iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VIII **Month of publication:** August 2020

DOI: https://doi.org/10.22214/ijraset.2020.30992

Biomethanation of Canteen Waste

Dr. D.C. Sharma[1], Sham Kumar[2], Poornima bai U[3], Ramkrishna[4], Ramya. H. N[5]
[1]*Professor,* [2, 3, 4, 5]*Student (8th Sem), Civil Engineering, Rajarajeswari College of Engineering, Bangalore, Karnataka, India*

Abstract: In our institute we have hostel and hospital canteen all having their own individual mess, daily a large amount of kitchen waste is obtained which can be utilized for better purposes. Biogas production requires anaerobic digestion Project was to create an organic processing facility to create biogas which will be more cost effective , Eco-friendly , cut down on landfill waste, generation a high-quality renewable fuel, and reduce carbon dioxide and methane emissions. Proper management and recycling of huge volumes of food waste are required to reduce its environmental burdens and to minimize risks to human health. Food waste is indeed an untapped resource with great potential for energy production. . This study was carried out to assess the production of biogas from canteen's organic waste as a solution for management of organic waste in Rajarajeswari medical and engeneering college, Biogas piolet plant with capacity 50 liters for 70 days The physicochemical parameters of canteen's waste. Similarly, volume of biogas, volume of methane and carbon dioxide in biogas produced were measured and CO_2 reduction from biogas plant was identified. The average values of physicochemical parameters of canteen's waste lied within the optimum range for biogas production. The biogas plant produced and 6.5 liters/day of biogas.
Keywords: Anaerobic digestion, Canteen waste, Organic Manure, sewage waste

I. INTRODUCTION

Biogas refers to a gas made from anaerobic digestion of kitchen waste. Methane is a clean energy one of the constituent of biogas which has a great potential to be an alternative fuel. Abundant biomass from various institutions could be a source for Methane production where combination of waste treatment and energy production. Objective of this study is to utilise the kitchen waste in a biogas digester to produce biogas which will be the alternative fuel for their kitchen energy need. This work was carried out to produce biogas in a Compact Water Plastic Tank with a fixed type, using different food waste from the hostel, and canteen in RRCE institute of technology Engineering College.

A. Objectives Of Present Study

1) Run a pilot plant biodigester
2) Treatability of canteen waste for bio gas recovery
3) Optimization of operational parameters to mixing biogas production
4) Development of control parameters (flow, bod, alkalinity, cod ,VFA) to scale up the field scale plant under construction at a RRMCH
5) Characterization of digester sludge for it is suitability as organic manure/compose
6) The measurement of the volumes and pressure of the biogas generated through the process

B. Scopes Of Present Study

1) Solid food waste is converted into usefull energy
2) The sludge is converted into compact. This compact is used as agriculture and gardening.
3) As a result of this treatment biogas liberated can be used for domestic purpose
4) The present highly BOD value is useful for canteen industries, houses etc…,
5) Global warming will be reduce.
6) The amount of landfill has also been considerable reduce

II. MATERIALS AND METHODOLOGY

A. Sources And Generation Of Food Waste

Food waste which is collected from RRCE Institute of Technology Engineering College canteen includes vegetables, fruits and other items. The treatment process of food waste products gives hazardous waste. The usage of chemicals are one of the main reason for this. The manufacturing of food items is a process that must be accomplished by adhering to strict controls of both the local and Federal food regulatory agencies. The items of food that are manufactured are as varied as the people they serve. Common staples, exotic delicacies, snack foods and ethnic specialties are all food items that go through a controlled and precise.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

B. Methodology

Anaerobic process takes-place in following 4 steps as follows;

1) *Step I:* Hydrolysis
2) *Step II:* Acidogenesis
3) *Step III:* Acetogenesis
4) *Step IV:* Methanogenesis

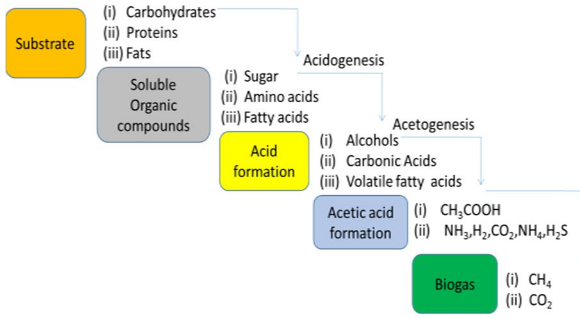


Figure 2.1: Schematic biodegradation steps of complex organic matter.

