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DEVELOPING INTEGRATED MALAPRABHA DIGESTER FOR MANAGEMENT OF KITCHEN WASTE AND HUMAN EXCRETA

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ABSTRACT

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos.[1] Well-researched domains of object detection include face detection and pedestrian detection. Object detection has applications in many areas of computer vision, including image retrieval and video surveillance.

Keywords - *yolo (You Only Look Once) , DPM(deformable parts models)*

INTRODUCTION:

Malaprabha digester is one of the component in Decentralized Onsite Waste Management system (DOSIWAM) developed by Padmashree late Dr. S. V. Mapuskar first successfully implemented in 1980 in Dehu village in Pune. Malaprabha Digester technology basically is a ‘toilet – linked biogas plant’ where human excreta are converted to biogas in a specially designed digester chambers. It has 3 chambers, the first chamber having Hydraulic Retention Time (HRT) of 30 days, and the rest two having together of 15 days of HRT. These final calculations have been estimated by research and development on many systems installed by Dr. Mapuskar. The HRT of the first chamber is high as compared to the other two as the gas from first chamber is only trapped for reuse. There is negligible amount of gas generation from the other two compartments, which escapes to the atmosphere. The effluent, after treatment, is discharged into the drainage system. *Salmonella typhii*, a pathogen found in night soil is the most harmful and having longest life span. It can survive for 6 weeks in anaerobic conditions. Thus, to ensure the pathogen free effluent, Hydraulic Retention Time (HRT) for the whole plant is 45 days.

The conventional Malaprabha digester was adopted for human excreta or human night soil. It was said by Dr. S. V. Mapuskar that Malaprabha system, with a little modification, can also be used for other feeds. In this project integration of kitchen waste and human excreta was adopted by using modified Malaprabha digester. A small scale model of Malaprabha digester was prepared considering all the standard design aspects. Leftover food, fruits peels along with human excreta was added daily in the model. As the part of the project study flaring time of biogas and reduction in outlet parameters like BOD, COD, TS, TDS, TSS after anaerobic digestion of kitchen and human excreta is studied.

DESIGN OF MODEL

Model was designed considering generation rate of kitchen waste and excreta of a single person. Acrylic material was used as its non-corrosive, strong and transparent. It has three compartments having total hydraulic retention time as 45 days. Model was prepared by a local craftsmen. Dimensions of model is shown below.

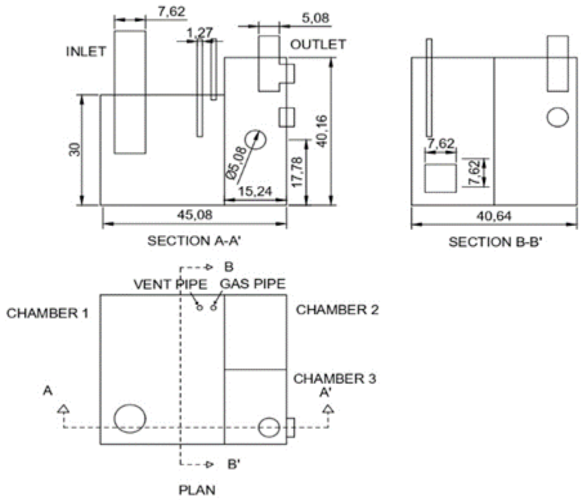

Fig-1: Plan and section of model (all dimensions are in cm)

Fig-2: Front view of model

EXPERIMENTAL WORK

Malaprabha digester was designed to run on human excreta and kitchen waste. Human excreta was collected at house and fed in the model manually. Kitchen waste was also collected at house as leftover food like rice, bread, potato, nuts, peels of vegetables and fruits etc. For proper digestion of integrated sample, kitchen waste was grinded before feeding in the model. Grinding helped to decrease size of kitchen waste and thus microorganisms got more surface area to act on. 0.1-0.2 kg of human waste and

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0.1-0.2 kg of kitchen waste was fed in the model every day. Following parameters were checked for the Influent and Effluent sample for Malaprabha digester model.

1. pH
2. Temperature
3. Chemical oxygen demand
4. Biochemical oxygen demand
5. Total solids
6. Total dissolved solids
7. Total suspended solids
8. Ignition of biogas

A plastic pipe with heat resistive ON-OFF knob was fixed to the gas pipe of the model. Gas was burn with the help of burning candle. Gas was allow to burn till it get completely finished from the model.

