

Business case: Biogas Production from Factory Waste

Support to Safety Retrofits and Environmental Upgrades in the Bangladeshi Ready-Made Garment (RMG) Sector

It is worth to install a biogas plant

RMG factories generate various types of waste through its operation. Some of the wastes could be good source to produce energy. RMG is a labour-intensive industry where huge numbers of workers are engaged in production process. To facilitate food support, many factories have their own cooking arrangement in their factory premises that generate good amount of kitchen waste every day. This kitchen waste is normally thrown in the nearby ditches or dumping ground. It is seen that, in almost all the cases, these are becoming breeding centre of flies and mosquitoes, spreading bad smell, creating health hazard. Sometimes, it is seen that the waste materials are covered with earth, which is extremely harmful to environment as it creates anaerobic condition for waste materials. In such cases, the organic waste is decomposed in an anaerobic condition and thus producing methane (CH₄), which is 21times more harmful than carbon dioxide. In most cases, there is no sewerage system in textile/RMG industries. Night-soil from septic tank is polluting sub-soil water. Trims of trees and grass are thrown indiscriminately. Textile waste are thrown or dumped in the same way. Biogas technology may be an effective tool for hygienic disposal of these waste materials. On the other hand, it gives clean gas for cooking and running engine. The effluent is valuable organic fertilizer. Biogas plant is considered as Effluent Treatment Plant (ETP) and hence exempted from environmental clearance.

Advantages of Biogas Technology:

- Gives gas, electricity and fertilizer
- Anaerobic process of biogas production kills pathogen and reduce disease
- Reduce GHG emission and improves environment
- Ensures hygienic disposal of waste
- Raw materials are locally available

In introducing biogas technology in textile/RMG industries some issues need to be considered. Different types of raw materials having different percentage of water content are used in a textile/RMG industry. For example, kitchen waste usually contains about 30% total solid, night soil contains 1% solid, textile waste contains 95% solid. But, to produce biogas, optimum total solid requires 8-10%. This has to be maintained by adding water or compromising with the optimum requirement.

¹BRTC China

²BRTC China

Approximate Investment Cost and Annual Savings (BDT)



Case study result from Dulal Brothers Ltd (DBL):

Dulal Brothers Limited (DBL) is one of the leading RMG group that leads many initiatives to reduce, reuse and recycle waste to increase productivity and profitability in business along with reducing carbon footprint to the environment to be sustainable. They have constructed a biogas plant of size 30m³ gas production per day using 30 kg kitchen waste and 400kg cow dung, at a cost of Tk. 675,000. More about their investment, savings and pay-back period is given in page 2.



Bio-slurry collection pit and vegetable garden using slurry

Construct biogas plant, harness energy, ensure hygienic management of waste

Biogas technology is an effective tool to transform waste into wealth by removing all harmful pathogens through process and reducing GHG emissions. The following table shows the results of multiple case studies from the RGM sector in Bangladesh:

Direct benefits:

Ensures hygienic management of generated waste	In most cases, the textile/RMG factories are located outside the coverage of municipality and there is no central body to look after. Waste is thrown in ditches and covered with earth which is detrimental to environment. These wastes can be converted to valuable energy by using biogas technology.
Reduce cooking cost	One of the major uses of Biogas is for burning and cooking purpose and thus reduces dependency on fuel wood and natural gas. Biogas also saves cooking time.
Effluent or slurry is valuable fertiliser	Effluent/slurry from biogas plant is valuable organic fertilizer which helps greening the industry area and reduces dependency on chemical fertilizer.

