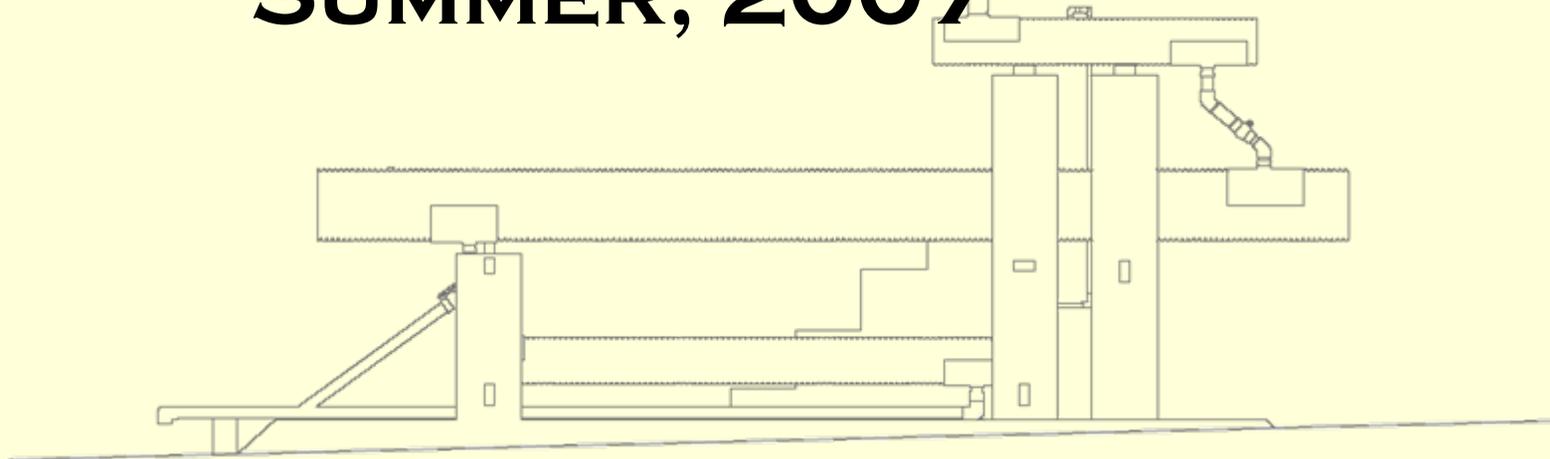


BIOGÁS NICARAGUA

BIOGAS KITS
USA

**MADMEC
SUMMER, 2007**





MISSION

COMBINING CHEMICAL ENGINEERING PRINCIPLES, ARCHITECTURAL DESIGN, AND MATERIAL SCIENCE, BIOGAS KITS DEVELOPS ALTERNATIVE BIOGAS ENERGY SOLUTIONS FOR RURAL AND URBAN POPULATIONS IN DEVELOPING COUNTRIES. BY TAKING INTO CONSIDERATION AND INTEGRATING SEVERAL IMPORTANT FACETS OF LIFE: COOKING AND LIGHTING REQUIREMENTS, HOUSING LOCATION, WASTE MANAGEMENT, SANITATION, AGRICULTURAL PRODUCTION, AND CONCERN FOR THE ENVIRONMENT, BIOGAS KITS IS ABLE TO OFFER EACH INDIVIDUAL CLIENT OR COMMUNITY A UNIQUE AND AFFORDABLE SOLUTION TO ACCOMMODATE THEIR ENERGY NEEDS IN AN ECO-FRIENDLY WAY.

**OUR IDEAL DIGESTER IS AFFORDABLE,
DURABLE, AND MASS REPRODUCIBLE
WHILE SENSITIVE TO THE SOCIAL
NEEDS OF NICARAGUANS.**

WHY BIOGAS? WHY NICARAGUA?



HAMBRE CERO

Text removed due to copyright restrictions.

Please see López, Ludwin Loáisiga.

“Denuncian exclusión con Hambre Cero.” La Prensa, July 13, 2007.