C. Method of Sample Collection

1) *Inlet Sample:* Grab sampling method was used to tabulate the result by uniforming the mixture.
2) *Outlet Sample:* Composite sampling method was used where the sample of whole day from the outlet were collected and mixed, test sample was collected from the mix

D. Sample Collection.

Samples for treatment of food waste, both solid and liquid were collected from RRCE Institute of Technology Engineering College hostel and canteen. About 18kg of waste items collected are categorized as vegetables, fruits, rice, other food items and waste water which mixing together, forms semi solid state.

E. Operational Parameters

1) pH VALUE
2) COD - CHEMICAL OXYGEN DEMAND
3) BOD - BIOCHEMICAL OXYGEN DEMAND
4) TS - TOTAL SOLIDS
5) VS - VOLATILE SOLIDS
6) SS - SUSPENDED SOLIDS
7) TDS - TOTAL DISSOLVED SOLIDS
8) VFA - VOLATILE FATTY ACIDS
9) C/N RATIO - CARBON TO NITROGEN RATIO
10) ALKALINITY
11) ACIDITY
12) TEMPERATURE

F. Experimental Procedure

The effective volume of the reactors was maintained at 50lit .the reactor was provide with suitable arrangements for feeding, gas collection, draining residues. Experiments were carried out in the ambient temperature. Each reactor was added with 5lit sludge and diluted to 50lit of working volume.

The characters of samples The semi solid waste used in this study is collected from hostel and college canteen. The sewage waste was added to the above food waste to supplement the reaction process. It is used as a seeding material for the reaction process in the Anaerobic Sludge Reactor Effective micro organism collected from private company was used to accelerate the reaction process. Also yeast is added for fermentation process to take place.

G. *Design of Pilot Plant*

1) Drum unit
2) Inlet and outlet pipes for feeds and removal of waste
3) Gas flow pipes
4) Control valves
5) Gas collection
6) Sludge outlet values

H. *Specification*

1) Dimension of drum
   a) Capacity = 50 liters
   b) Height =595mm
   c) Diameter = 280mm
   d) Weight =2.8kg
2) PVC pipes
   a) 2 inch pipe
   b) 2 inch tank nipple
   c) 2 inch collar
   d) 1inch tank nipple
   e) 1inch cpvc pipe with L bend
3) Gas connection
4) Gas connector value

Fig: 2.6 Reactor

III. RESULT AND DISCUSSION

A. *Test And Results For Influent*

days	pH (inflluent)	NH3-N in mg/l	COD(in) in mg/l	BOD in mg/l	alkalinity mg/l	VFA in mg/l	TDS in mg/l	TVS in mg/l	TSS in mg/l	alk/VFA
	0									
1	6.8	5	16000	12800	1100	400	9500	8500	14000	0.363636
5	6.4	5.8	18400	14720	1120	570	10200	9800	15900	0.508929
12	6.6	4.8	15500	12400	1080	395	9200	9000	13800	0.365741
20	5.8	8.4	37600	30080	800	680	12800	4775	18700	0.85
30	6.4	6.1	19200	15360	1280	610	10600	10200	16400	0.476563
45	6.5	5.5	17800	14240	1180	510	9450	9350	15950	0.432203
60	6.2	5.2	16600	13280	1160	440	9650	9450	14500	0.37931
stddev	0.318479	1.220265	7804.242	6243.393	148.9647	109.9621	1243.315	1824.658	1706.465	0.171624
mean	6.385714	5.828571	20157.14	16125.71	1102.857	515	10200	8725	15607.14	0.48234
co-eff-var	0.049874	0.209359	0.38717	0.38717	0.135072	0.213519	0.121894	0.20913	0.109339	0.355815