Indirect Benefits

Health	Waste materials generated in any industry contains harmful bacteria that cause disease. To produce biogas, these materials are to remain in an anaerobic condition for 30-40 days in biogas plant. As a result, all bacteria die eventually. Consequently, diseases reduced drastically. Thus, biogas technology works as an effective preventive measure for health.
Environment	Methane (CH ₄) is 21 times more harmful than CO ₂ for the environment. It is commonly seen that, textile/RMG factories are dumping their organic waste on earth for environmental reason but practically it helps anaerobic decomposition of waste that ultimately spread methane in the air. Introducing biogas technology is the best solution to address this environmental pollution.
Social	It is generally seen that, industries in Bangladesh are disposing their waste in open space creating odour which make local people dissatisfied and critical. Biogas solution of waste management will solve the issue permanently in a suitable way.

Some Other Rationale:

- Industry sector contributes ³35.15% in GDP in 2018-19 and deserves attention of all
- After Rana Plaza incident, safety and environmental issues are getting increasing attention in Bangladesh
- Waste management dictates environment
- Biogas technology is an effective tool for waste management

³Source: WHO

⁴Source: M/O Industry

Calculate payback period of a biogas plant:



Cattle shed at Jinnat Complex, DBL Group

Jinnat Complex, Kashimpur, Gazipur is a garment factory owned by DBL group. There is cooking arrangement for 200 staffs generating about 30 kg kitchen wastes every day. Within the factory, there is a dairy farm having 24 cows disposing about 500kg dung every day. To ensure hygienic disposal of kitchen waste and dung, they have constructed a biogas plant there in 2013 at a cost of Tk 675,000/-. Two burners consuming about 2m³/hr each are running for 8 hrs/day.

Cost of the plant		
Sl	Item	Cost (Tk)
1	Cost of the biogas plant	675,000
2	Pipeline	
3	Biogas stove	
Annual savings		
1	Biogas (25x15x365)	137,500
2	Bio-slurry	38,500
Total annual savings		176,000
Payback period		4.8 years
Annual maintenance cost		Negligible
Additional benefits		Environment
		Health
		Waste disposal



'Mita' floating dome model biogas plant

Case Study Spotlight: Jamia Islamia Obaidia Madrasha, Nanupur, Fatikchari, Chittagong.

Jamia Islamia Obaidia Madrasha, Nanupur, Fatikchari, Chittagong established in 1957. The initiative of building this institution was taken by some social activists with the aim to eradicate illiteracy from the poor dropout boys. It is also known as Nanupur Madrasha. At present, there are about 8,000 students, 200 teachers and 100 staffs residing in the Madrasha. To meet their cooking need, they were using 5 tons of fuel wood everyday costing around Tk 18,750/- i.e. Tk. 6,843,750/- annually. They are generating about 500 kg of kitchen waste that they used to dump in the nearby ditch. Which has been a breeding hotspot for flies and mosquitoes and causes health hazards as well as pollution to environment. There is a septic tank, but not adequate to accommodate faecal sludge of so many people. As a result, overflowing of faecal sludge was common. There is a dairy farm having 60 cows and buffaloes in the Madrasa which



are generating about 1000 kg dung every day.

Later Nanupur Madrasha came to know that, there were many madrashas nearby of its locality which had biogas plants where night soil and kitchen waste were being used to produce energy. Good to note that in almost all the Rohingya refugee camps in Cox's Bazar district, they are using biogas technology as a means of waste management.

Following examples of others, Nanupur Madrasa has constructed a biogas plant in early 2019. The size of the biogas plant is ideal to produce 520m³ gas per day by using both night soil and kitchen waste as raw materials. Size of digester is 14m diameter and 8



8 meter in height. Total investment was Tk 9,000,000/-.

Biogas digester

Gas is used for cooking and the effluent is used as valuable organic fertilizer. Due to use of biogas, their daily fuel wood use reduced to 85 tons/day and thus cost came down to Tk.12,750/day i.e. Tk 4,653,750/Year. Their annual fuel cost saving is Tk. 2,190,000/year. Thus, the total investment is coming back in five years (Source: Nanupur Madrasha).

For the biogas plant, O & M cost is almost nil. The effluent is used as organic fertilizer in the vegetable garden within the compound of 50 acres of land of the madrasa.