<http://www.laprensa.com.ni/archivo/2007/julio/13/noticias/politica/202973.shtml>

HAMBRE CERO

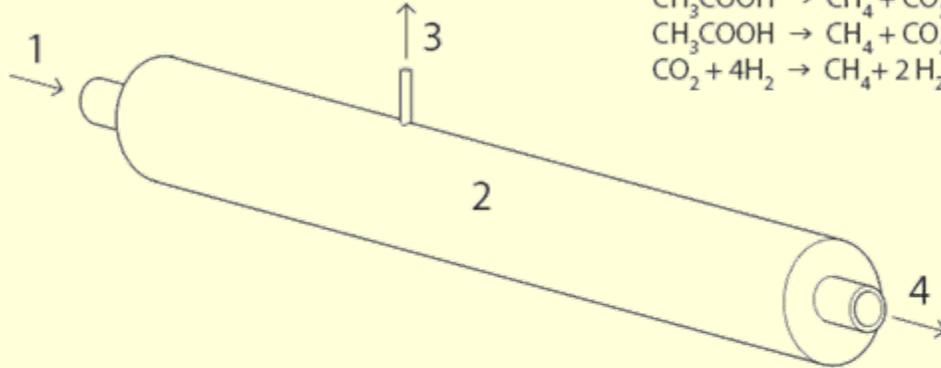
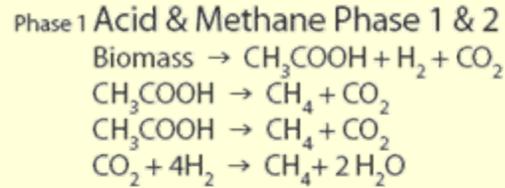
Text removed due to copyright restrictions.

Please see C., Lucía Vargas. "Producen gas con excrementos." La Prensa, July 13, 2007.

<http://www.laprensa.com.ni/archivo/2007/julio/13/noticias/regionales/202916.shtml>

Existing Technology

Single Phase Digester



1. Animal manure is biomass input
2. Biodigester (Acid Phase, Methane Phase 1 & 2)
3. Biogas stream
4. Output waste stream (fertilizer)



Current biogas technologies use a single low density plastic liner (such as a low grade polyethylene) as the container for a plug flow digester system. The system is inexpensive, but **vastly inefficient** and problematic. Various problems including frequent **breaks and leaks** (as seen in the image to the left), and a **high residence time** (defined as the time it takes to yield biogas output from a biomass input), consistently retard production of biogas.