Fig-3 Burning of biogas

RESULT AND DISCUSSION

Samples from inlet and outlet from the Malaprabha model were analyzed for pH, temperature, BOD, COD, TS, TDS and TSS. Biogas was observed at 10th day from the first feeding. Gas was burnt at alternate day and time of flaring was measured. Following is the analysis and statistical representation of the performed experiments.

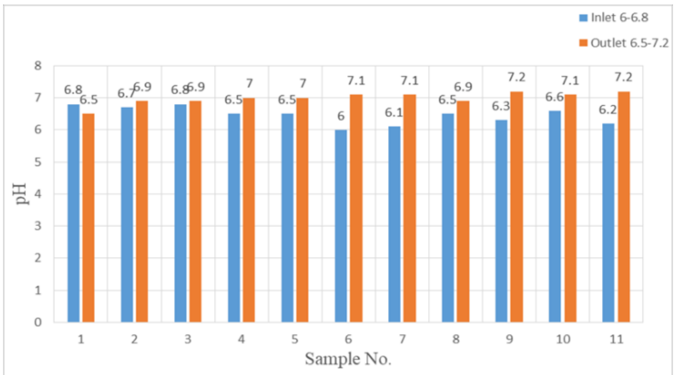

Chart-1: pH results from inlet and outlet samples

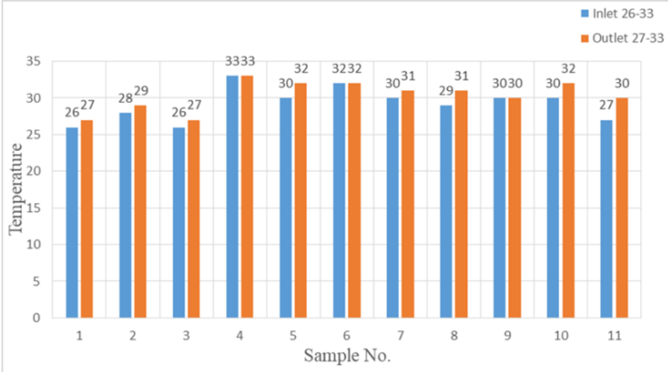

Chart-2: Temperature results from inlet and outlet samples

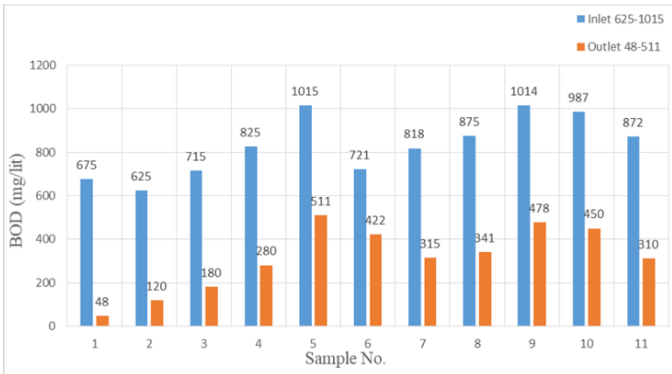

