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A PILOT PLANT FOR THE BIOGAS PRODUCTION

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ABSTRACT

Manure and Putreseible garbages are some of the main sources of Pathogenic germs in countrisides. On the other hand demand for fertiliser and energy increases in rural areas every day. To study Potential of cow manure for these requirements a 16,5m^3pilot plant was designed and constructed as fermentation tank near animal husbandary of Agriculture Faculty of Karj. Some 260kg cow manure and water with the ratio of 4 and 7 was fed to fermentation tank every day. Average daily biogas production was 3.4m^3. Which was burned successfuly in a gas range. Gas Production was reduced by 86% during coldest Winter days.

Desing for control of gas pressure and reservation of

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excessive gas was suceeessful. Concentration of nitrate in sludge increased by 1.6 fold comparing with row material. Some bacteria and Parasites were reduced drasticaly.

INTRODUCTION

Decay of dead animals and plants is the natures disposing method of waste material. This may be accomplished under controled conditions of aerobic or anaerobic organisms. When anaerobic decomposition takes place two main gases-eg methane and carbon-dioxide and some other minor gases are released, and undigested matters leftout as residue. Environmental factors aleviating the processes. include, Mixing, PH, Temperature C/N Ratio and etc. such factors must be matched to an anerobic digestion Process. Van Helmont in 1630 analysed biogas and determined methans and fifteen other gases (1). Shirley in 1667 discovered marsh gas(1).However, generation of bio gas is attributed to Volta in 1776. According to Van Brakel, Plinius was one of the pioneer who used earth gas for lights and flames (7). Gayon who was louis Pasteur's student had generated 100 liters of methane gas from one cubic meter of manure in 1884 (1).

Since then bio gas had attracted people in England, Italy, France, Germany and many other countries.

In 1939 more than 22000 vehicles were using bio gas as fuel in Germany. This number was increased by four fold during World War II (5).

A Pilot Plant for producing of bio gas was started

by Sathianathan in India in 1925 (3).

Seven millions of such plants were estabilished in China during a decade, starting from 1972 (1). Special interests have been paid to this matter in South Korea, Phillipines, Thailand Nepal and many Latin American countries during recent years.

The famous Sheikh Bahai's Public Bath in Esfahan,have been warming up since 1507 until the beginning of this century by methane gas generated probably from sewage pits or from marshes near the bath (4).

However the Purpose of this study is to answer the following questions.

1- How is the simplest way to constract a Biogas plant with horizontal mixer and natural insulation of digestertank.
2- How is the gas production and Health aspect of output slurry.

MATERIALS AND METHODS

A fermentation system was constructed in Karaj near animal husbandry of school of Agriculture (fig 1). In the system, a 16.5 m^3 fermentation tank, a floating gas resergoir and an inlet and outlet for raw and fermented materials was included respectively. Other accessories were thermometer and a wet-test-meter for gas measurement.

As can be seen from the figure 1, the gas reservoir has a floating lid which moves up and down according to the amount of gas production. This movement took place

inside a deep slot provided around the main tank and filled with thick oil to prevent any gas leakage into atmosphere.

It is very beneficial to stir the contents of digester, because it increases the gas production, break up the Scum layer on the surface and brings the organisms in centact with the food supply (6) .

The speciality of this system is the design of its mixture, The mixture was designed for horizontal rotation and mixing the introduced materials without upsetting the biological processes (fig. 3).

To minimize the effects of ambient temperature, the whole system was accomodated in a pit, and insulated with straws filled in annular space between earth and thank (fig.2).

Material that was used for decomposition was cow manure,the system started with 4736 kgs fresh manure mixed with 8325 liters of water. After three weeks, when disign of bio gas production was observed, 260 kgs of manure and water was added daily. infact, Moisture content of slurry is one of the most important Parameters for Biogas production, so that cow Dung should bc first equally mixed with water according to ref. No.(2). But in this experiment the ratio of manure to water was 4/7.