B. Test And Results For Effluent

days	pH (effluent)	NH3-N(eff) out mg/l	COD(eff) in mg/l		alkalinity mg/l	VFA in mg/l	TDS in mg/l	TVS in mg/l	TSS in mg/l	alk/VFA	methane (CH4) in l
3	7.3	9	7600	2280	1800	110	4200	3000	5000	0.061111	6
8	7.1	10.2	8400	2520	1850	125	5300	3650	6950	0.067568	8
16	7.2	9.1	7350	2205	1795	105	4000	3450	4850	0.058496	7.35
25	5.9	14	21850	6555	1200	400	5450	7850	1250	0.333333	2.35
35	7.2	9	8150	2445	1950	115	4800	3595	6550	0.058974	6.85
50	6.2	10.5	8250	2475	1880	118	5450	3650	7100	0.062766	7.35
70	6.4	9.5	7950	2385	1850	127	5500	3700	5300	0.068649	7.8
stddev	0.574042	1.78459	5266.618	1579.985	252.6926	107.3707	634.0535	1658.794	2009.087	0.10228	0.652857
mean	6.757143	10.18571	9935.714	2980.714	1760.714	157.1429	4957.143	4127.857	5285.714	0.101557	6.528571
co-eff-var	0.084953	0.175205	0.530069	0.530069	0.143517	0.683268	0.127907	0.401854	0.380097	1.007118	0.1

C. Efficieny of the Removal

days	efficiency of COD removal in %	efficiency of BOD removal in %	efficieny of VFA removal in %	efficieny of TDS removal in %	efficieny of TVS removal in %	efficieny of TSS removal in %
3	52.5	82.1875	72.5	55.78947	64.70588	64.28571
8	54.34783	82.88043	78.07018	48.03922	62.7551	56.28931
16	52.58065	82.21774	73.41772	56.52174	61.66667	64.85507
25	41.8883	78.20811	41.17647	57.42188	-64.3979	93.31551
35	57.55208	84.08203	81.14754	54.71698	64.7549	60.06098
50	53.65169	82.61938	76.86275	42.32804	60.96257	55.48589
70	52.10843	82.04066	71.13636	43.00518	60.84656	63.44828
average	52.08985	82.03369	70.61586	51.1175	44.47054	65.39154

D. Corrected Physiochemical Properties Of Canteen Waste Without The Error Data

Parameters	UNITS	inlet	outlet	Removal efficiency
pH		6.48±0.31	6.9±0.068	
NH3-N	mg/l	5.4±0.09147	9.55±0.068	
COD	mg/l	17250±0.083	7950±0.050	53.79
BOD	mg/l	13800±0.083	2385±0.0507	82.67
Alkalinity	mg/l	1153.333±0.0626	1854.167±0.03	
VFA	mg/l	487.5±0.1852	116.66±0.72	75.52
TDS	mg/l	9766.67±0.0539	4957.1±0.133	50.06
TVS	mg/l	9383.33±0.0634	3507.5±0.07	62.61
TSS	mg/l	15091.7±0.0744	5958.33±0.17	60.73
Alk/VFA		0.4210±0.1465	0.06±0.068	

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

COD removal shows a efficiency of 52.08% removal which is considerably ok .A good reactor should show efficiency of 75% to 80% removal in the overall incoming concentration .Therefore to increase the efficiency of the reactor catalyst or admixture like aluminium oxide Al2O3 which exhibits the resistance to acid formation and with higher COD removal efficiency.Higher COD removal efficiency shows higher yield in biogas production table

