NATURAL BUILDINGS

Erasmus+

ACARBIO ONLUS

Building YOUR HOME

Introduction

Society as we know it today is a concept that started to be shaped when mankind have stopped to be nomadic and become sedentary, building their shelter in order to stay. Houses were finally made, built with what mother nature could offer, fully aware of the importance to preserve what was around them for the purpose of surviving. Thousands of years later, we find ourselves in a completely different reality, where human kind forgot about nature and even believes it doesn't need it, and the way we build our home today is a clear statement in that direction. We have adopted unhealthy lifestyles and built recklessly without thinking to the worrying implications for human health and the environment.

That is why these days we often hear about the need to get back to the past, to connect to our origins. What our world really needs though is the word "sustainability" that have to become the normal way to approach development and this is also apply to the constructions of our houses. It therefore becomes important to promote the construction of ecological homes, fuel-efficient energy, that respect the environment and local cultures, allowing us to actively participate in a real sustainable development. To achieve this objective and to preserve the lives of future generations on our planet it is essential to invest to raise awareness among young people and to lead the new generations to engage in this process.

It's time to dirt our hands with mud and open up our minds to creativity once again, as it was when we were kinds and we liked to make drawings of our future house or even build it with plastic blocks or cardboard.

It's exactly in this context that we felt the need to organize a training course which brought together 34 young leaders and educators that work with young people in their local organizations, coming from 16 countries (Europe, Eastern Europe and Caucasus, Mediterranean) for the purpose of enabling them to spread the concept of eco-building, sustainability and healthy life style in their communities among young people.

The training course took place in Tramonti (Amalfi Coast, Italy) and it lasted 10 days in which participants acquired skills and knowledge in the field of non-formal education that they will transfer in their activities for youth.

This training course "Eco-Building a Better World" was supported by the Eramsus+ programme. During these 10 days we discovered the opportunities offered by "learning by doing" activities as well as non-formal education, putting also a collective effort to make an old abandoned building more ecological using straw-bales and clay. We also built a Bio-digester for the production of green-gas from organic waste.

This technical and pedagogical guide is the result of the work we did together and that shows how we went from theory about eco-building to practice.

Youth workers and the young people themselves may get inspiration from this work in order to set up various experimental workshop aimed to raise the awareness of and inform the young peo¬ple of their local communities. We hope that this work will contribute the promotion of a "green" lifestyle and construction techniques as well as of the civilian's ecological consciousness!

Each one of us can help taking care of the environment and have a say in what kind of world we want to leave to the next generations. Might it be green!

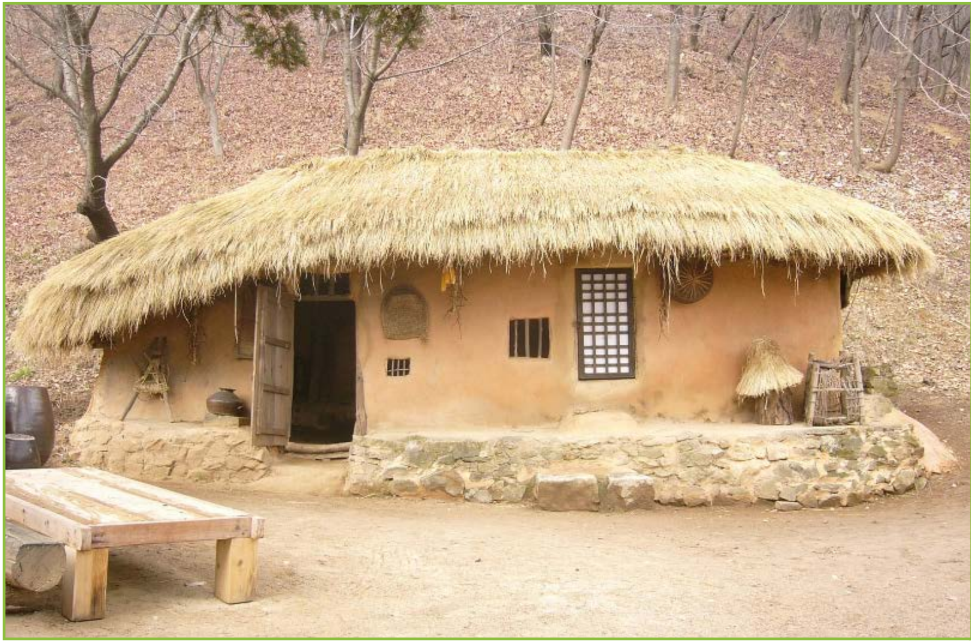
You can do it.

What is Natural Building?

Natural building means sustainable building at its "greenest."

Natural building utilizes minimally processed, nontoxic materials and systems used appropriately for the climate, site and intended use. It incorporates primarily natural materials rather than high embodied energy, processed commercial materials, with a focus on getting these natural materials from as local a source as possible--ideally, from the building site itself.

NB



Introduction to natural building

Natural building and bioclimatic architecture are two techniques which result in the safe management of resources and energy, the first during the construction of the building and the second in maintaining the standard living conditions. Both resulting in great environmental but also economical benefits.

Natural building is a fairly new term which is used to describe an approach to building with a direction towards the use of local, carefully selected or recycled materials, simple tools and techniques.

In almost any environment, nature provides us the buiding materials that we need. Since these materials need the least amount of processing or transportation, the economic and environmental costs are low. Some of these materials are renewable (as are trees and straw) and others (like rocks and soil) exist in such abundance that they are practically inexhaustable. Another advantage of building with local materials is that the building is in absolute visual harmony with its surrounding environment.

Bioclimatic architecture uses the energy of the sun (sunlight, wind etc) combined with thermal absorbing or insulating materials in order to establish comfort temperature in the house with the lowest carbon footprint possible.

Bioclimatic architecture is equally – if not more - important with natural building be-cause its benefits will last as long as the house is inhabited.

Our house is the extension of our self. It reflects our feelings about the environment and at the same time shapes them. In as much as the shell of a mollusc is also a part of it, so is our home a part of our self. It should suit our needs and provide us with security and comfort.

Ecobuilding in practice - Warehouse reconstruction

The building we wanted to reconstruct is a 20 year old farming warehouse. The walls are made of concrete blocks and the roof of ceramic tiles. The building dimensions are 19,50 by 7.60 and the height is 3 meters.

The main goal was to improve the thermal capacities of the building using as much natural and local materials as possible. For that reason we used 200 straw bales with dimensions 120 by 50 by 35 cm for the insulation.

There are two diametrically opposite large sliding opening doors in the narrow sides of the building and one series of six 80 to 120 cm windows in each of the large sides. The building had no insulation at all.

We also used local soil as an adhesive and for plastering purposes. Because the quality of the soil was very poor, we used lime and volcanic ash to improve it.

Walls

To insulate the walls, we installed a 25 cm layer of straw in their inner part. To do that, we had to cut a straw bale in its long side in half, after securing it with four more parallel strings. That produced two separate bales of 120 by 25 by 35.

Perimetrically in the inside of the building, we raised a rock foundation of an average height of 20 cm in order to keep the insulating material dry from the upcoming moisture. As an adhesive material we used one part of lime, one part of volcanic ash and six parts of sand.

Those bales were attached to the wall by drilling four holes to the wall for each bale. Subsequently strings were fixed in the outer side of the wall and throurgh the holes were tied up around the bales using also two parallel slats for better results. 600 meters of wooden slats 15 by 25 mm was used for that reason. The bales were placed with the same logic of the brick building.

Natural Building types

Cob

Adobe bricks

Earth bags

Straw bales

Straw and clay

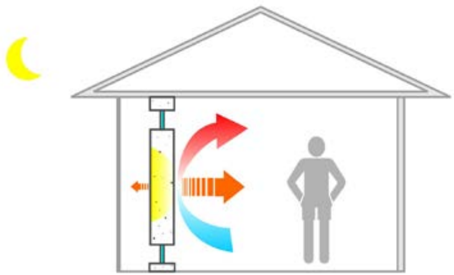
Rammed earth

Half of the window openings were sealed to reduce the temperature loss and the other half were opened a bit to fit upcycled windows.

After installing the straw bales, a thin layer of clays soil was applied to them in order to insure better adhesive qualities.

Finally the wall was plastered with a mixture of one part of soil, one part of lime, one part of volcanic ash, seven parts of sand.

Two of the openings will be build with adobe bricks so that they will be used as passive solar walls (trombe walls).



Roof

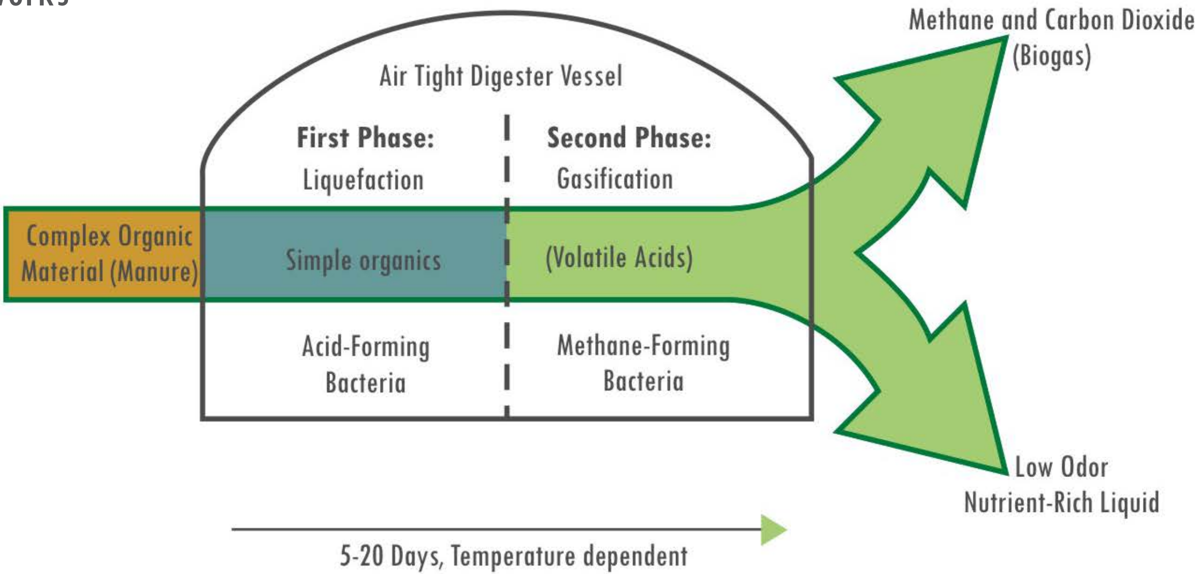
It took approximately 4.000 reeds for the insulation of the roof. We collected them from nearby streams, pealed them and cut them the same size with the space between the roof beams.
Then, using thin metal wire we produced grids we attached to the rafts.

After attaching the grids to the roof, we placed carton (upcycling carton boxes from the super markets) on top of the grid.
Then we filled the gap between the tiles and the grids with straw.

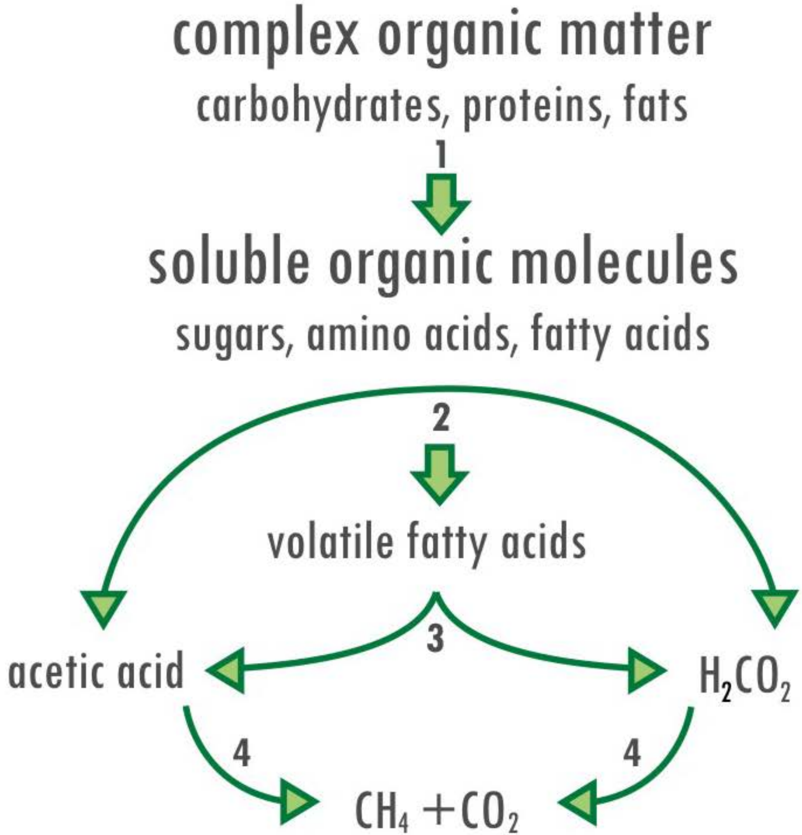
Digester

Anaerobic digestion is the natural biological process which stabilizes organic waste in the absence of air and transforms it into biofertilizer and biogas. Anaerobic digestion is a reliable technology for the treatment of wet, organic waste. Organic waste from various sources is biochemically degraded in oxygen-free conditions resulting in the production of biogas which can be used to produce both electricity and heat. Almost any organic material can be processed with anaerobic digestion. This includes biodegradable waste materials such as municipal solid waste, animal manure, poultry litter, food wastes, sewage and industrial wastes-quality biomethane. The nutrient-rich digestate also produced can be used as fertilizer.

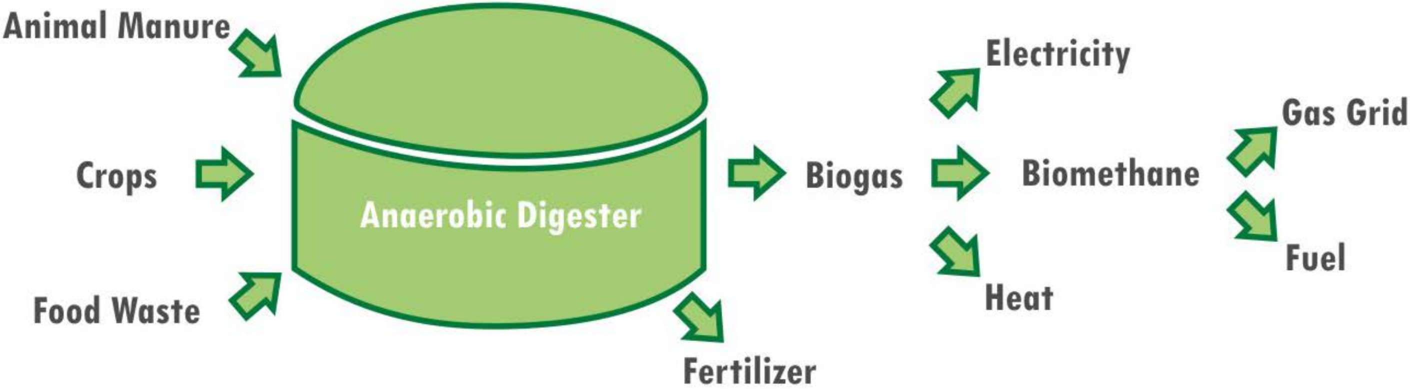
How it works



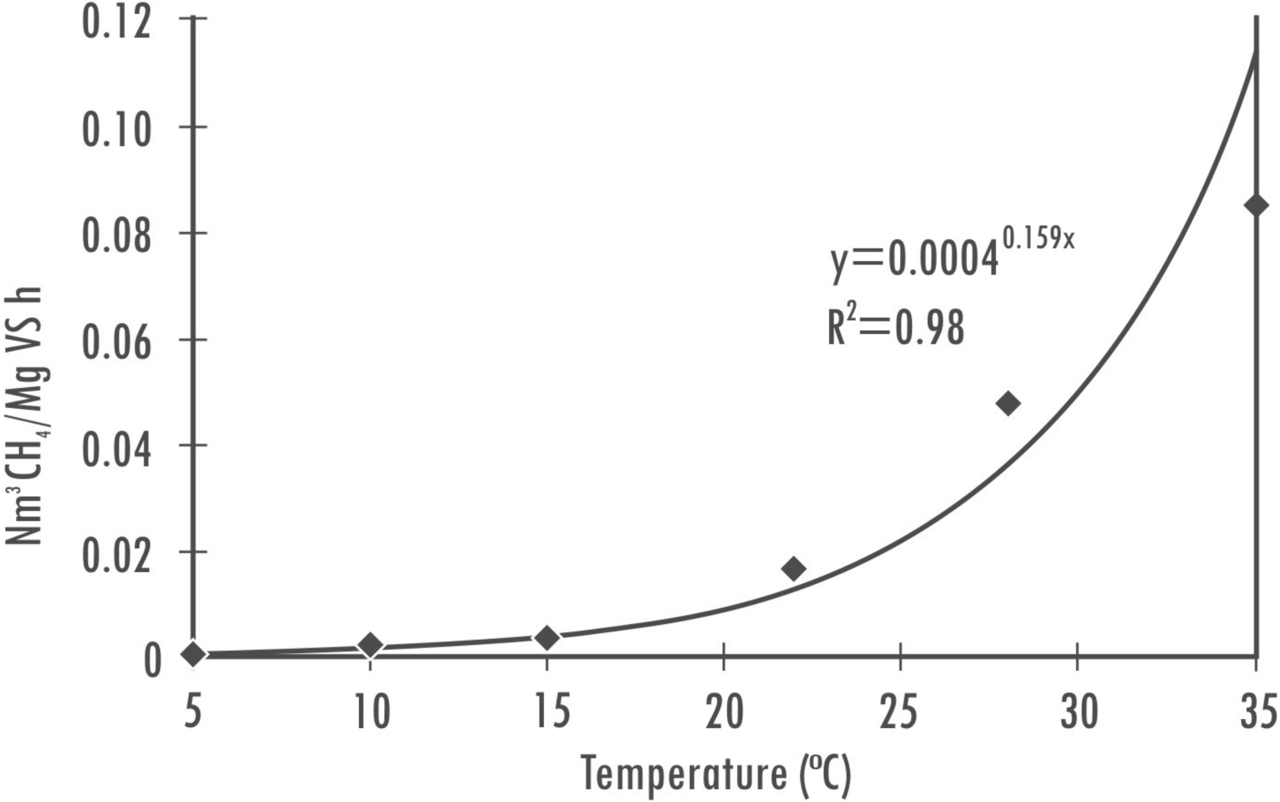
1. hydrolysis
2. fermentation
3. acetogenesis
4. methanogenesis



An anaerobic digestion plant produces two outputs, biogas and digestate, both can be further processed or utilized to produce secondary outputs. Biogas can be used for producing electricity and heat, as a natural gas substitute and also a transportation fuel. A combined heat and power plant system (CHP) not only generates power but also produces heat for in-house requirements to maintain desired temperature level in the digester during cold season. In Sweden, the compressed biogas is used as a transportation fuel for cars and buses. Biogas can also be upgraded and used in gas supply networks.



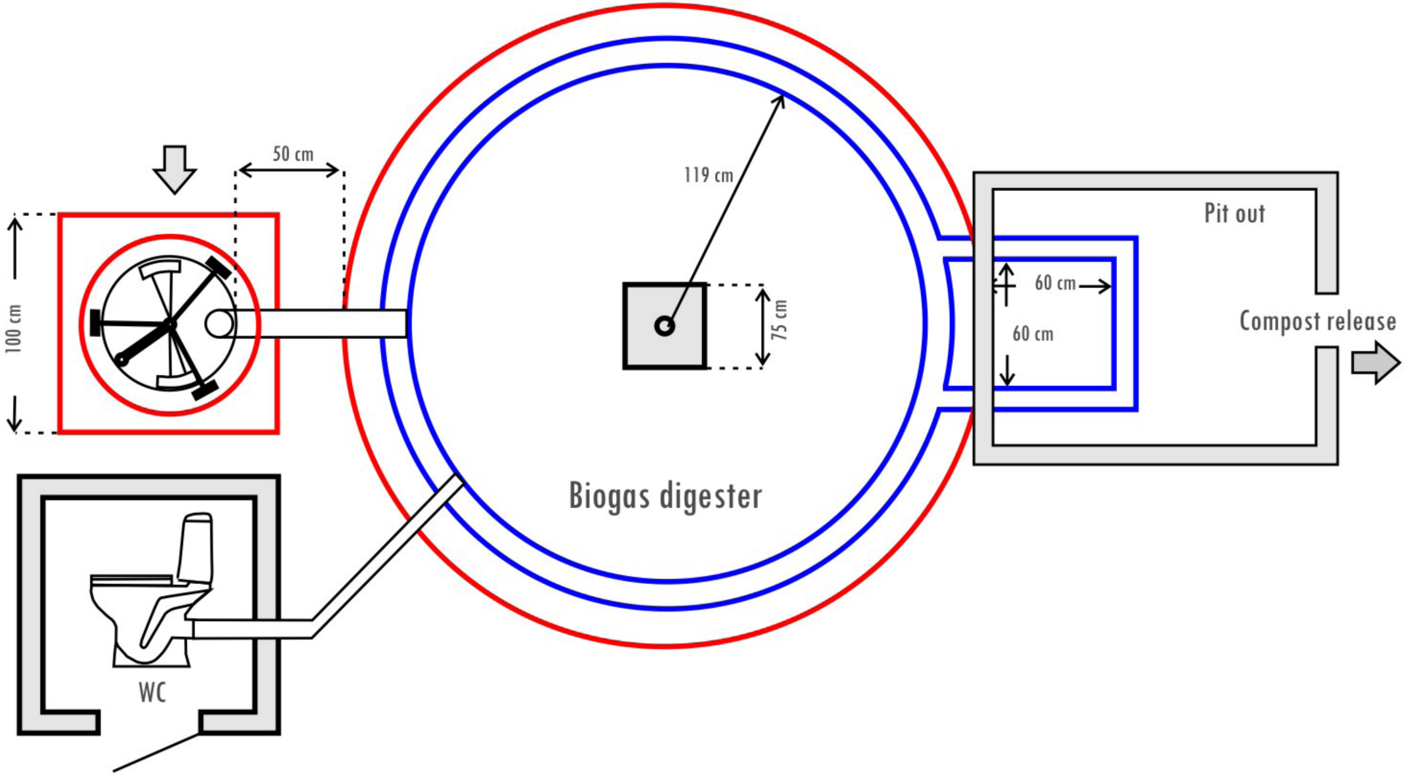
Methane production rate



Biogas is a mixture composed primarily from methane (50-70%), and dioxide carbon (Co2), with varying quantities of water vapor and sulphide of hydrogen (H2S).

Biogas system production

Draw by Mohamed Chaabouni
Date 03/09/2015 - bottom view



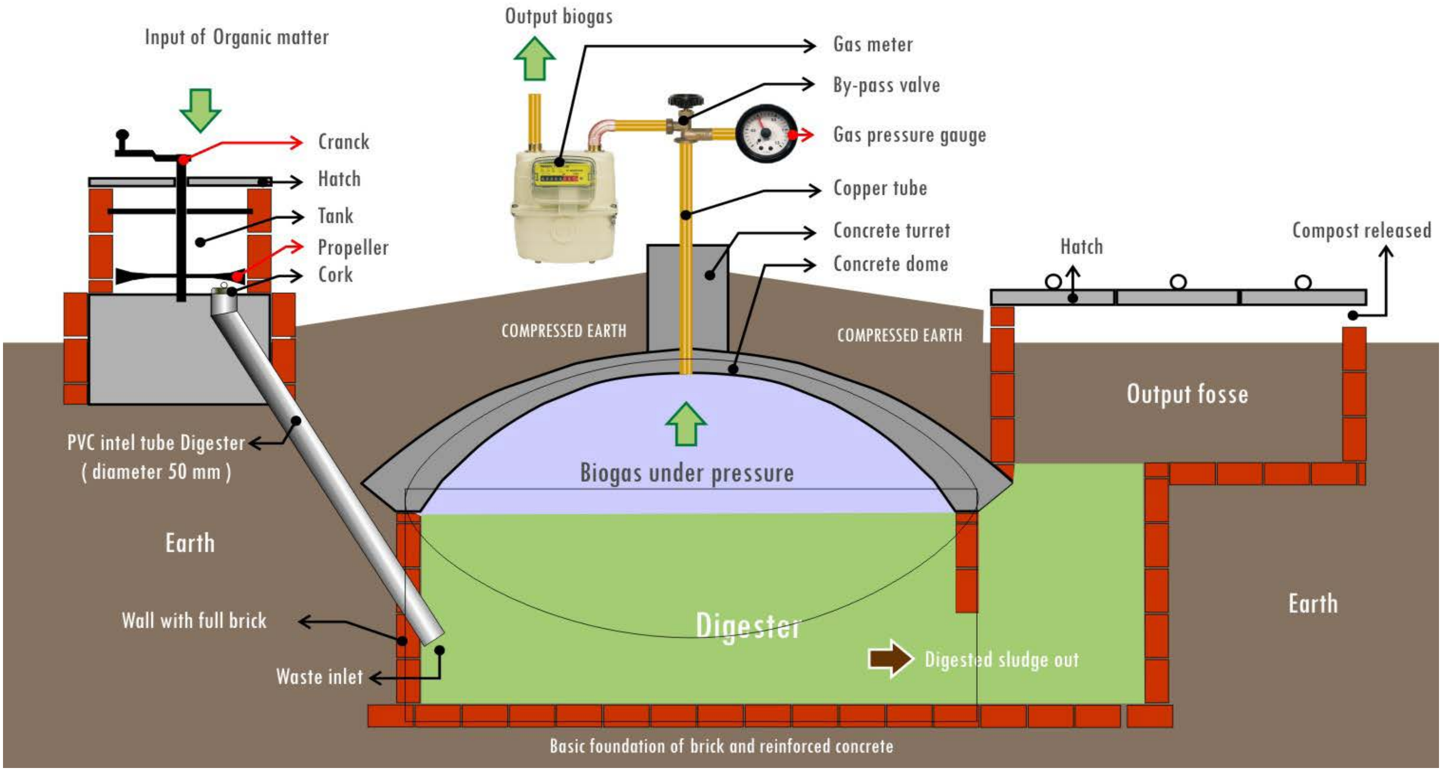
Biodigesters, do benefit from heating to operate in wintertime, however, they do not need to be anywhere near peak performance temperatures of 38 degrees Celsius. They need only minimal operating heat between 15 degrees and 25 degrees. Secondly, the heat that is produced, needs to be focused in the “active zone” in a biogas digester, which is located on the bottom of the digestion chamber, half-way between the center and the inlet.

The “Active Zone” of a plug-flow biodigester is located ½ the distance between the center of the digestion chamber and inlet

Biogas is a mixture composed essentially from Methane (50 to 70%) and dioxide carbon (CO_2) with varying quantity of water vapor and hydrogen sulfide (H_2S)

Anatomy of biogas system

Draw by Mohamed Chaabouni
Date 04/09/2015



List of materials

Pressure gauge

Copper tubes

Insulation

Pvc tubes

Gas meter

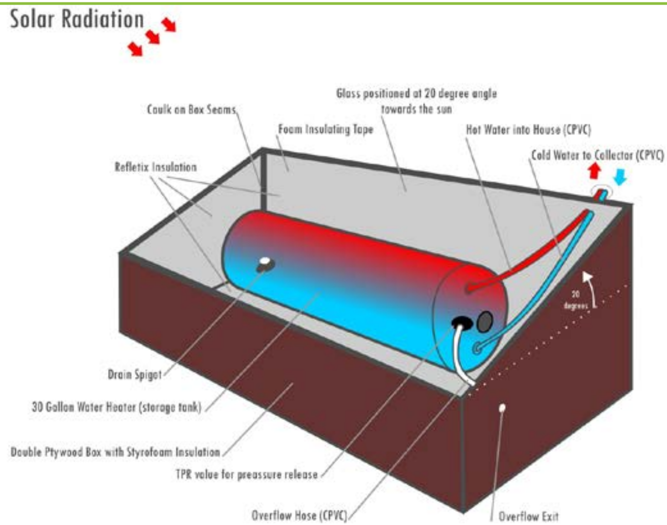
Tank

Heating system

Option 1: Water hose spiral

Option 2: Water heater with plastic bottles

Option 3: Water heater with reflective mirror



Inside the digester

Below we describe in steps the phases of making a biogas digester in “Eco-Building a Better World” project in Tramonti. Its main chamber has a capacity of 2.000 liters and in will be enough to cover the Acarbio’s cooking needs.

Leveling the surface

We first cleared the surface vegetation in an area of 50 square meters and leveled an area of 2 by 2 square meters. We then made a mixture of one part of lime, two parts of volcanic ash and nine parts of pumice we dug out of the construction site. Using 0,5 cubic meter of this mixture and a frame of upcycled iron banisters we extracted from the building windows as reinforcement, we made a base for the digester, solid enough to bear the two ton weighting digester (when full). Then we made a second base for the solar water heater, facing south at an ankle of 45°.

We picked a place with an altitude difference of two meters between the digester and the water heater. This helps the water circulation (with the Bernoulli effect) and the orientation of the water heater. It will also help the slurry management.

The main chamber

We drilled two holes of 70 mm in diametrically opposite positions, 20 cm higher from the bottom of the tube. There we installed the inlet and outlet of the system with PVC tubes.

We also drilled two holes of 20 mm 10 cm higher from the bottom of the tube and we installed internally the hose that will receive the warm water from the solar water heater from one end, make a spiral in the active zone of the digester and finally lead the cooler water back to water heater.

We drilled one 15 mm hole on top of the chamber and we installed a copper tube for the biogas outlet and a pressure gauge.

Finally we sealed everything with epoxy resin.

Water heater

We made a 50 by 50 by 10 cm box, using 10 cm wide plank for the round frame, a 3 mm thick metal sheet for the bottom and glass for the top. Everything was up cycled. Then we put a water hose inside the box coiling it like a spiral. We painted everything inside the box black for better absorbsion of the solar heat, insulated the hose parts outside the box with neoprene and finally covered the box with glass and sealed it with silicone.

Final installation

We placed the main chamber in place.
We connected it with the solar water heater.
We run a test leakage test filling the system with water.

Annexe

designbuildlive.org

ECO-kitchen:

http://www.riservabiosferacostiera.org/images/download/eco-kitchen.pdf

www.cob.gr

Italy, Tramonti

2015