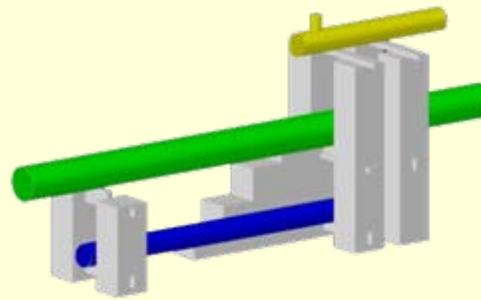
UNRELIABLE

SLOW

EXPENSIVE

Proposed Technology

Tri Phase Digester



**Methane
Forming
Bacteria**

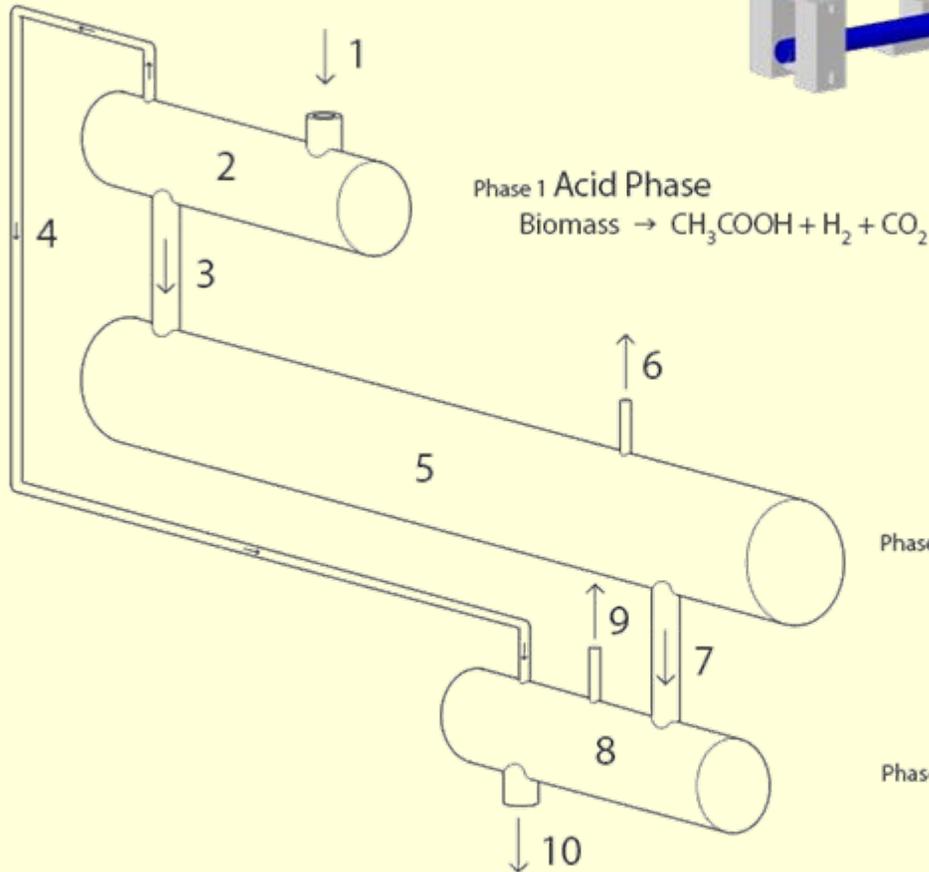
Mc. mazei

Mb. Sohngeniei

Ms. methanica

Mb. formicicum

Methanosarcina barkerii



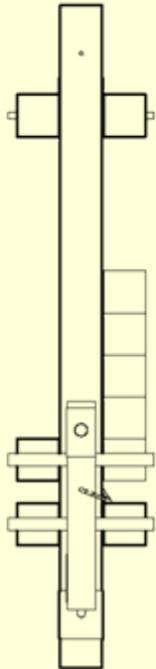
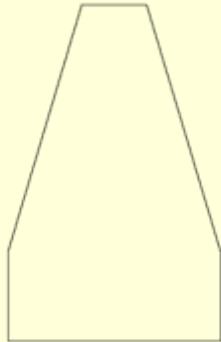
1. Animal manure is biomass input
2. Biodigester (Acid Phase)
3. Acidified material from the Acid Phase Digester is input to the Methane Phase 1 Digester
4. Carbon Dioxide gas is recycled from the Acid Phase Digester to the Methane Phase 2 Digester
5. Methane Phase 1 Digester

6. Biogas produced from Methane Phase 1 Digester
7. Material proceeds from the Methane Phase 1 Digester to the Methane Phase II Digester
8. Methane Phase 2 Digester uses carbon dioxide from the Acid Phase and biomass material from Methane 1
9. Biogas stream from Methane Phase 2 Digester
10. Output waste stream (fertilizer)