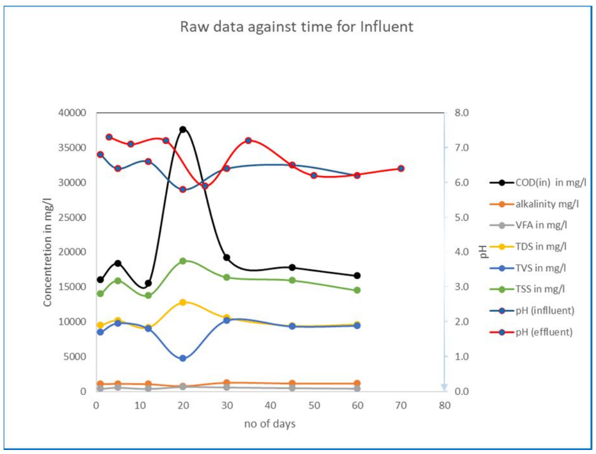
BOD which is completely consists of organic matters shows a higher tendency in removal efficiency with 82.033%

VFA are the important elements in controlling anaerobic digestion process .It has two roles i.e decomposing organics and generating gasses ,methane , carbon dioxide . The reactor shows 71% removal of VFA content in the waste after digestion ,which indeed shows good production of biogas by reactor

TDS is the mixturevolitale solids and suspended solids. The reactor showed and a 51% removal efficiency and 49% comes out untreated

TSS is the suspended solids with settleable and non settleable solids ,the reactor show a 60% removal were the rest 40% lies inside the reactor which may settle at the bottom or float on the surface by which the efficiency of the reactor decreases. To maintain proper efficiency the reactor should be cleaned time to time

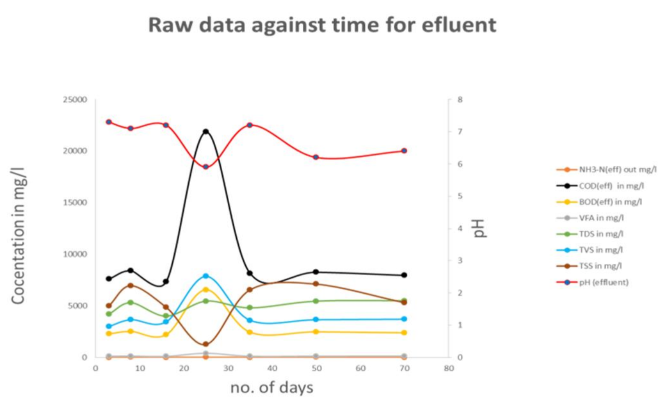
E. Raw Data Against time for Influent



Graph :1

The above values were obtained by testing canteen waste mixture .And grab sample were collected from the mixture for testing.The above graph shows changes in parameter for in going feed that are likely to be faced by the acid forming bacteria's

