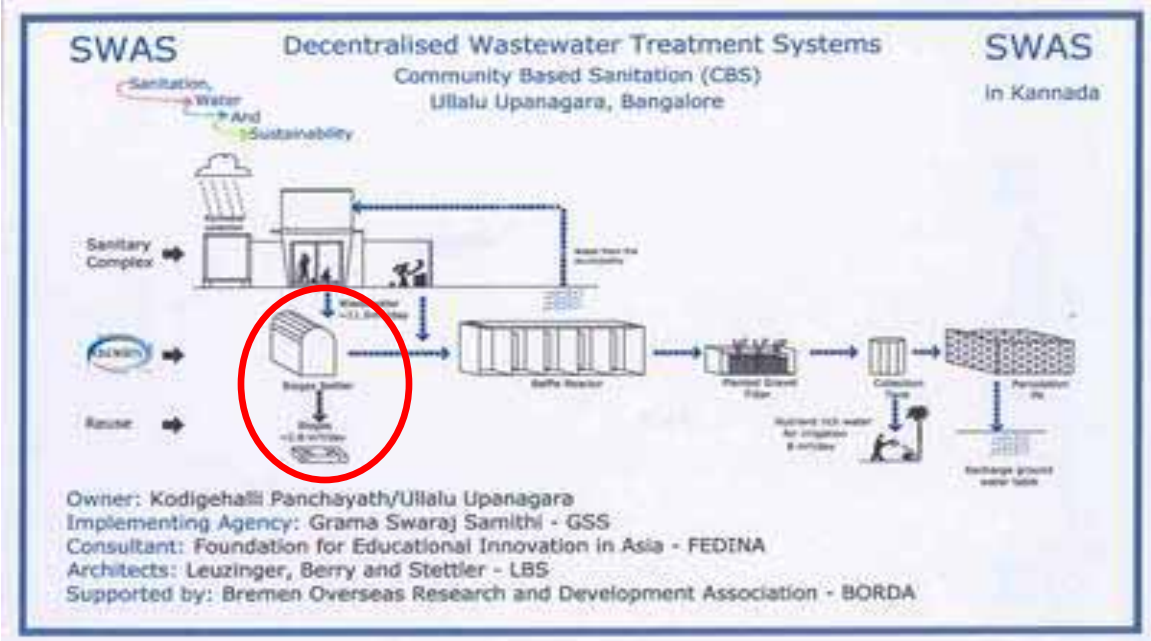


**Figure 1 Community Based Sanitation approach**

**Figure 2 DEWATS with Biogas digester at Friends of Camphill**

In India, cultural stigmas surrounding human waste add to the myriad challenges to the sustainability of any community sanitation development project. Accordingly, a significant part of the project is social measures such as hygiene interventions, informed choice options, education, awareness, capacity building and sensitization activities. The willingness to accept treatment and resource recovery approaches therefore increases the demand for wastewater treatment strategy and its sustainability, sound strategies that can ensure their sustainability.

**Figure 3 Capacity building interventions with communities**

Biogas produced during anaerobic wastewater treatment can capitalized on as domestic wastewater has suitable organic content (80% from human excreta) that can be partially trapped in a biogas settler where a high concentration of organics makes biogas recovery an interesting feature. The average temperature in India is around 22°C-35 °C which is also an ideal precondition for biogas production. Normally this gas is vented out. By replacing the conventional wastewater settler with a Biogas settler, the gas can be collected and delivered for use as a resource. Also, by burning the gas, one source of odour from the treatment unit is eliminated adding also to reduction of green house gas emissions.

**Benefits of BIOGAS-DEWATS**

Although the amount of biogas produced may not be highly significant from the energetic point of view (2-8 $m^3$/day of biogas produced, Table 1), combining BIOGAS and DEWATS works because while the biogas settler aids in the pollution reduction component, the biogas resource is for communities an incentive to own and maintain the infrastructure. Thus, if BIOGAS and DEWATS are combined successfully, there is potential to increase sustainability through:

- Increasing public health through usage of sanitary facilities that supply the BIOGAS digester with human waste
- Reducing the ecological footprint of the community through reducing the level of pollution discharged to water bodies and the atmosphere
- Raising the social acceptance for the treatment approach, through increased resource provision and to a certain extent, economic incentives

**Table 1 Biogas generation & Carbon dioxide equivalent**

| | | |
|---|---|---|
| Biogas generation | 2-8 $m^3$ /day ≡ 1000 – 3000 $m^3$ /annum | |
| Methane generation | 650 – 2000 $m^3$/annum | |
| Diesel equivalent | 500-1600 l/ annum | |
| $CO_2$ equivalent of $CH_4$ | 10 to 40 T/annum | 12-48 T/ annum |
| $CO_2$ generated / substituted | 2 – 8 T/annum | |

