



BIOGAS PLANTS AT SINZA HOSPITAL; DAR ES SALAAM

Final Report

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Planning discussion with Hospital authorities, construction form and consultant

1. Introduction

After the construction and implementation of the placenta biogas plant at Mwananyamala Hospital through UNDP and Ministry of Health, it was decided to construct a next biogas system for placenta digestion at Sinza hospital in Dar es Salaam.

The site visit showed that the space available favored the installation of two digesters. This provides a long retention time for the placentas which are categorized as infectious waste. The long retention time of more than 180 days assures the elimination of potential pathogens and allows to classify the effluent sewage in the range of “normal sewage”. The contract for implementation for the construction of biogas plants at Sinza Hospital was awarded to MOCUBA Enterprises Co. Ltd. It was decided to organize an office meeting at UNDP headquarter on the 30th of October and a site visit at the hospitals with the hospital authorities on the 31st of October.

The consultant suggested an exposure visit for MOCUBA Enterprises in Arusha where similar biogas systems were visited. Also, the system at Mwananyamala was visited in preparation for this work.

In order to bridge a knowledge gap for MOCUBA it was suggested to incorporate in the company an experienced mason for the construction of respective systems.

2. Objective of the biogas plant implementation

The main objectives of the implementation were:

1. All placentas generated in the hospital are disposed in hygienic, not disturbing and socially acceptable manner.
2. Placentas and other organic waste are pretreated anaerobically and produce as a secondary benefit *energy* in form of biogas which is used for small scale cooking.

3. Construction work

The construction firm received detailed instructions which were all followed

Clarify with all stakeholders the feasibility as well as constraints and challenges of the suggestions of this feasibility study

Modify plans in cooperation with the consultant.

Assure that during construction the adjoining septic tank is regularly emptied to avoid seepage of wastewater in the excavated site.

Consider dug out soil for intermediate store or final use

Set reference line, define levels

Lay out all underground structures to be established

Carefully dig out to consider all underground structures

Assure that all functions are remaining intact, water, wastewater, electricity during construction.

Redirect pipes where necessary in consultation with hospital personnel.

Decide in which order to build the digesters

Provide pump sump and pump to remove underground water when necessary
Organize building material
Define center and radius point
Dig out strip foundation
Cast concrete ring in strip foundation
Immediately lay lines of solid concrete blocks (no bricks in Dar-es-Salaam) (mortar mix 1:3) including inlets and outlets (this holds water outside the structure)
Plaster the outside wall with chicken wire
Backfill the outside wall with the soil dug from cone and debris from concrete layer
Shape cone and cast cone floor (10cm)
Continue dome construction with lintels, placenta inlet pipe and displacement tanks, covered with tunnel shape, inlets and outlets, square or round as provided on drawing. Install gas outlet pipe and gas testing unit as on drawing.
Plaster outside and provide backfilling instantly and evenly in all directions
Provide internal plaster layers with water proofer cement additive. Final layer cement and water proofer sludge
Provide curved separation wall internally $\frac{1}{4}$ brick without plaster
Avoid bonding separation wall to the gastight layer in the gastight zone, leave 2 cm or less space.
Place manhole and covers where required
Make pressure test on both digesters separately.
Connect placenta inlet to digester 1
Start feeding food residues on second inlet.
Connect toilets to inlet of digester 2
Connect showers to septic tank
Lay gas piping system to cafeteria/point of gas use and provide pressure indicator
Level the soil and beautify the site from debris stones
Instruct all stakeholders on plant operation and gas use.

The implementation work started with site layout and digging work on 20.11.2019 and the Mason from Arusha joined from the 25th of November onwards. Before the work was completed the consultant/planner visited the site four times, for planning, pressure test first approval and final approval after elimination of snags.



The old underground structures and the underground water were not unexpected, but quite some challenges for the construction workers.





4. Pressure test



The pressure test was well conducted and proved good quality of the workmanship applied. Both digesters are gastight and watertight. The pressure indicator was holding the pressure constantly over 4 hours.

5. Finishing touches

The following measures were done to complete the job:

- Connect overflow to septic tank
- Connect all sewage lines to digester
- Exchange toilet bowl in the hospital
- Connect toilet for placentas to placenta inlet
- Gas piping
 - Install gas line, assuring condensation water to flow back in digesters.
 - Explain gardener where the gas pipes are running
 - Install gas stove with valve. Assure that the stoves operate well.
 - Assure (with hospital) that the gas stoves installed are user friendly and that there are kettles, pots with lids a frying pan. A table for the stove a cupboard.
 - Install pressure indicator with valve
 - Conduct pressure test of piping system assure gas tightness.
 - Show how to operate the stove (it is expected that gas burns after a few days)
- Install manhole covers
- Build rainwater drain/bypass
- Level soil, remove surplus soil
- Communicate with hospital to know what they still require from you before you leave the site. (client must be happy).
- Regular follow up visits.

Encourage hospital personnel (at least 3 people should be present)

- for placenta feeding
- on other organic waste feeding
- beautification of the site after construction
- Planting flowers
- Economic gas use
- Observation of pressure indicator and acting accordingly



Before and after. At the onset of the project wastewater was overflowing from the soak-away pit. In order to keep the precise maximum level in the sewage piping system to avoid clogging of pipes, an overflow pipe was installed and precisely levelled. When water levels reach the top of the pipe a vacuum tanker must empty the soak-away pit.



If a biogas piping system is laid up and down, condensation water can clog it. The pipe had to be re-done with a constant slope towards the digester so that condensation water flows back in the digester.



The gas produced by placentas and other organic waste started burning on the 21st of February 2020. The fixed installed pressure indicator will provide an overview on how much gas is available in the digesters.

6. Obligations of the hospital authorities

Plant grass and/or flowers to beautify the site.

Separate food residues from other waste (at source in different bins) and added into the digesters. observe the gas use with the help of the pressure indicator. If the suggested gas use method is adopted by the hospital personnel, the pressure should occasionally be below 70 cm water column (7 kilo Pascal or 7 kPa). If it is always at maximum (100 cm WC or 10 kPa), more gas use options must be identified.

7. Conclusion

The cooperation with MOCUBA turned out quite satisfactory. They accepted to pick up an experienced know how carrier into their team. It can be expected that the system will work satisfactory. It is likely, that there will not be enough gas use (too much gas produced) with the present gas use concept of having a double stove tea kitchen. The hospital needs to be reminded that they will have a reasonable source of energy free of charge to their disposal and they must identify means and ways to use that.

Regarding the wastewater produced at the hospital, **it is strongly advised that there is frequent control of leakages of unused water ending up in the sewer system.** This will save cost for the water and for the wastewater disposal.

8. Recommendation

The main recommendation at this stage refers to the tendering process of UNDP. This is now the second time (1. Mwanyamala; 2. Sinza), that the company selected did not have biogas experience. This is unfortunate and a serious hinderance of the workflow and loads quite some responsibility on the shoulders of the consultant. In both cases we could overcome this deficiency, but it would be better that the selection criteria for selecting a company are taken seriously.