F. Raw data Against time for Effluent

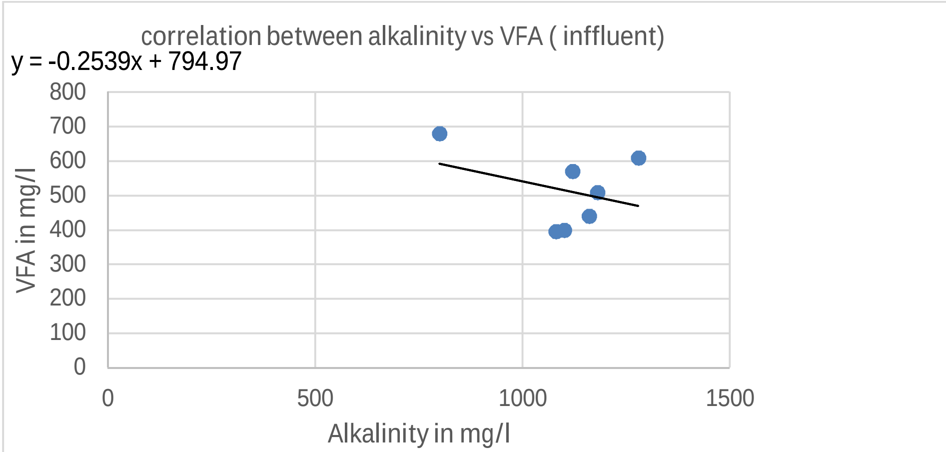


Graph:2

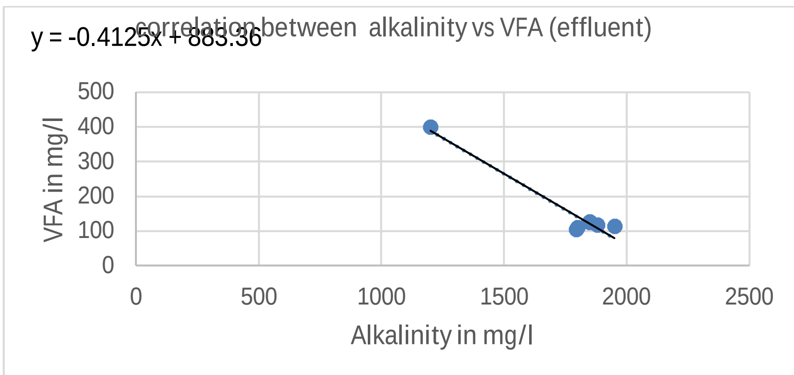
The above graph (2) show a uniform variation of all parameter between the period of 1-20 and 30-60 for the feed canteen waste mixture,and in between there is a sudden fluctuation in the graph (1) and graph (2) at inlet and outlet on the 20^{th} and 25^{th} day of tabulation respectively .Showing rapid fluctuation in the parameters

IV. RELATIONSHIP BETWEEN PARAMETERS

A. Correlation Between Alkalinity v/s VFA



Graph:1

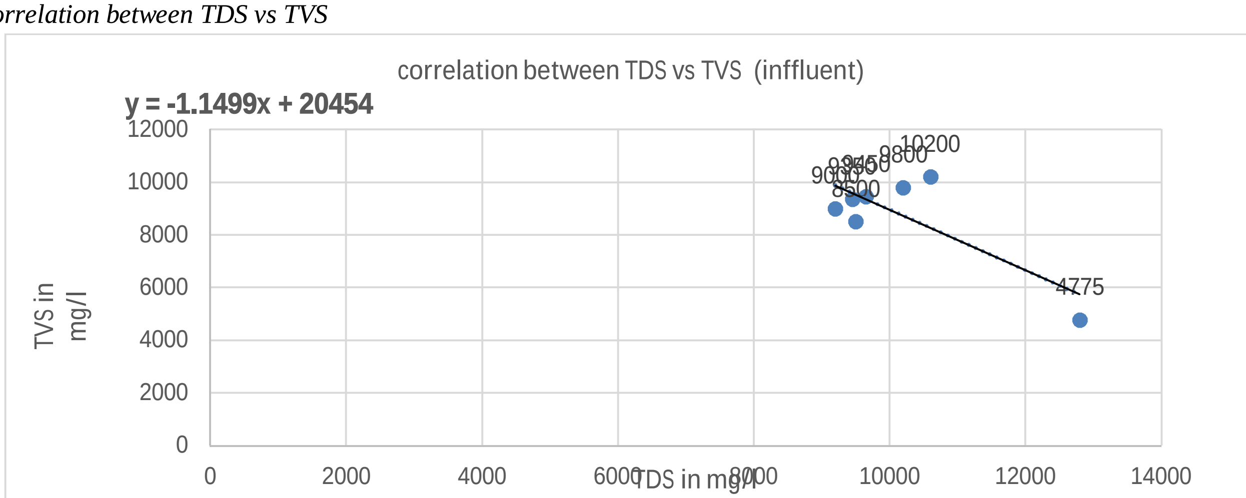


Graph: 2

The above graph shows the correlation between alkalinity and VFA .The trendline in the graph shows linear decrease in VFA mgL-1 as Alkalinity increase