Biogas burner

Environmental Impact of the biogas plant:

After construction of the biogas plant, overflowing of faecal sludge is stopped and no odour generates around the environment. All organic kitchen waste is now going to biogas plant as raw materials and remains in anaerobic condition for 30 days to produce gas instead of spreading odour and germinating pathogenic bacteria there. Thus, both health and environmental condition has been improved drastically.



Cooking with biogas at Nanupur Madrasha

Overcoming social barrier:

The total cost of the plant including digester, inlet, hydraulic chamber, pipeline, burner etc is Tk 9.00 million. 10 big size gas burners of size 2.2m³ gas/hours are running for about 8 hours. Due to use of biogas their fuel consumption came Down drastically. In addition, huge quantity of bio-slurry is collected and used in the vegetable garden as organic manure directly in the field. Staffs and students of the madrasa eventually welcome this initiative after realising the real benefits of the plant though they

have a reservation at the beginning about night soil-based biogas as cooking fuel. After completion of the plant, they have experienced no odour, gas is similar to natural gas, and they gladly accepted the technology. It may be stated here that, the first night-soil based biogas plant was constructed in Bangladesh in Faridpur Muslim Mission. Seeing its success, there are now more than one hundred night-soil based biogas plants in the country. Specifically, in greater Chittagong, there are a good number of night-soil based biogas plants. So, the technology is known in the surrounding. This helps to overcome psychological and social the barrier.

References for sustainable energy and environmental issues in Bangladesh

In Rio Earth Summit 1992, the world leaders stressed on environmental issues. Responding to the call, Government of Bangladesh passed Environment Act 1995, keeping provision for environmental clearance for the establishment of industries. Garment industries are taking several steps for the improvement of their environment. Yet, there are scopes for further improvement. For example, on 25th January 2020, GIZ team visited one garment industry in Mymensingh district and have seen that they are generating about 800kg food waste, 200kg kitchen waste, 400 kg cattle dung, 1200kg cotton waste and some other wastes. They are using the dung as fertilizer and the rest are dumped in the vacant land creating health hazard. Realizing the environmental issues, the industry owner has taken decision to construct a biogas plant there. This is common in all garment industries. At present there are about 4,500 garment industries in Bangladesh, but biogas solution like Dulal Brothers Limited is rare. Realizing multiple benefits of biogas technology, Sustainable and Renewable Energy Development Authority (SREDA) recently prepared 'National Guideline on Biogas Technology' and has taken several steps for promoting biogas technology.

Key Steps Required for Implementation

In Bangladesh, there is no industry without waste. These wastes are thrown in the nearby ditch, pond or some low land causing hazard to the environment, which is highly discouraged by the international buyers. Factory owners also do not want to see this happen. If they can be made aware about biogas solution, they may show interest. This needs mass awareness among them. If they can be made aware about biogas solution, they can follow the following steps:

- Identify the sources of waste and their quantity
- Find out a suitable agency for providing technical support
- Construct a biogas plant like DBL
- Use gas and fertilizer eliminating odour

In general, it may take about 3-4 month to build a biogas plant after placing an official request/order including designing, raw material sourcing, plant making an commissioning. Timeline may vary subject to size or location of the biogas plant to be made.

Availability of Materials in Bangladesh

Raw materials of biogas i.e. faecal sludge, kitchen waste, cotton waste, cattle dung/poultry litter etc are locally available. Technology is simple, known and locally available. There are good numbers of trained technicians in the country. Since 1972 about 135,000 biogas plants have been built in the country. There is growing interest among the common people towards biogas technology.

Possible Sources for Financing

SREUP credit line could be a good source of financing for such an investment.

