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# Biogas Generation Potential from Textile Wastewater: Aggregation Analysis of Hundred Textile Facilities in Greater Dhaka Bangladesh

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**Abstract:** ***The intended mandate of this study was to highlight the untapped potential source of renewable energy and the associated lost economy. In this context this paper reports on a theoretical evaluation conducted to ascertain the potential of electricity generation from anaerobic wastewater stabilization from textile wastewater generated from textile processing facilities of 100 factories clustered around Dhaka city the capital of Bangladesh. The total energy generation capacity from the 100 factories by anaerobic stabilization of their wastewater would be 185538 KWh per day or a power generation capacity of 7.7 mega watts. In terms of monitory value this amounts to lost revenue of Taka 512 million or US dollars 6.6 million per year. This is a substantial energy and revenue source that is literally wasted down the drain and should be harnessed.***

**Keywords:** Anaerobic treatment, Textile wastewater, Renewable energy

## 1. Introduction

Bangladesh with its sustained economic growth of above 6.5% GDP per annum [1] requires sustainable energy. One of the main draw back to the growth potential of Bangladesh is the shortage of energy and power supply interruption due to an aging inefficient distribution system. Bangladesh currently imports electricity from India and has plans to import from Nepal and Bhutan too [2], [3], [4]. In this context in our study we are looking at the potential of anaerobic wastewater treatment of textile processing wastewater to generate methane as the source of renewable energy. In anaerobic treatment organic substances present in wastewater are converted to methane and carbon dioxide. The process is microbial mediated where wastewater is treated in an anoxic condition and at the same time produce off gas which is methane rich which then can be used as a fuel for energy production. Figure 1 below summarizes the process of anaerobic waste stabilization by bacteria to produce methane gas [5]-[7].

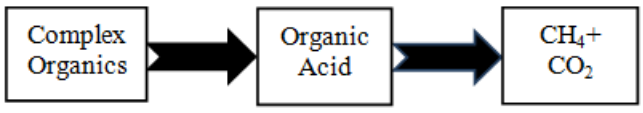


**Figure 1:** A simplified diagram showing the steps involved in the microbial conversion of organics found in wastewater to methane gas [6].

In this paper, we are reporting on a theoretical evaluation conducted to ascertain the potential of electricity generation from anaerobic wastewater stabilization from one hundred textile processing facilities clustered around Dhaka city. The study was based on published data regarding the characterization of the wastewater with respect to waste strength, we than looked at the waste strength of the wastewater and converted it into the methane generating based on theoretical conversion of microbial conversion of organics to methane gas; conversion of methane to energy, and relating it to monetary terms. The overall objective of this study is to highlight a potential source of untapped renewable energy and its lost economy.

## 2. Background

To be energy sufficient it is forecasted that Bangladesh needs to triple its electricity production 2030 to meet the energy demand [2], [3]. The textile sector is one of the major contributors of the economic growth of Bangladesh. Textile industries generally account for 18% of the GDP [4]. The main hub of textile industries is Dhaka and Chittagong. Majority of the factories are clustered around the capital city of Dhaka [4]. The textile industry is also a major consumer of power and water. To supply the need for energy the Government of Bangladesh is welcoming initiatives to harness energy from renewable sources.

## 3. Methods

We conducted a survey of published documents to obtain data to conduct a data aggregation analysis of potential electricity generation from textile processing wastewater from 100 textile processing plants in greater Dhaka city in Bangladesh where majority of the textile processing facilities are located in Bangladesh. From the secondary data, we have collected chemical oxygen demand (COD) value for one hundred textile mills [8]-[14]. To obtain the COD loading per day we obtained the published wastewater generation rates from twelve factories and took their mean as the value ($9622m^3$/day) for calculating the daily wastewater COD loading [8]-[14]. Another assumption in calculating the theoretical methane production was that complete COD conversion of the specific wastewaters was possible. The methane production was based on 5.62 standard cubic feet (scf) at Standard Temperature and Pressure (STP) of methane production per pound of COD converted. The value for relating methane to electrical energy in KWh was 0.29 KWh per scf of methane combusted. We took the reported per capita consumption of electricity of 5 Kwh /day [5]-[7] to correlate electricity generated to the need for the population. To quantify the potential energy production we took the Bangladesh Government rated industrial unit costs of energy as 7.66 Taka/KWh.

The data aggregation analysis for COD, methane generation potential, energy and electricity generation potential calculations and trend analysis were done using MS Excel spreadsheet. The values were plotted in the respective graphs against serial number.