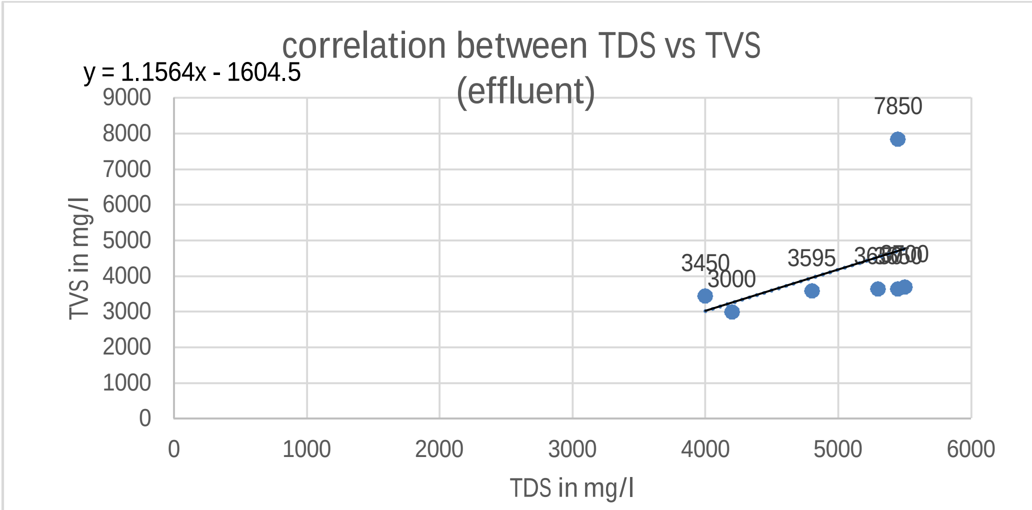
For a good data all the points should in the graph should be in same or nearby ,if any scattering of point seen when graph is plotted for outlet , it mean that reactor is not working properly

B. Correlation between TDS vs TVS



Graph:3

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com



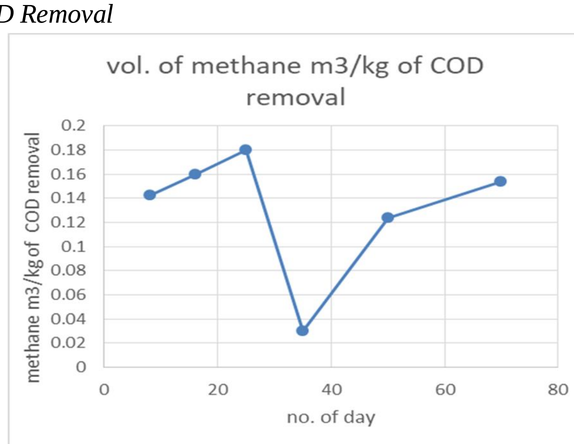
Graph 4

The above shows the correlation between TDS and TVS .The trend line in the graphshows linear decrease in TVS mgL-1 with decrease in TDS mgL-1 when compared to influent graph

V. GAS PRODUCTIONS FOR REMOVAL OF COD ,BOD ,VFA IN M3/KG

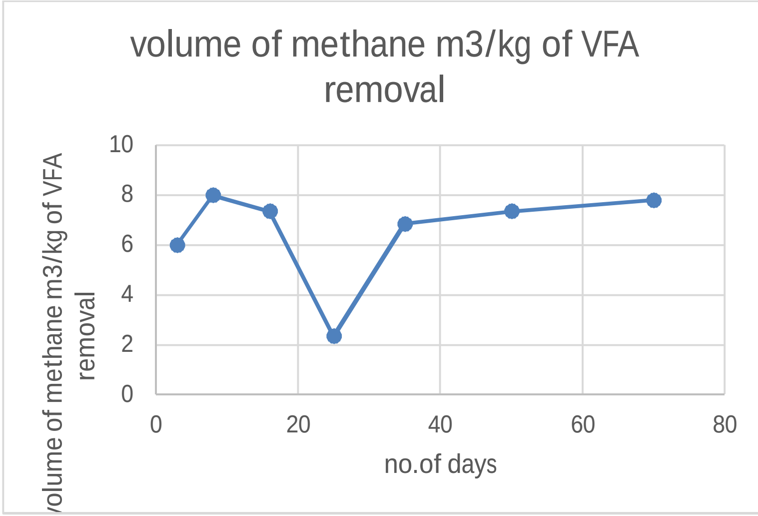
days	vol. of methane m3/kg of COD removal	vol. of methane m3/kg of BOD removal	vol. of methane m3/kg of VFA removal
3	0.142857143	0.114068	4.137931
8	0.16	0.131148	3.595506
16	0.180368098	0.144188	5.068966
25	0.02984127	0.019979	1.678571
35	0.1239819	0.106078	2.767677
50	0.153926702	0.124947	3.75
70	0.180346821	0.143185	4.984026
average	0.138760276	0.111942	3.711811