Main Feature of SREUP Credit Line	
Loan Type	Normally Term Loan
Discount	Provision and possibility of 20% discount from loaned amount
Loan Tenure	3-5 years in general and in special case up to 7 years
Loan Limit	Normally up to 1 Million Euro and can be increased up to 3 Million Euro in special cases
Interest Rate	7% p.a. (maximum)
Grace period. Debt: Equity Ratio. Repayment	All issues are subject to agreement between borrower and lender

Conclusion:

Biogas technology deserves attention of all. Climate of Bangladesh is suitable for biogas production. Potential is huge. All hazardous wastes are the raw materials of biogas. It has multiple benefits. It gives gas for cooking, lighting, running engines etc. The effluent is valuable organic fertilizer and essential for soil health. Anaerobic process of biogas production kills harmful bacteria and thus acts as an effective preventive measure for health. It drastically reduces greenhouse gas emission, environment pollution and gives ideal solution of waste disposal. In an industrial unit, it acts as ETP.



Waste disposal polluting environment



Using wood for cooking helping deforestation

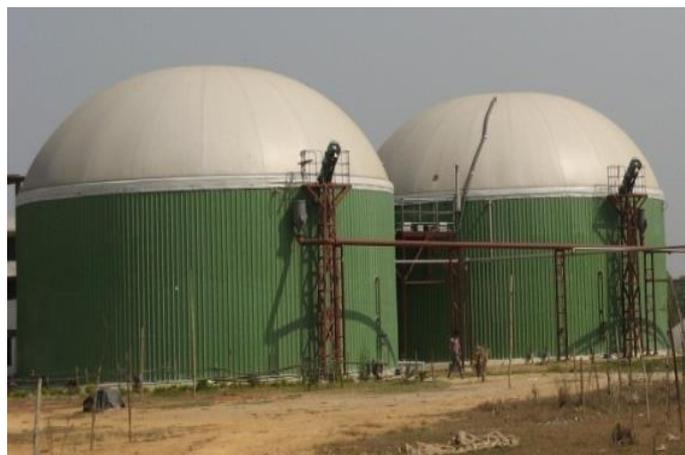
Issues need to be resolved:

Organic matters like cattle dung, poultry litter, kitchen waste, faecal waste, city waste, agriculture waste, industrial waste etc if are decomposed in an anaerobic condition, that produces biogas. Experiment shows that, optimum gas production is seen, when carbon and nitrogen ratio (C/N ratio) of the raw materials is around 25, temperature inside the gas digester is 38°C and total solid content is 8%. In a garment industry, generally four types of waste are available i.e. faecal waste, kitchen waste, cattle dung and cotton waste. C/N ratio of faecal waste is around 6, kitchen waste is 19 and cattle dung is 25. C/N ratio of cotton waste varies. Normally, temperature in Bangladesh varies from 6°C to 40°C, but inside temperature of a biogas plant varies from 20°C to 30°C. Optimum temperature is 38 degree which can be achieved by artificial means. May be by using waste heat. To maintain optimum temperature, need additional cost. For a domestic or medium size biogas plant, it is not economically viable. Usually Total solid (TS) of cattle dung is 18% and that of kitchen waste is 30%. To achieve required TS water is mixed. In case of faecal waste, TS is 18%. During clinching, additional water needs to be mixed and it depends on the clinching method. Someone is using pot and some are using cistern. When pot is used, TS come down to 2%. Yet gas is generated, but at low rate. But, when flushing cistern is used, TS become less than 1% and in that case gas production is completely stopped. In DBL, they are using flushing cistern, so, there is no scope of introducing biogas technology. In Nanupur Madrasha, they are using pot for clinching. Moreover, use of cattle dung and kitchen waste without mixing water improved TS to a great extent. It is seen that, under normal condition 0.04 m³ biogas can be produced from 1 kg cattle dung and 0.05 m³ biogas can produced from 1 kg kitchen waste.

Raw materials	Normal Temperature (°C)	TS (%)	C/N ratio	Gas production (m ³)/kg
Cattle dung	25-30	18	25	0.04
Kitchen waste	25-30	30	19	0.05
Human excreta	25-30	20	4	0.04



Commercial use of biogas at Daikundi



Biogas plant in Mymensingh running 260KW generator



Waste creating health hazard



Clean cooking with biogas