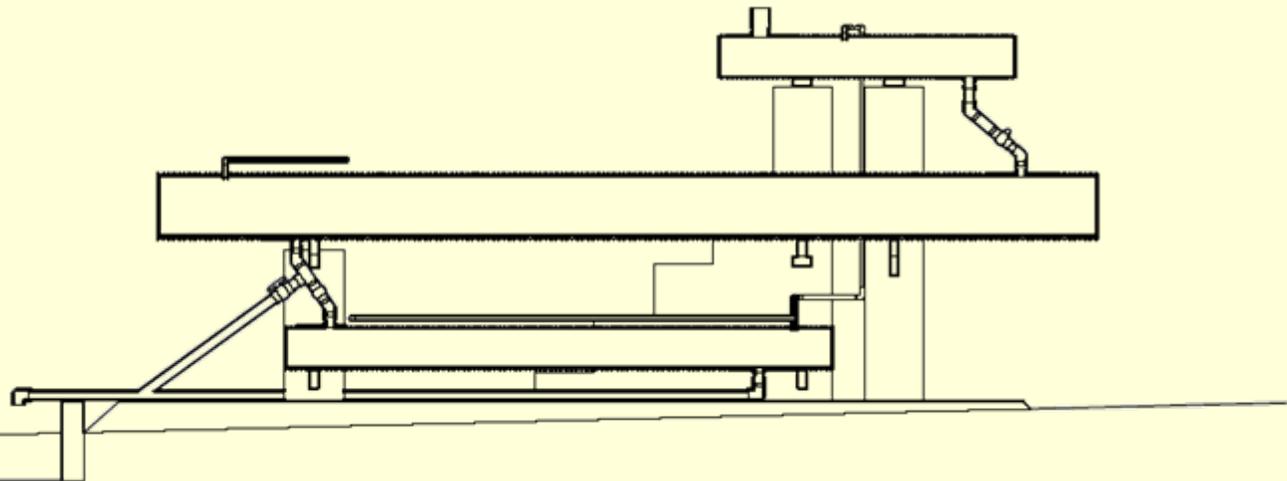


SMALLER & FASTER

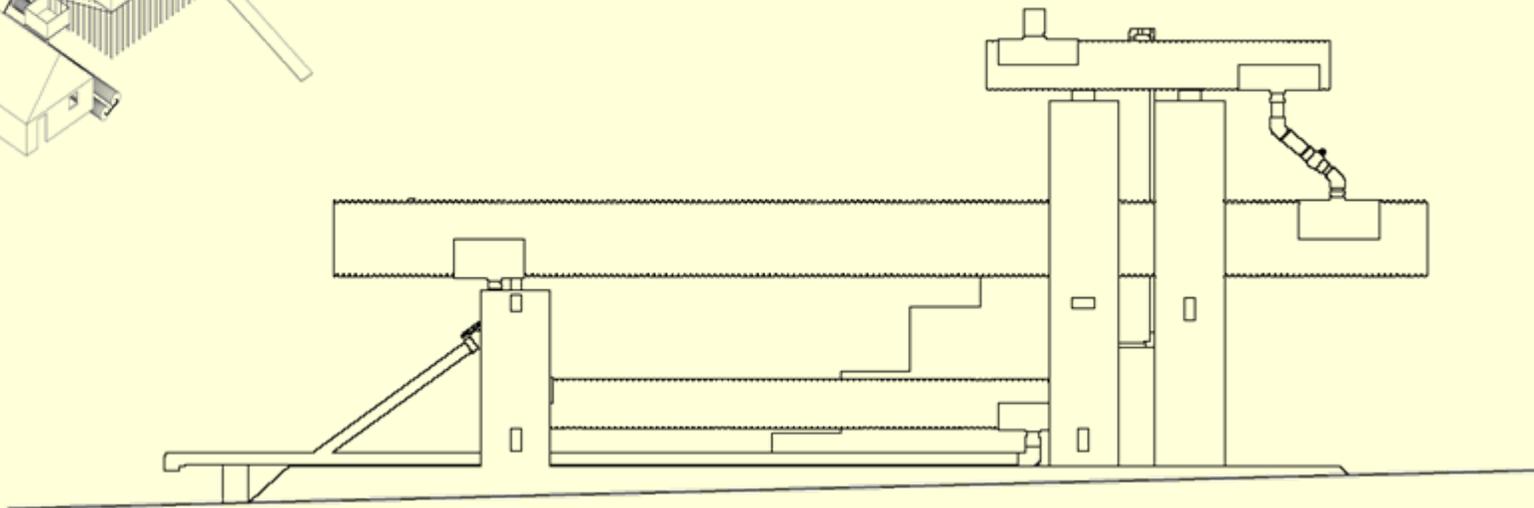
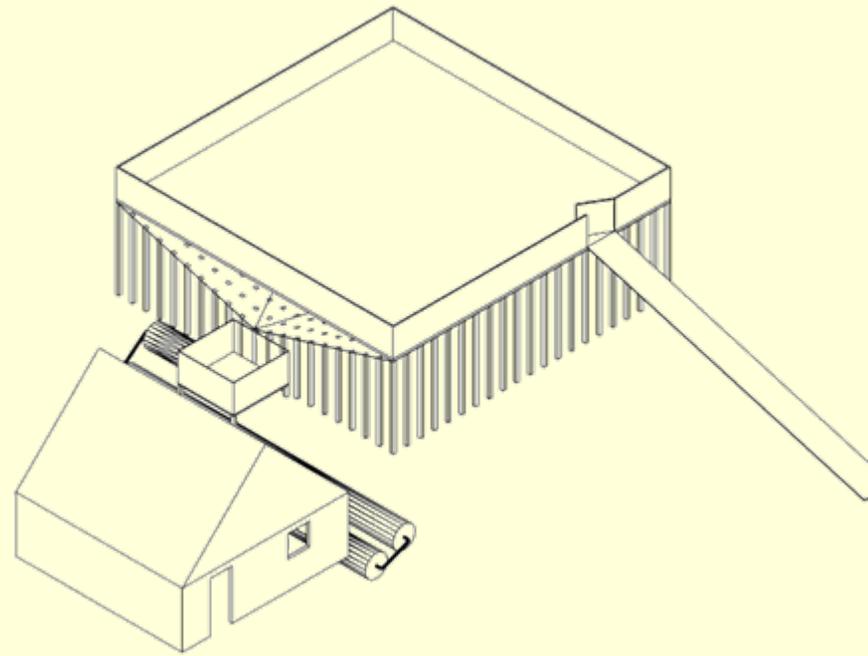
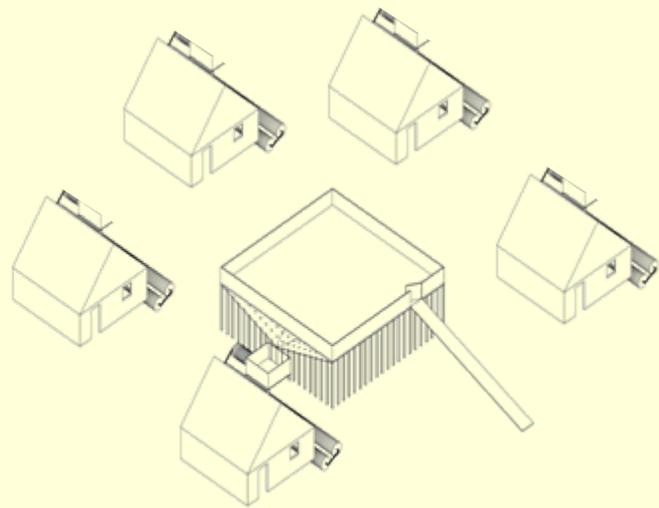
CHEAPER & INTEGRATED