A. Volume of Methane m3/kg of COD Removal



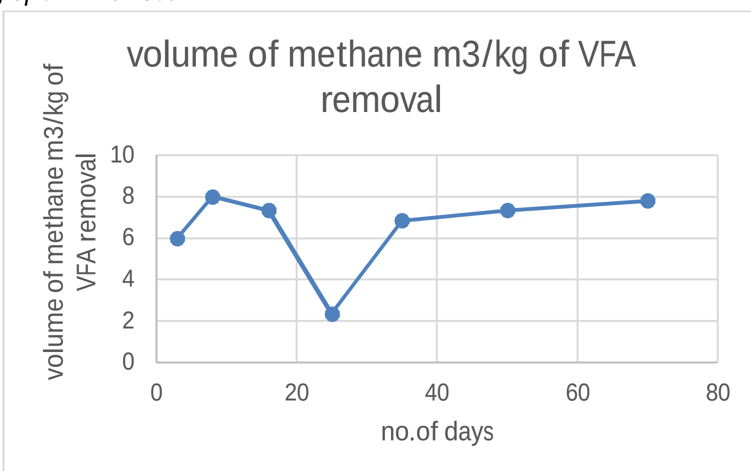
Graph:1

B. Volume of Methane m3/kg of COD Removal



Graph:2

C. Volume of Methane m3/kg of VFA Removal



Graph:3

The above graph(1,2,3) shows the same variation in production of gas for a kg of removal with respect to time

VI. CONCLUCTIONS

A. This process is highly acidity and alkalinity depended therefore this parameters are to be strictly adhered too.

B. Any abnormal feed creates upset condition in the reactor leading to drastic damage in methane gas production and the efficiency of pollutant and the efficiency of pollutant removal

C. Most of the TDS is of organic in nature which is participating in the reactor converting into methane gas therefore the outlet TDS value are lower

D. The study shows that per kg of COD removal gives 370 liter volume of methane gas

E. There is a good correlation between alkalinity and VFA with the ratio both at inlet and outlet. This shows the operation of reactor has been very smooth. But for the abnormal value which indicates that it had been error due to the operators.

F. the further efforts must be made either through the addition of additives or catalyst, so the 53% of COD removal could be taken up to 75 to 80%.