A fifty day retention time was maintained in the system through-out the opperation. The minimum temperature was 11^{oC} in winter which was quite good comparing with karaj outdoor temperature which reaches down to-20^{oC}.

RESULTS AND DISCUSSION

The special Horizontal stirrer breaks up the scum layer and Mix the materials Homogeneously, so that a good environmental condition for Bacteria was stablished.

The rate of gas generation was measured by wet-test-meter ranged 893 to 6572 liters per day.

However, the yearly average gas production was 3.4 cum per day. This amount was produced from fermantation of 100 kilograms of cow manure.

Generated gas was burned satisfactorily in a water heater and a gas range.

Chemical and biliogical characterisitics of raw and digested materials are given in tables 1 and 2. which shows some reduction in bacterial counts.

During this experiment feasibility of the method in cold weather, the efficiency of the special type Mixer and characteristics of sludge was examined.

Gas generation was continued in the coldest days of winter but the amount was reduced by 86% Considering more gas requirement during winter which means that a more efficient insulation should be administered for maintaining suitable temperature inside the tank.

Mixing was good both for breaking the thick scum of surface layer and mixing of raw materials.

As can be seen from table 1 the amount of nitrate which is an essential nutriant for the growth of plants is increased from 1.79 to 2.71 but remarkable reduction

was observed in BOD[1]. COD[2] SS[3], VSS[4], and TSS[5].Although colony count showed a relevent reduction of organisms but the number was still high in outlet samples.

In conclusion the system can be recommended for areas that supply of natural gas is either unpractical or uneconamical. However, better insulation and longer retention time may be needed for better elimination of microorganisms.

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1- Biological Oxygene Demand
2- Chemical Oxygen Demand
3- Suspended Solid
4- Volatile Suspended Solid
5- Total Suspended Solid

Table 1: Chemical analysis of materials at inlet and outlet of Bio-gas generator.

Matter	Inlet	Out-let
PH	6.8	5.1
BOD mg/l	31360	19800
COD mg/l	44800	27860
SS mg/l	73950	62000
V.SS	47900	35000
TSS	77654	67522
No_3-N	1.79	2.71

Table 2: Bacteria and parasites in inlet and outlet samples.

Organisms	Inlet		Outlet	
	1 st	2 nd	1 st	2 nd
Total colony counts	$1x10^6$	$1x10^3$	$1x8^5$	$1x10^4$
Candidium Albicans	+	Absent	-	Absent
E-Coli	+	+	+	+
Bacilus Aerrobactor	+	Absent	+	Absent
Animal Ascaris	+	Absent	-	Absent
Bacillus subtilis	+	Absent	-	Absent
Proteus vulgaris	+	+	+	+

