

Waste to Energy

Biogas Production Utilizing Palm Oil Mill Effluent (POME) in Indonesia

*Sundar Bajgain
Senior Advisor, SNV*

Background

Palm oil mills are one of the most important agro-industries in Indonesia as Indonesia is one of the largest palm oil producers in the world. While processing palm oil, the mills discharge highly polluting waste-water, known as Palm Oil Mill Effluent (POME), which is generally discarded in open disposal ponds. POME is an oily wastewater generated by palm oil processing mills and consists of various suspended components. On average, for each ton of FFB (fresh fruit bunches) processed, a standard palm oil mill generates about 1 tonne of liquid waste with biochemical oxygen demand (BOD) 27 kg, chemical oxygen demand (COD) 62 kg, suspended solids (SS) 35 kg and oil and grease 6 kg. Since the POME is non-toxic by nature it is a good source of nutrients for microorganisms therefore, production of methane is highly potential.

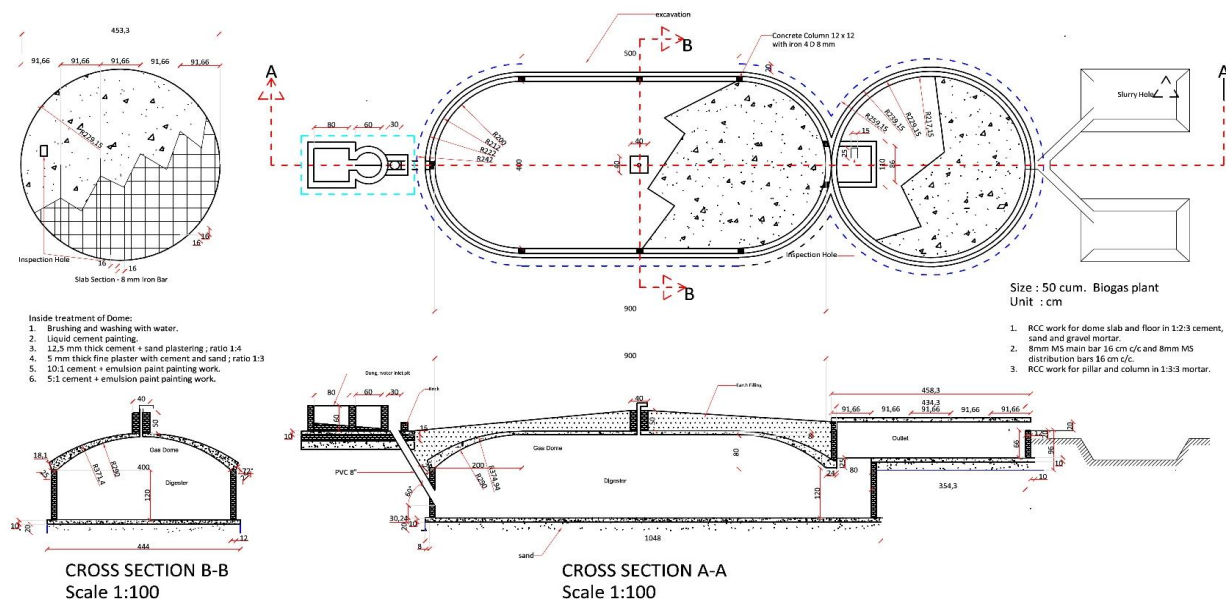
The POME in Indonesia is generally disposed in ponds at the mill premises in 3 stages. The first POME which is discharged directly from the mill has more solid contents with lots of oil and grease. Once it gets cold, it turns into sticky semi-solid material and does not easily mixed up with water. If we use the first fresh POME for biogas, it has a high chance that it gets sediment into the digester. Once POME comes to the first pond, it passes to a second pond through soil filtration in which the amount of solid contents and greases will be less. The POME from second pond further passes to third pond in the same process which has even less solid contents. The picture below shows 3 types of POME collected from the ponds.



