TESLA TECHNOLOGIES

BRIDGE TO THE FUTURE

MOBILE CYCLONE GAS GENERATOR

Main characteristics of Mobile Cyclone Gas (MCG) generator

Currently, gas fuel, for example, in the form of methane (CH4), a natural gas, has found wide application in equipment that produces energy (heat, electricity). In this case we propose a description of the industrial design of gas-generating equipment, hereinafter referred to as the “Mobile Cyclone Gas Generator” (MCG). The main characteristics of the MCG:

- Multi-fuel - the ability to generate synthesis gas from many types of solid fuels (wood waste, agricultural waste, bird droppings, peat, brown coal and others);
- In the existing energy-producing equipment, our synthesis gas burns like methane, therefore, methane-based equipment can run on our synthesis gas as well;
- Proposed industrial MCG prototype has a gas power of 2.5 - 4.0 Megawatt / h (depending on fuel) and mass- dimensional characteristics that ensure placement in its equipment in four twenty-foot containers not exceeding 10 tons of the total weight of the equipment.

The importance of MCG in reduction of costs

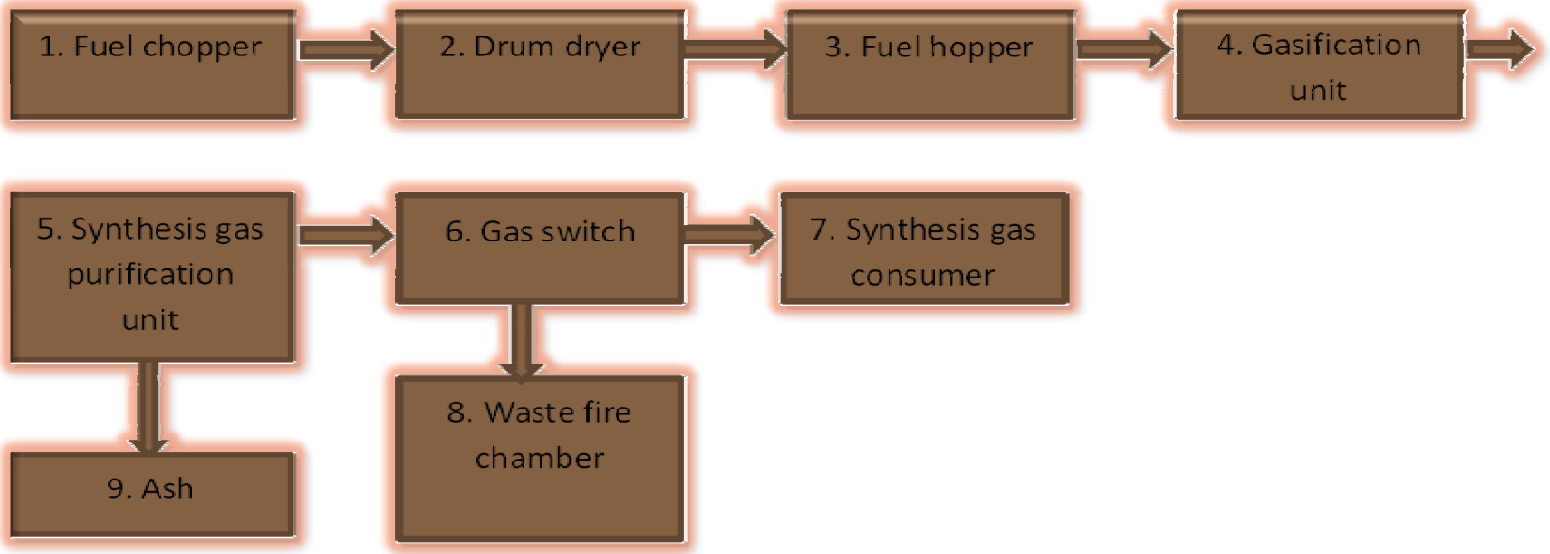
Using the proposed MCG is able to solve the energy problem - the production of synthesis gas (energy supply), the environmental problem - the disposal of waste, for example, chicken manure (ecology) and the task of providing synthesis gas in an autonomous mode, next to the location of the fuel (autonomy). MCG can be applied both to existing enterprises and to those under construction.

At present, the possibilities of such a physicochemical effect as gasification are underestimated in the world. The use of gasification will reduce the dependence on imported natural gas. The most effective use of gasification is where there is an internal accumulation of waste materials (fuel), for example, bird droppings, agricultural waste, peat, brown coal and others.