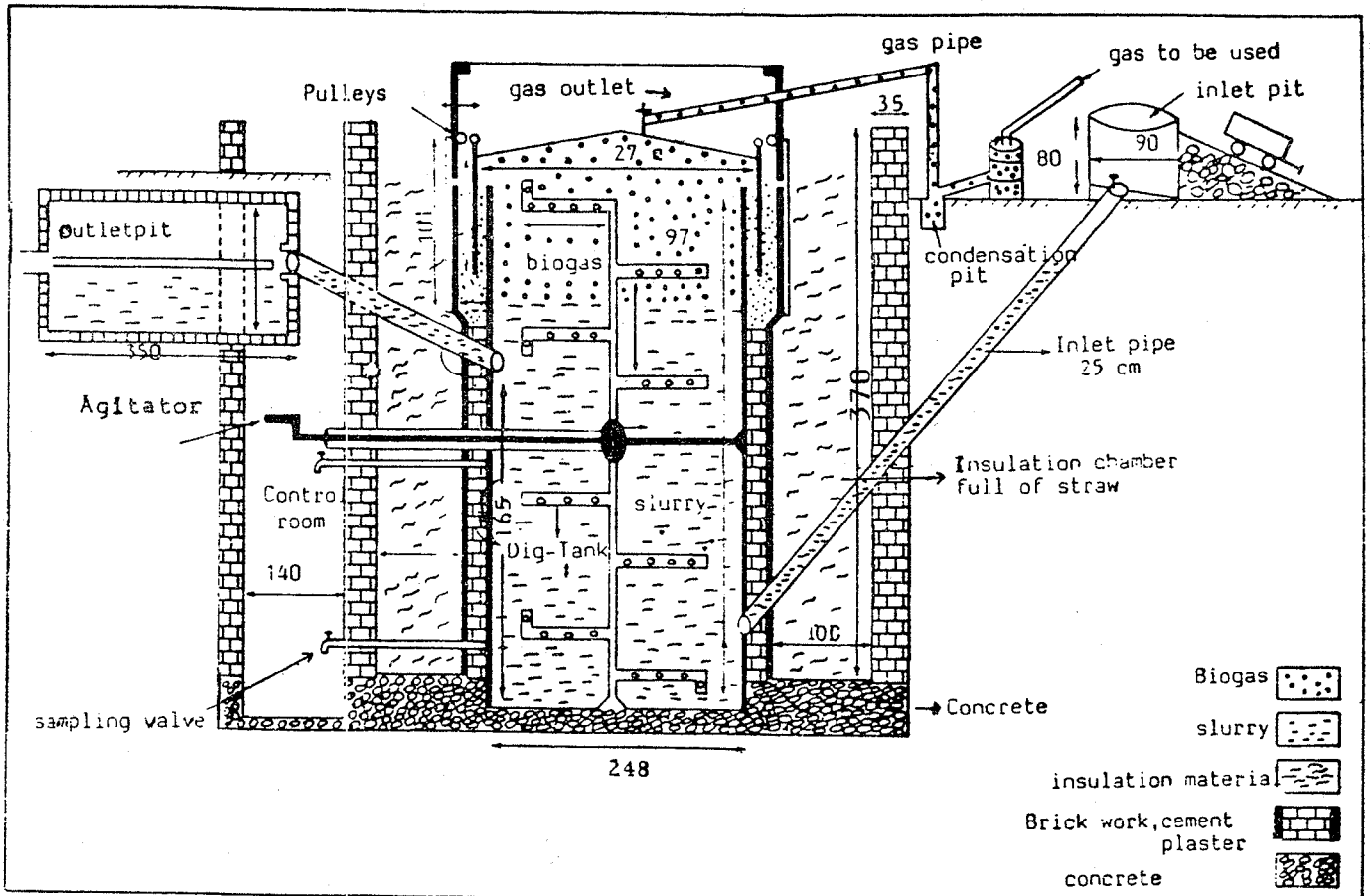

Fig. 1. General Construction of Biogas Plant of Karaj , Dimension in cm . Supported by Jahad-e-Daneshgahi