Looking into the large potential of biogas from POME, a pilot digester was installed in Muaro Jambi of Sumatra at community centre to capture the methane from POME and convert into clean energy and fertilizer. The main objective of the pilot was to see whether sufficient gas is produced from the POME, whether community can manage the transportation of POME from the mills and extend of market response for scalability. For this purpose, a 50 m³ digester was designed and constructed. The distance from the biogas digester to the Palm Oil Mill is around 6 km and users manage transportation and storage of POME for regular feeding. The 3rd type of POME was available from a government owned mill called PTPN and used in the pilot biogas digester. 9 local masons were trained on biogas during the digester construction. About 5,500 USD was the cost for constructing a digester and training to the masons.

Digester design

A cylindrical concrete dome digester of 50 m³ capacity was designed and installed¹. The HRT was for 50 days and maximum gas pressure height was 110 cm. Biogas digester construction took 20 days slightly longer than our estimate because of continued rain and shortage of labors. During construction, users participated actively and understood the technique of digester construction, importance of leakage control, safety procedures and repair and maintenance techniques.



¹ The digester was designed by Mr. Prakash Ghimire, Senior RE Advisor of SNV for cattle dung which was slightly modified and adapted for POME digester.

Feeding

As at the initial stage large quantity of feeding material was required and some cattle dung was already available nearby, about 30% of initial feeding was from cattle dung. Rest of the feeding was from POME which was transported from the mill and fed into the digester in alternate days. 2 plastic tanks of 2,000 ltrs each along with a water pump were used to pump and transport POME from the mill as trucks regularly return empty from the mill while delivering palm fruits at the mill. Transported POME was stored at the digester site for regular feeding. The feeding rate was 15 ltrs per m³ without adding water. The average temperature at the construction site was 26⁰ Celsius.

Results

After initial feeding of POME, the gas production started in 10 days. Total 15 houses were connected through pipelines and gas was supplied particularly for cooking purpose. On average, each house use stove for 3 hours per day. As the rate of gas consumption by stove was about 325 ltrs per hour, the total gas consumed by 15 houses was about 14,600 ltrs per day. This indicates that 1 ltr of POME produces about 19.5 ltrs of biogas.

The slurry is almost liquid and not practical to make compost. Users are using slurry as liquid fertilizer for vegetable production, crop production and even plantation of palm trees. The effect of slurry on agriculture production is still to evaluate.

The local government officials are very happy with the results. The biogas users are highly satisfied as they have access to clean cooking fuel at home and high quality fertilizer for crop production. There is already a quite good demand of such digesters in surrounding communities.

Some photos related to the pilot digester





Challenges and lessons learned

Producing biogas from POME is not a very new concept but producing biogas by transporting POME from the mill and manage as a community biogas is a new. The palm mills are generally far away from the communities and is not feasible for supplying gas to the community if the digester is installed at mill premises. In this situation, the only possibility is to install large digester and produce electricity using POME.

As most parts of Indonesia is electrified and cooking fuel is main concern to the families, digester at community for cooking purpose is more important and beneficial. However, we have faced some challenges particularly on managing the digester:

- a. Initially Palm Mill owner were not willing to make available of POME for biogas. Purchasing POME and use for biogas will make it more expensive. Therefore, educating palm mill owners on the benefit of biogas utilizing POME was very important. SNV is

trying to overcome this problem jointly working with government and local organizations.

- b. Even if POME is available from the mill, transporting regularly to the digester site is also a challenge and costly for the community. As trucks regularly transport palm fruits to the mills and return empty, SNV has suggested the users to use those trucks for transporting POME.
- c. SNV has developed different operations models and suggested to the users applying them based on their choices. a) Digester operating committee can be formed among the users who is responsible for transporting POME and day to day operation. The committee members are trained on how to manage the digester. b) Alternatively, a private company or Palm Oil Cooperative can take the responsibility of digester management and charge a monthly fee to each household user for the services. In case there are many community digesters installed in the nearby areas, this can be a good business for a company.
- d. This can be a good business for the mill owners as well as they have freely available POME and can install biogas digester and sell gas or electricity to the community. In this case mill will manage the digester.

Conclusion

POME is very good source for producing biogas. The fresh POME discharged at first pound has high fiber as well as oil and grease and make higher potential for biogas production however, sedimentation at the bottom of digester and outlet can be a problem. As our digester has no agitation mechanism inside the digester, the second or third type of POME is suitable for the small digesters. Even mixing with some cattle dung together with POME is the best way for maximizing gas production. In case of using fresh POME, the retention time in the digester should be longer than 50 days.