Chart-3: BOD results from inlet and outlet samples

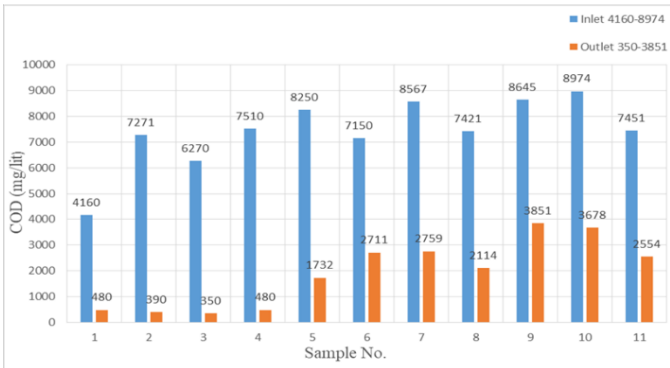

Chart-4: COD results from inlet and outlet samples

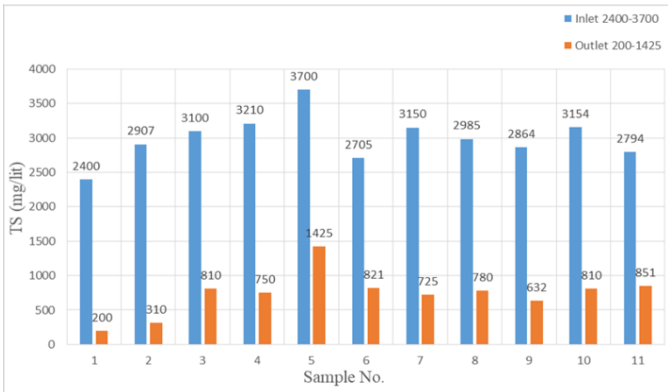

Chart-5: TS results from inlet and outlet samples

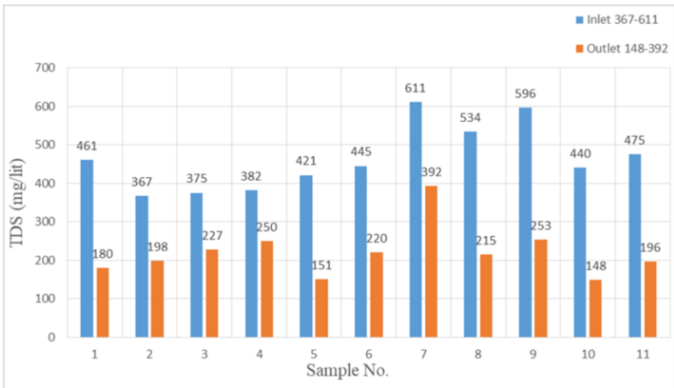

Chart-6: TDS results from inlet and outlet samples

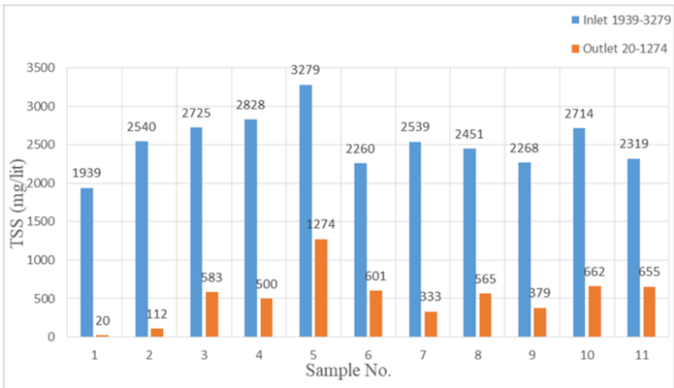

Chart-1: TSS results from inlet and outlet samples

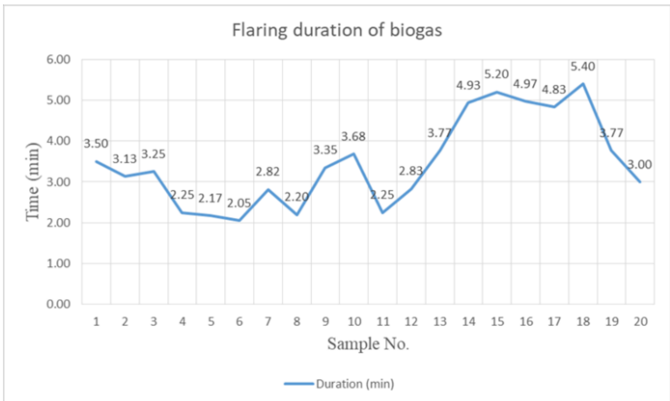

Chart-8: Flaring duration of biogas (1-20)

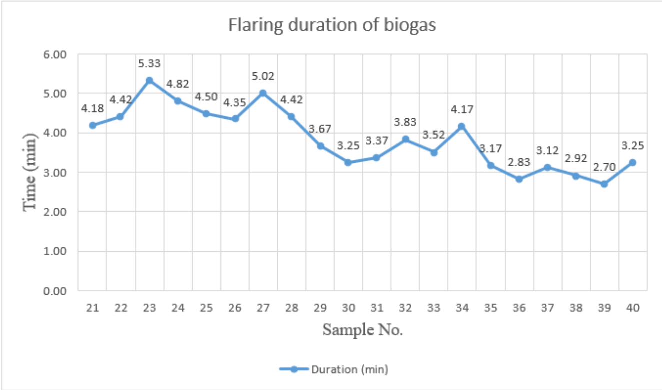

Chart-9: Flaring duration of biogas (21-40)