The payback period of investments in our equipment is significantly short.

The introduction of MCG into the industry will lead to a reduction in energy costs in production, which will lead to a reduction in the cost of industrial products.

Structual diagram and description of the complex MCG



1. Fuel chopper
2. Drum dryer
3. Fuel hopper
4. Gasification unit
5. Synthesis gas purification unit
6. Gas switch
7. Synthesis gas consumer
8. Waste fire chamber
9. Ash

Fuel is supplied to the Fuel chopper (1) for grinding to a fraction of less than 10 mm. The crushed fuel is dried in the Drum dryer (2) to a working humidity of not more than 12%. From the output of the unit (2), the working fuel enters the Fuel hopper (3) and then is supplied to the Gasification Unit (4) with the help of a screw. From the output of unit (4), a mixture of synthesis gas and ash is supplied and fed to the Synthesis gas purification unit (5). Ash (9) is separated from one output of the unit (5), and purified syngas is fed from the other to the Gas Switch (6). From block (6), the purified synthesis gas is supplied to the Consumer (7). At the time of ignition of the MCG, all synthesis gas is supplied to the Waste fire chamber (8) in which it is burned to complete combustion.

The gasification unit (4), containing chamotte masonry, is designed for a life of 10 years. After 10 years, this unit must be replaced. All electric motors and electronic devices used at the MCG are manufactured at the enterprises of the European Union and have a 2-year warranty period.

The chemical composition of the synthesis gas

No	Name	Units of measurement	Value
1.	Hydrogen (H_2)	Voluminous %	10
2.	Nitrogen (N)	Voluminous %	50 – 52
3.	Oxygen (O_2)/	Voluminous %	0
4.	Methane (CH_4)	Voluminous %	2.5
5.	Carbon dioxide(CO_2)	Voluminous %	12
6.	Carbon monoxide (CO)	Voluminous %	20-22
7.	Ethylene (C_2H_4)	Voluminous %	1,5 – 1,8
8.	Ethan (C_2H_6)/	Voluminous %	0,6
9.	Propylene (C_3H_6)	Voluminous %	1,2 – 1,4
10.	Propane (C_3H_8)	Voluminous %	0,2 – 0,3
11.	Calorific value (calorie content)	Kkal/nm3	1100-1300

About device: introduction

A gas generator is a technical device that provides the conversion of solid (liquid) carbon-containing fuel into gaseous fuel.

The main benefit of using gaseous fuels is the high efficiency of boiler equipment, gas piston and gas turbine engines.

The use of a gas generator as a pre-converter of a wide range of different types of solid fuels into gaseous fuel that is supplied to the boiler as the main fuel significantly increases the economic efficiency of boiler equipment. Our practical experience shows that the energy efficiency of the gas generator for various types of solid fuels is at least 95%. By energy efficiency we understand the ratio of the calorific value of the gas at the outlet of the gas generator to the calorific value of the input solid fuel loaded into the gas generator.

Fuel and calorific value of gas at the outlet of the GG station

We consider wood waste with the following characteristics as fuel:

- the size of the pieces is not more than 10mm
- working humidity 12%

Calculation of fuel calories (MW per 1 t.):

$KMwt = 1.163 * (4.5 - 0.05 * Wr (\%)) = 1.163 * (4.5 - 0.05 * 12) = 4.54$ Mwt per 1 ton of fuel, (1.1)

Where 4.5 cal / t - calorie content of absolutely dry wood

0.05 - a coefficient that allows you to calculate the calorific value of wood depending on the working humidity

Calorie content of wood, expressed in Gcal per 1 t. Is determined by the expression:

$KGkal = 4.5 - 0.05 * Wr (\%)$

1.163 - conversion rate Gkal to Mvat. $KMwt = 1.163 * KGkal$.

Working humidity - $Wr = 100\% * Mh2o / (Masd + Mh2o)$, where

Mh2o - mass of water in a test sample of fuel

Masd - mass of absolutely dry wood fuel test sample

2.3. Calculation of gas calories at maximum GG station productivity

The calorific value of the gas at the outlet of the GG station is equal to $Kgaz = 0.95 * 0.750 * 4.54 = 3.2$ MW / h,

where 0.95 - Energy efficiency of the GG station,

0.750 t / h is the mass of fuel supplied by the screw (maximum capacity of the screw).