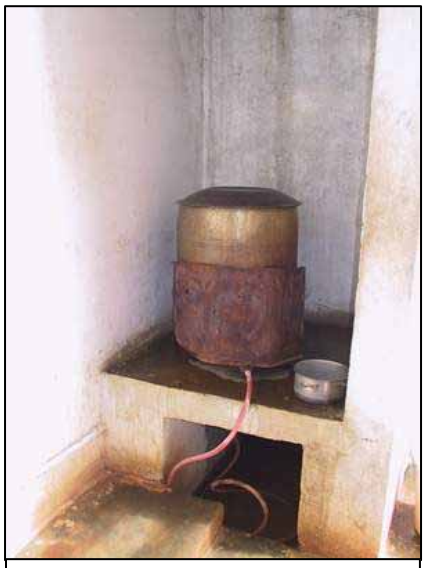

**Figure 4 Biogas to heat bathing water**

**Figure 5 Biogas to light Biolamp in a children's toilet**

**Figure 6 Biogas as cooking fuel**

The experience and learning of all community based sanitation projects linked with biogas or reuse of resources has been that initially there is outright rejection (based on the described cultural stigma and ignorance). After exposure visits to systems in operation turns the rejection in to acceptance, more demand for such units and then even a sense of ownership. This shows that technology can overcome these stigmas. Some limitations that community based sanitation

installations face is of availability of skilled labour for construction, availability of pre-fabricated units and also that regular maintenance of these units is not easy enough.

**Two Case Studies: Biogas-DEWATS implementation in a Slum and an Institution in Bangalore, India.**

BORDA with its partners has implemented the BIOGAS linked DEWATS units for the benefit of slums and institutions in India. Two cases are compared below. While the technical implementation was similar, the benefits for each project differ. Quantity of wastewater and biogas at the two sites are given in Table 2.

**Table 2 Wastewater and biogas generation**

| | **Ullalu Slum** | **Friends of Camphill, Hostel** |
|---|---|---|
| **Wastewater generation** | 11.5 $m^3$ /day | 12 $m^3$ /day |
| **Biogas recovery** | 4-8 $m^3$ /day | 3-4 $m^3$ /day |

BORDA's experience with BIOGAS has shown that the greatest benefits for community projects such as Ullalu slum are an increase in social status and dignity. Hot water for bathing and lighting of the toilet complexes at night are two major improvements to existing hygiene facilities that improve the standard of living for communities. For BIOGAS use in a hostel institution such as Friends of Camphill, the greatest benefits are financial gains Table 3 shows that the cooking fuel savings over 10 years outweigh the added infrastructural costs of a biogas settler over a conventional settler. Table 3 also quantifies the equivalent financial benefits to the Slum due to hot water provision.

The Ullalu case study shows better repayment (half the time of the institution for cost recovery), the impression is that this is not due to economic reasons or is not driven by financial viability as in the case of the institution, but by the use of facilities and benefits that are offered.

**Table 3 Financial comparison of conventional settler and biogas settler (for 10 $m^3$ wastewater /day)**

| | **Settler** | **Biogas Settler** | **Costs / Benefit for biogas settlers** |
|---|---|---|---|
| **Construction Costs (INR)** | 79, 000 (~ 1740 USD) | 1,50,000 (3300 USD) | - 71,000 (1560USD) |
| **Running Cost (INR/year)** | 1000 (22USD) | 2500 (55 USD) | - 1500 (33 USD) |
| **Income / savings in 10 years at Friends of Camphill** | | Biogas as cooking fuel 1,20,000 | + 1,20,000 (2640 USD) |
| **Repayment period** | | | Approx. 6 years |

| | | | |
|---|---|---|---|
| **Income / savings in 10 years at Ullalu** | | Biogas as fuel for heating bathing water 3,65,000 | + 3,65,000 (8022 USD) |
| **Repayment period** | | | Approx. 2 years |

**Future potential of BIOGAS-DEWATS**

Experiments to increase biogas recovery from decentralised wastewater treatment units (DEWATS) by the 'co-treatment' or 'co-fermentation' approach are being carried out in collaboration with the Central Pollution Control Board of India. Under the approach to increase the organic volumetric load in the biogas digesters by adding co-fermentation substrate with high BOD concentration from dairy's and distilleries, the biogas production capacity of the unit could be increased. It is targeted to provide the following advantages:

- Increase the efficiency of biogas digesters and provide the owner of DEWATS linked biogas units additional biogas usage
- Treatment fees could be charged by the owners
- Industries could turn waste into use

From the treatment process and its technical implementation not too many difficulties are envisaged, but logistical and management measures will be the challenge for co-fermentation in the DEWATS sector.

BORDA's approach adopted for decentralised wastewater treatment and resource recovery has so far met with success and it has been able to generate a demand for the concept. It is BORDA's objective to increase significantly the number of DEWATS units with biogas recovery facilities in the future for different sectors including community based sanitation initiatives. Conversion of simple settlers into biogas plants (biogas settlers) is being adopted as a strategy by BORDA as it allows for gas burning that has benefits for the communities and it adds to the factors that ensure acceptance and sustainability of this type of projects.