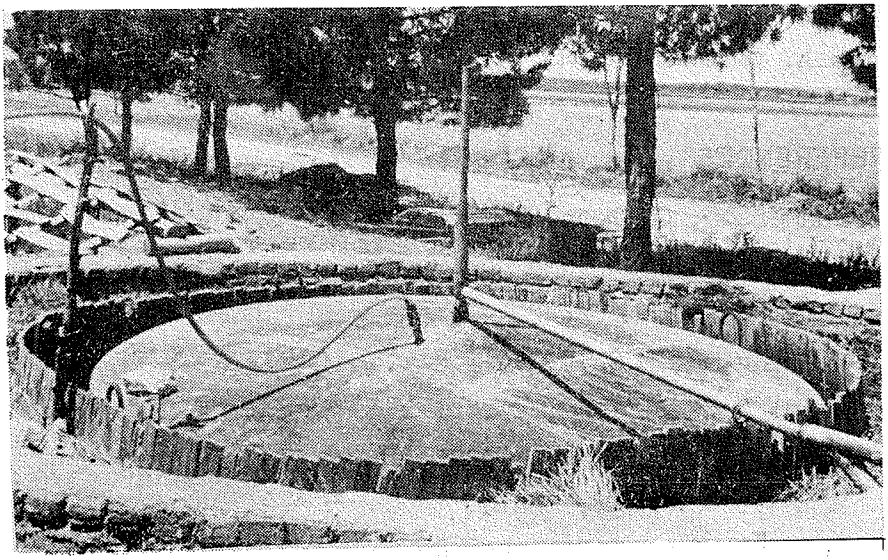

Fig 2:Bio gas plant with floating gas Holder and insulating space.

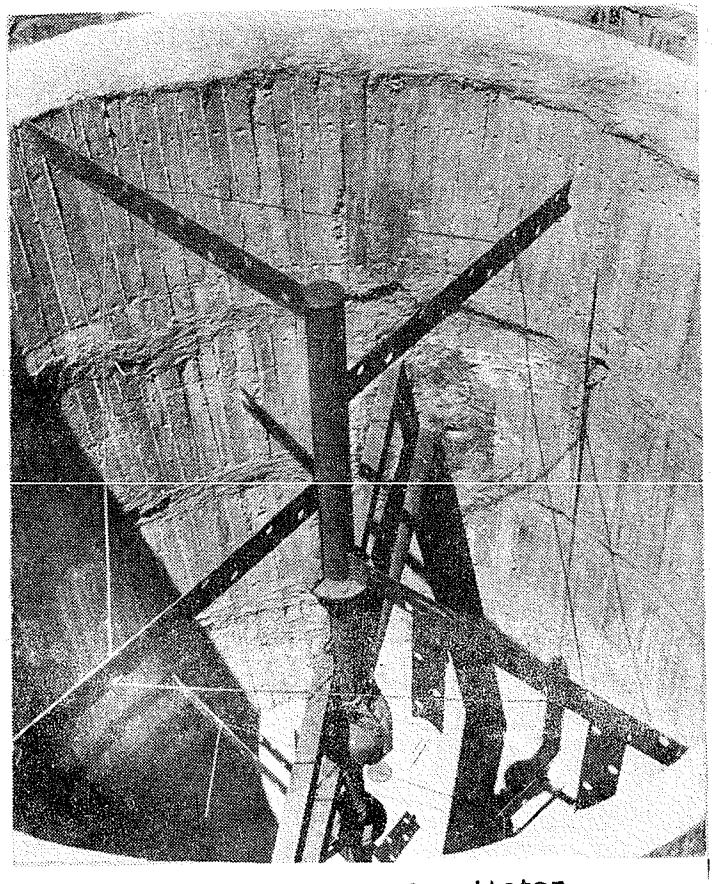

Fig 3:Horizontal agitator

REFERENCES

1- Gunnerson, Ch.G and D.C Stuckey (1986):
Integrated resources recovery, aerobic digestion.
UNDP Report, No.5, P.1-2. the World Bank.
Washington, D.C.,U.S.A.

2- Khadi and Village industries commission (1977):
gobar-gas, why and How.
Bombay. 400 o 56. India.

3- Moulik. I.K. (1982): Biogas energy in India.
Academic Bookcenter. Ahmedabad. India.

4- Rahbani, M. (1982): To free from magic the seiekh
Bahai's Public bath. Daneshgahe - Enghelab Publication. No-12.s.71.

5- Sathianathan, M., A (1975): Biogas achievements and challenges. Association of voluntary agencies for rural development A/1.
Kailash Colony, New Delhi, 110048.

6- Uited Nation guidebook on Biogas Development Energy Resourses Development Series. (1980) No-21 New Yourk.

7- Van Brakal, J. (1980): The lgnis fatuus of Biogas small Scals anaerobic digestors: A critical review of the pre-1970 literature, Delft University Press.