## 4. Results and Discussion

The intended mandate of this study was to highlight the untapped potential source of renewable energy and the associated lost economy. The concept of waste to energy generation is not novel and yet is underutilized. In the context of Bangladesh waste to energy generation is limited to agricultural application where waste cow dung is digested at household level to generate methane. Nothing has been done at the industrial level and the concept of generating methane from wastewater rich in organics is novel. In this context this paper reports on a theoretical evaluation conducted to ascertain the potential of electricity generation from anaerobic wastewater stabilization from textile wastewater generated from textile processing facilities based on wastewater characterization of 100 factories clustered around Dhaka city the capital of Bangladesh [8-14]. Figure 2 shows the distribution of the chemical oxygen demand of the different wastewater. The COD value ranged from the highest of 2518 mg/L to a low value of 120 mg/L, with the average COD value of 833 mg/L. The corresponding methane generation capacity from stabilization of the wastewater using anaerobic process is illustrated in Figure 3. The highest methane generation capacity of a individual industry from anaerobic treatment of the wastewater 19351 and the lowest 922 scf/day at STP with the average methane generation potential of 6398 scf/day at STP. Figure 4 the graph of potential electric energy generation shows that at a minimum of the hundred factories surveyed. This would correspond to a potentially highest energy generation capacity by a textile processing factory of 5612 KWh/day and lowest value of 267 KWh/day, with an average potential energy generation value of 1855 KWh/day (Refer to Figure 4).

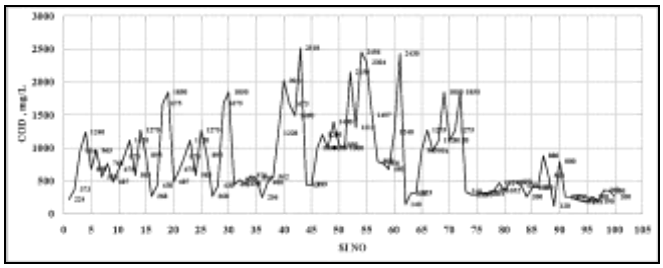

**Figure 2:** Distribution of chemical oxygen demand (COD) of the wastewaters for the hundred textile processing wastewaters.

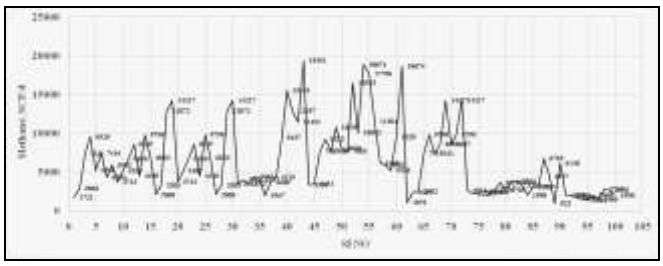

**Figure 3:** Potential methane generation capacities of the hundred textile processing facilities from its wastewaters being stabilized using anaerobic treatment process.

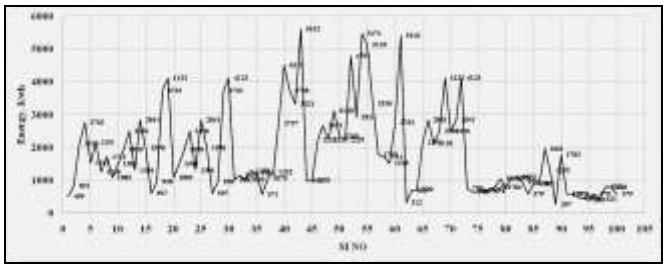

**Figure 4:** Corresponding energy generation capacity from the generated methane gases the hundred textile processing facilities from its wastewaters using anaerobic treatment process.

The total energy generation capacity from the 100 factories by anaerobic stabilization of their wastewater would be 185538 KWh per day or a power generation capacity of 7.7 mega watts. This would meet the daily demand of 37,000 people of Bangladesh or provide sufficient energy to power a very large textile processing industry of Bangladesh. In terms of monitory value at the industrial electrical energy rate of the Government of Bangladesh this amounts to lost revenue of Taka 512 million or US dollars 6.6 million. This is a substantial energy and revenue source that is being literally wasted down the drain and can be easily harnessed.

## 5. Conclusion

The data aggregation analysis of potential electricity generation from textile processing wastewater from 100 textile processing plants in greater Dhaka city in Bangladesh showed clearly that anaerobic treatment of the wastewater has a substantial methane generation potential which can then be converted to electrical energy as a source of renewable energy. The energy production from this source is substantial in terms of the economy of scale and should be utilized.

## 6. Future Scope

The paper is limited to theoretical assessment and needs to be expanded to actual bench scale or pilot studies to ascertain the biological methane potential.

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