Operating Conditions and Parameters				
Biogas Digester Alpha (actual)				
	Unit of Measurement	Phase 1	Phase 2	Phase 3
Diameter	inches	10	14.25	10
Length	inches	73.88	236.5	138.3
Volume	inches ³	5802.51673	37718.15043	10862.04743
Working Volume	inches ³	4642.013384	30174.52	350.32 (0.203)
Mode of Operation	mode	Continuous Daily		
Retention Time	days	1	6.5	7
Loading Rate	lbs/day	43.55	43.55	** .029 ft ³ /day
Temperature	degrees Celsius	Ambient (but the hotter the better)		
pH	no units	5.5-5.8	7.0-7.2	6.5-8.5



FUTURE OF BIOGAS NICARAGUA



POTENTIAL BUYERS

Name: Don Jose Dans

Occupation: Restaurant Owner in the City of Diriamba

Statement of Interest: “I am a retired electrical engineer. I would love to have this system for my restaurant and I am very interested in automating it with 12V solenoid valves so that it can be completely automated

Social Status: Upper Middle Class

Name: Richard Stephens

Occupation: Farmer and Horse Owner in Diriamba

Statement of Interest: “I have to buy gas every single month from Tropigas. I have plenty of Horses and cows to supply a biodigester with and am also very interested in eco-friendly energy solutions.”

Social Status: Upper Middle Class

Name: Jose Medrano

Occupation: Pig Farmer and land owner north of Managua

Statement of Interest: “I saw your article in the newspaper and I am definitely interested in buying your biodigester. I am particularly interested in it to make fertilizer which I use and sell. I will pay \$2,000 for the device.”

Social Status: Upper Middle Class

MATERIAL OBJECTIVES

- **DURABILITY**

- DIRECT SUNLIGHT (UV EXPOSURE)
- ANIMAL INTERACTIONS
- GENERAL ABUSE

- **ECONOMY**

- INEXPENSIVE
- EASY SCALABILITY
- AVAILABILITY OF STANDARD COMPONENTS

LDPE-PLASTIC BAGS

PROS

- EXTREMELY INEXPENSIVE
- UNIVERSALLY AVAILABLE

CONS

- VERY FRAGILE
- NOT UV RESISTANT
- DIFFICULT CONNECTIONS
- NEEDS EXTERNAL PROTECTION



PVC TUBING

PROS

- **RESILIENT MATERIAL**
- **WIDELY AVAILABLE**
- **SOME STANDARD COMPONENTS**

CONS

- **POOR UV RESISTANCE**
- **MUCH MORE EXPENSIVE THAN LDPE**
- **MFG'D END CAPS UNAVAILABLE**



HDPE TUBING

PROS

- RESILIENT MATERIAL
- WIDELY AVAILABLE
- MANY STANDARD COMPONENTS
- UV RESISTANT



CONS

- MUCH MORE EXPENSIVE THAN LDPE



CAUPOLICAN TARPS

PROS

- RESILIENT MATERIAL
- CUSTOM FABRICATED
- UV RESISTANT

CONS

- MORE EXPENSIVE THAN LDPE
- POSSIBLE DIFFICULTY IN MEETING LARGE DEMANDS
- REQUIRES MORE ROBUST STRUCTURAL SUPPORT
- TIME REQUIRED FOR MANUFACTURE



Materials Matrix

	Poor	Average	Good
UV Exposure	LDPE, PVC		HDPE, Tarp
Animals	LDPE		HDPE, Tarp
Anticipated Abuse	LDPE	PVC	HDPE, Tarp
Price	PVC, HDPE, Tarp		LDPE
Scalable		Tarp	LDPE, HDPE, PVC
Standard Components	LDPE	PVC, Tarp	HDPE



QUESTIONS?

BIOGÂS NICARAGUA

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EC.715 D-Lab: Disseminating Innovations for the Common Good
Spring 2007

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