COST ESTIMATION OF THE PROJECT

Following calculations are done considering the digester is constructed in a building of 40 so total families each having a population of 5 people per family, 200 users. For the calculation purpose it is assumed that 30 liters of water will be used for flushing by each person. Therefore, volume of the tank required will be 200×30×45 = 270000 liters of digester volume excluding storage space for gas etc. will be required. By considering space for gas accumulation and the space taken by organic waste, design value for the volume of system required is taken as 294 cubic meter. Volume of 1st chamber is taken as 10 m x14 m x1.5 meter Volume of 2nd and 3rd chamber is equal and taken as 4.95 m x 7 m x 1.5 meter. The plan and section view of such a system is shown below.

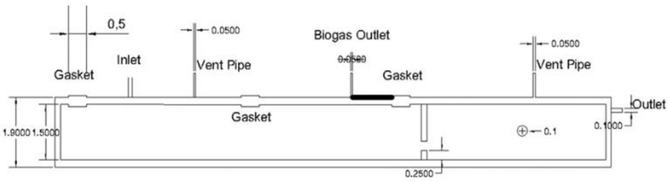

Fig-4: Section

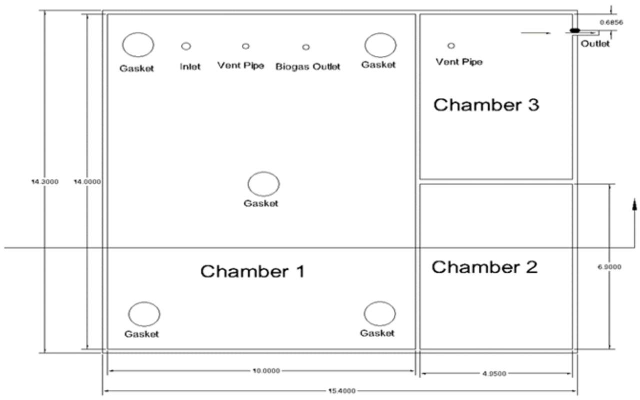

Fig-5: Plan

The gaskets for the purpose of removal of scum are provided at 4 corners and one at middle for ease of removal of scum. The overall length and breadth of the tank will be taken 15.4 meter and 14 meters respectively. Height of the tank is taken as 1.9 meter. Construction cost of this size of a tank will be approximately equal to Rs.36, 00,000, that is Rs.18000 per user for a life time of energy and their waste management with little to no maintenance. However, since we are planning to construct it in prefabrication, the cost of construction will decrease by a significant amount. (Based on rough estimate, it will be around Rs. 20 lakhs) Also, it will lead to saving of 4.3 gas cylinders per family per year, which would mean saving of 172 cylinders for the whole building per year. Also, the generated stabilized faucal sludge can be sold in the market as economical and nutritious manure for farmers.

CONCLUSION

From the above results feeding 200 gm kitchen waste and 200 gm human excreta, we were able produce 5.4 minutes of combustible gas. If this analogy is to be applied to a family of 5, we would be able to produce approx. 30 minutes of cooking time using biogas. It was observed that there is reduction in BOD, COD, TS, TDS and TSS levels. Reduction of about 42 % to 93 % in BOD, 56 % to 94 % in COD, 61 % to 91 % in TS, 35 % to 64% in TDS and 61 % to 98 % in TSS was observed.

Anaerobic process is very much dependent upon temperature variation and pH. An optimum pH is necessary i.e. about 6.5-7.5. Regular monitoring of various parameters is required to get best results. Integration of kitchen waste and human excreta in anaerobic digester can produce some amount of scum layer if implemented in large scale. Such problem can be solved with the help of gaskets. If this project if used on actual ground, can help to reduce the pollution parameters to great extent and this can be economical method which will be used to treat human excreta and kitchen waste. Construction cost a brick masonry tank for 200 people will be approximately equal to Rs.36, 00,000. If non-conventional construction material like ferro-cement is used, then cost will be reduced by 50 %. Outlet slurry can be used as excellent manure.

FUTURE SCOPE

1. Further optimization in model to reduce size and cost.
2. Design of technology for mounted shredding machine so that municipal biodegradable waste can be added to the tank.
3. Proper disposal of the outlet slurry
4. Further cost reduction by adopting non-conventional construction materials like ferro-cement, precast cement etc.
5. Detailed gas measurement studies so that provision can be made to store excess gas.

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