4.54 Mvat / t - calorie content of 1 t.

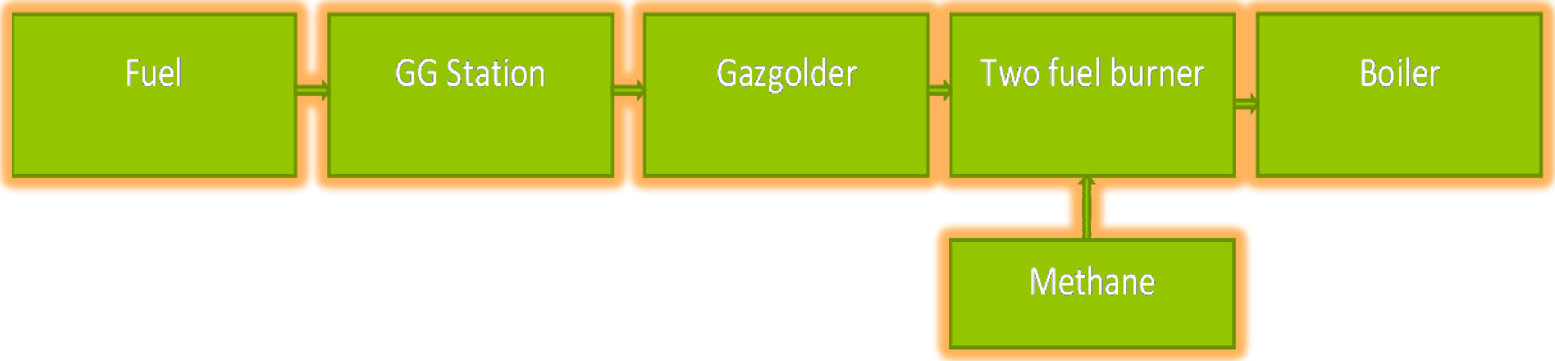
2.4. The experiments showed that the minimum GG productivity of the Kgaz station $= 0.95 * 0.07 * 4.54 = 0.3$ Mvat / h, where

0.07 t / h - minimum fuel screw performance.

2.5. The dynamic range of station productivity is from 3.2 MW / h - 0.3 MW / h.

3. Block diagram of the production of thermal energy

3.1. The following block diagram is proposed.


Fuel
GG Station
Gazgolder
Two fuel burner
Boiler
Methane

Solid fuel is supplied to the GG station. From the GG outlet of the station, synthesis gas is supplied to the gas tank (synthesis gas storage). From the outlet of the gas holder, synthesis gas is fed to a two fuel gas burner. Natural gas (methane) can be supplied to the burner. The boiler can operate in one of two modes: a) 100% on methane (there is no synthesis gas) b) a mixture of synthesis gas with natural gas in various proportions. At the maximum capacity of the GG station, the methane fraction is minimal and represents a background torch (for example, 0.05%). The background torch is designed to quickly transfer the boiler to methane at an unexpected stop of the GG station.

3.2. Let us evaluate the requirements for the capacity of the gas tank, which should ensure the transition of the boiler to methane in case of an unexpected stop of the GG station.

3.2.1. We assume that the main mode of the boiler is a gas mixture: synthesis gas * 99.95% + methane * 0.05%.

3.2.2. We assume that with a sudden stop of the GG station, the maximum time for the boiler to transfer to methane * 100% is early 15 min.

3.2.3. The calorific value of the synthesis gas is 1200 Kcal / m3 = 1.4 Kwt / m3.

3.2.4. At a maximum boiler output of 3 mW / h in 15 minutes power consumption is 3/60 * 15 = 0.75 MW = 750 kW

3.2.5. The required capacity of the stabilization gas tank is 750 / 1.4 = 535 m3 at atmospheric pressure.

3.3. It is advisable to use two gas burners in order to minimize the risks of producing thermal energy at the boiler outlet and maximize profits (since the cost of synthesis gas is much lower than methane).

4. Estimation of the maximum amount of heat produced per month.

3.2 Mwat * 24 h * 30 days * 0.95 = 2188.80 Mwat / month

5. The composition of a set of equipment:

a) GG station

b) two gas burner with a set of automation

c) stabilization gas tank with a capacity of up to 1000m3.

THANK YOU

For more details please contact: info@trueteslatechnologies.com