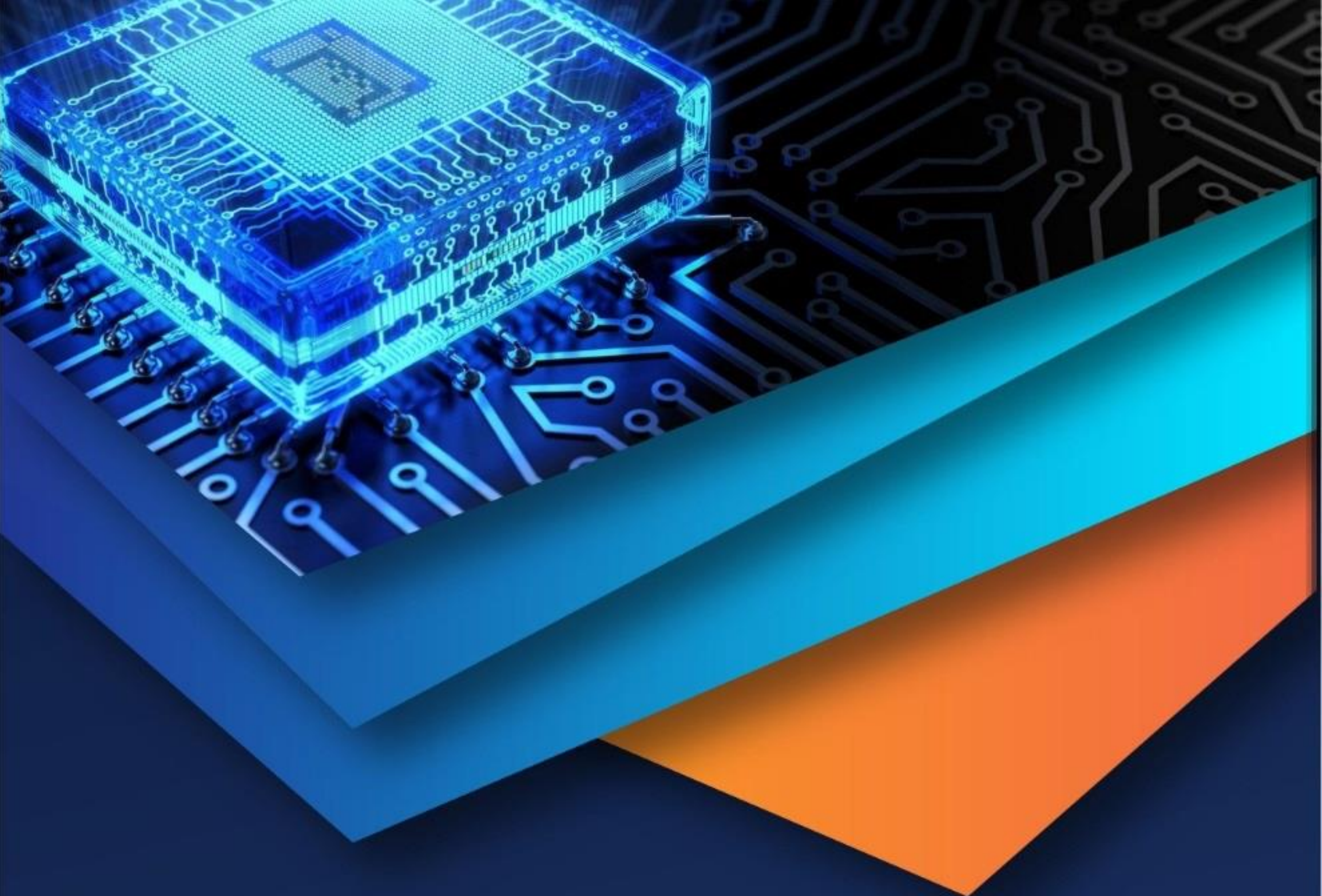
G. This processes is highly acidity and alkalinity depended therefore this parameter are to be strictly tested

H. For stable working of the reactor the pH in the reactor should be maintained in betwwen 6.5-7.5. This can be maintained by proper feeding with dilution ,so the feed itself maintains pH above 6.5

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

REFERENCE

[1] BryersID. And Mason e.A. biopolymer particular turnover in biological waste treatment system: a review. Bioprocess Eng.2,95-109(19870)
[2] Valentini A ,Grant G. and Rozzi A. Anaerobic degradation kinetics of particular organic matter: a new approch. Water Sci Techno!.36,239-246(1997)
[3] Aeiunbaatar,J.;Panico,A.;Esposito,G.;Pirozzi,F,;Lens,P.N.L> pretreatment method to enhance anaerobic digestion of organic solid waste.Appl.Energy2014,123,143-156.
[4] Kale, S.P and Mehele, S.T. kitchen waste based biogas plant .pdf. Nuclear agriculture and Biotechnology/ Division.
[5] Karve .A.D. (2007), Compact biogas plant, a low cost digester for biogas from waste starch.
[6] Karve of Pune A.D (2006). Compact biogas plant compact low-cost digester from waste starch.
[7] Shalini sing, sushil kumar, M.C. Jain, Dinesh kumar (2000), the increased biogas production using microbial stimulants.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY