Energy Production Through Organic Waste Gasification

ECO SOLUTION

Installation of 100,000 tons / year
Săcele – Brasov

Presentation of the Technology

Fields of application:

- Energy recovery from municipal waste;
- Energy recovery from waste resulting from sorting and recycling;
- Energy recovery from biomass, agricultural waste and forestry;
- Energy recovery from oil waste;
- Energy recovery of organic and dangerous biological waste;
- Treatment of gaseous pollutants.

Energy recovery involves:

- Turning waste into a synthesis gas with energy value containing hydrogen and carbon monoxide;
- Recovering the heat resulting in the process;
- Derived fuel production;
- Electricity production in cogeneration / trigeneration.

Benchmarks of eco-efficiency

Disposal of the waste by putting it into value;

Zero harmful emissions into the atmosphere, soil or water;

Treating all types of organic waste, including those of hazardous and toxic type;

Safety in operation.

Stages of the process

Waste reception;

Sort (optional)

Recyclable waste recovery;

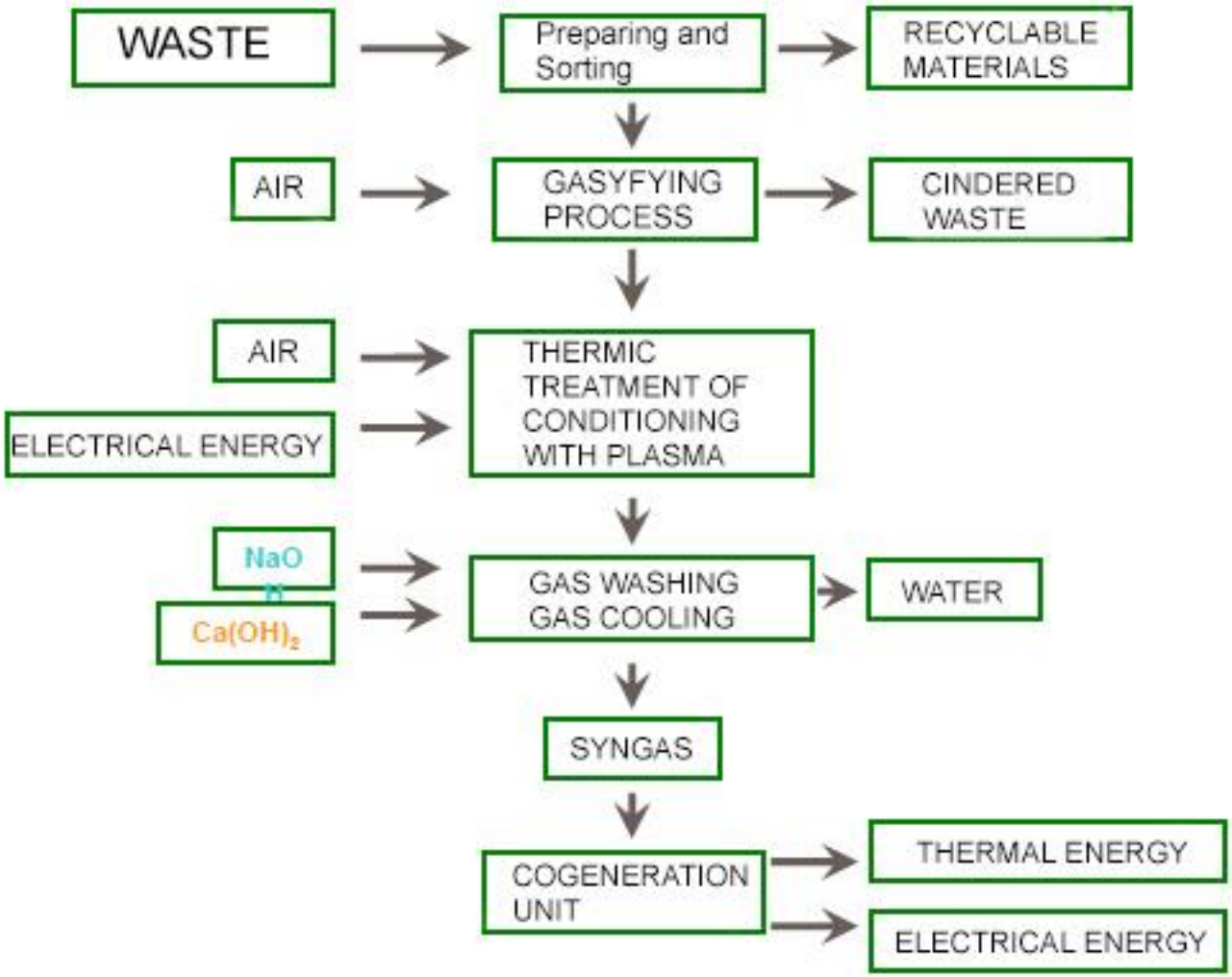
Preparing for gasification;

Gasification of waste;

Thermal and chemical cleaning of the synthesis gas;

Production of electricity in cogeneration / trigeneration.

The block diagram



Reception and sorting of the waste

Waste Reception

In this area the waste is placed on a conveyor belt introducing them in a plastic bag opener and then they are transported to the sorting line.

Sorting

In the first phase of sorting a rotating cylinder separates liquids and small materials by centrifugal motion.

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In the second stage of sorting, we are separating paper, glass and plastic items manually for recycling.

In the third stage of sorting we separate automatically with magnetic and diamagnetic devices ferrous and non ferrous metal objects for recovery through recycling.

Preparing for gasification

In the first stage of preparation, waste is stored in bins according to heat capacity.

In the second phase of preparation, according to mixing recipes of the heat value, the waste is automatically retrieved from storage bunkers, shredded in a shredder and transported to the gasifier.

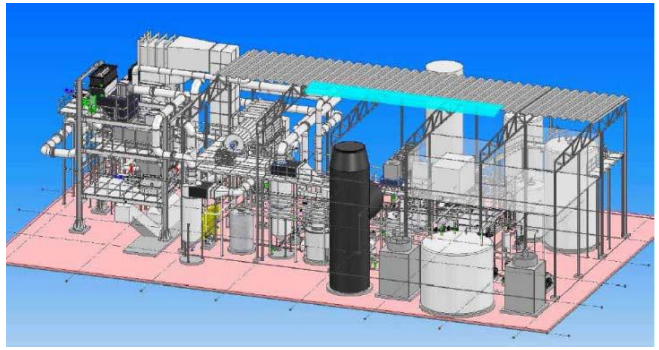
Waste gasification

The gasyfying unit is a sealed-tight reactor where the organic waste is transformed into gas and anorganic waste is evacuated as cinder (2-5% of the total waste weight).

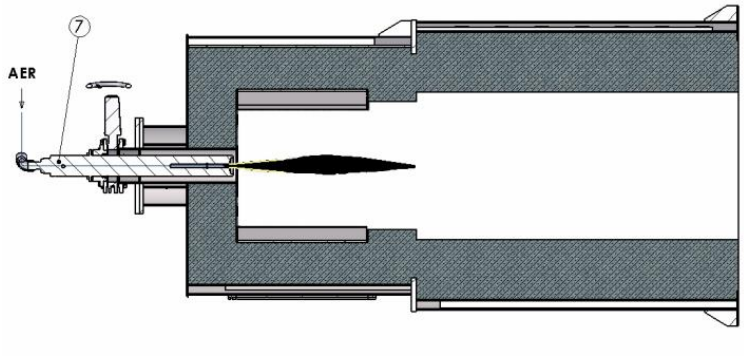
The gasyfying unit has 4 different areas arranged in cascade. The first area is for waste ingestion, the second is for preheating at low temperatures (max 180 C), the third is the pyrolysis and gasification and the fourth is destined for treating and disposing of the inert cinder.

Heat and chemical treatment of the synthesys gas

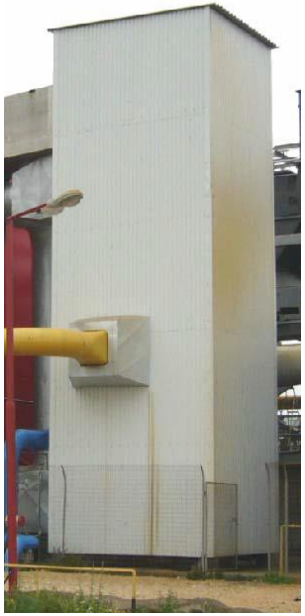
Syngas derived from the pyrolysis and gasification area contains tars, biological macromolecules and inorganic particles. This is introduced in a plasma reactor for the thermal decomposition of macromolecules.



Syngas decomposes in the ionized plasma environment at temperatures over 10,000 ° C into basic chemical components. Here also, carbon is oxidized to CO.



Syngas is passed through a gas-gas heat exchanger to reduce its temperature up to 60 º C. The amount of recovered heat is supplied to the gasification reactor.



The Syngas, cooled to 60 º C is basic washed in a scrubber for cleaning by spraying and retention of acidic components, after which a condensation and separation of water droplets takes place in a demister to remove moisture.

Treatment unit for the process water

Consists of 6 areas:

- The precipitation and liquid-solid separation with a hydrocyclone;
- The neutralization area;
- Collecting the silt, fine gravel and sand filtering area;
- The dosing and distribution of chemical agents area;
- Buffer zone;
- Area for measuring the final parameters.

First, the sulphate ions are precipitated using a calcium hydroxide solution, and the suspension formed subsequently is introduced in the hydrocyclone.

Solid fraction is pumped into a sludge collector, the liquid fraction enters the unit for agglomeration / neutralization.

- A solution of trivalent (flocculant) iron ions is added to agglomerate suspended solids in agglomerates.
- After the reaction, the pH level will be adjusted. We use NaOH alkaline solution or HCl acidic solution to increase or decrease pH levels.
- Water will be placed in a filter for separation of agglomerates, which are subsequently transported in the sludge collector.
- Before the water reaches the control area it will be filtered through a laminated filter.
- The last stage will measure the water pH, ensuring thet it has ideal parameters for reuse in the system.
- As a safety measure there is an additional tank which removes the risk of total shutdown of the entire installation.

- Following the heat and chemical treatment we obtain a clean gas with low energy (5-8 MJ / Nm^3), but also lower emissions at the chimney than those from methane gas.

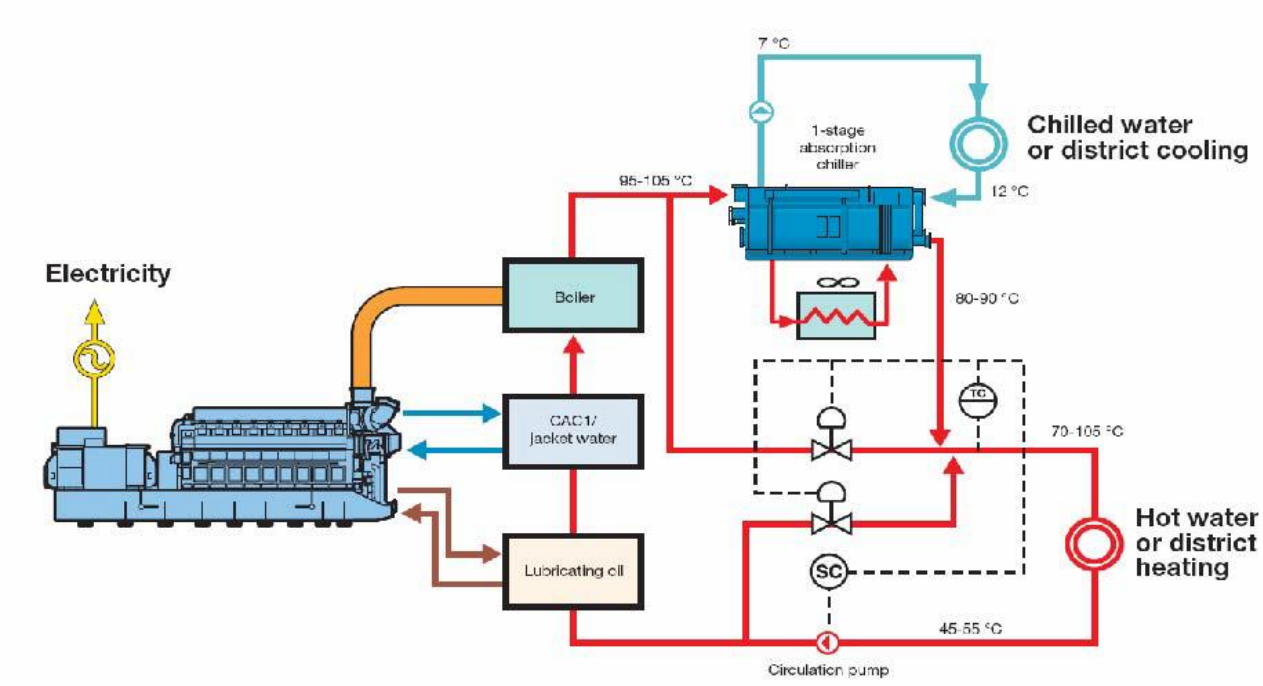
- The gas thus obtained is optimum for usage in a cogeneration / trigeneration generator, for obtaining heat and electricity.

Electric energy production in cogeneration / trigeneration

- The current level of technology allows different solutions to put to value the resulted gas according to the quality of the waste used and the local energy it needs to produce:
  - Electricity;
  - Process steam;
  - Hot water;
  - Air / hot water heating apparatus;
  - Cold ambient air for cooling.

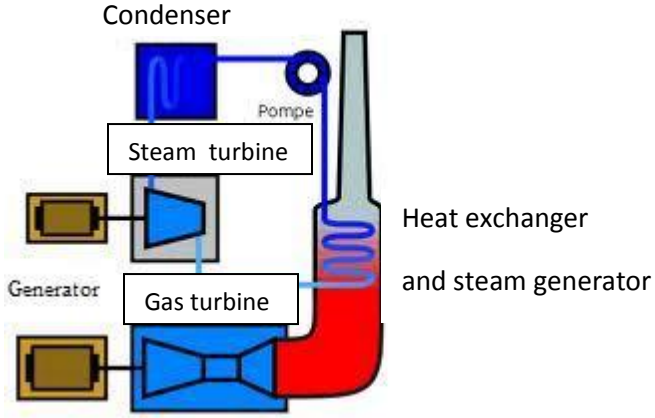
- The 5 solutions can be used individually or simultaneously in any combination required.

Producing electrical energy Engine-Generator groups



Producing electricity with or without cogeneration / trigeneration using engine-generator groups with high electrical efficiency (44-48%) can be applied together with domestic hot water production and agent for thermal heating and ambient cooling.

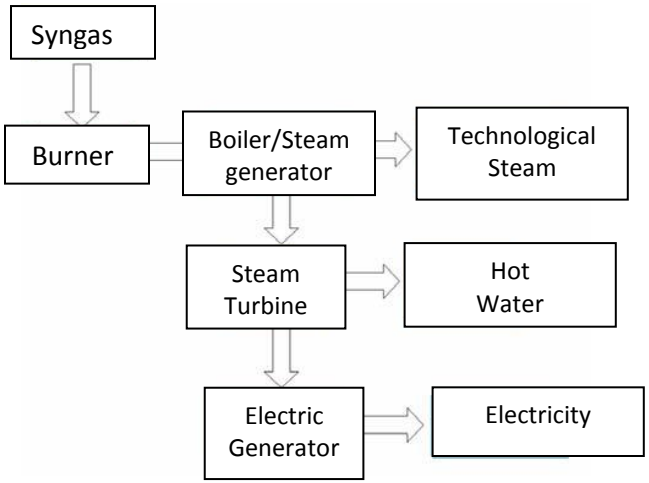
Producing Electricity Generators groups with gas turbines



Electric gas turbines have efficiencies of 32-34% and there are used in cogeneration / trigeneration similarly to the piston or combined cycle engines, where electrical efficiency reaches 48-50% and the heating is negligible.

Producing Electricity
Steam turbines generating groups

- Steam turbines have the lowest electrical efficiency, 24-26%, but in cogeneration it can exceed 100%. This solution is preferred when there is a technological steam consumer or networks for distribution of centralized heat.
- This is the general solution of gas energy recovery. In the case of centralized heat distribution networks we can locally produce cold water and air for ambient temperature control.



Installation dimensions

Waste reception area: Lxlxh [m] 150x20x15

Gasification area LxWxH [m] 15x15x20

The gas and water treatment
process includes operating room area of 25 m2:
Lxlxh [m] 15x23x14

Thank you for your interest !