

POWER MODULE

ELECTRICITY FROM WASTES



2 tons/hour
Wastes →

MES Engineering



Gasification
plant

Product - Gas →

Furnace oil →

OPRA



Turbine 1
1.85 WMe



Turbine 2
1.85 WMe



3 MW/h

CAPABILITIES OF THE COMPLEX. PROCESSING

Possibilities of the facility. Recycling:

- **SMW**
- **Industrial waste**
- **Liquid oil slimes (incl. tars)**
- **Pasty oil slimes**
- **Oil-polluted soils**
- **General mechanical rubber goods (incl. tires)**
- **Coal cake**
- **Brown coal**
- **Peat**
- **Agricultural wastes**
- **Rail ties**
- **Medical wastes**

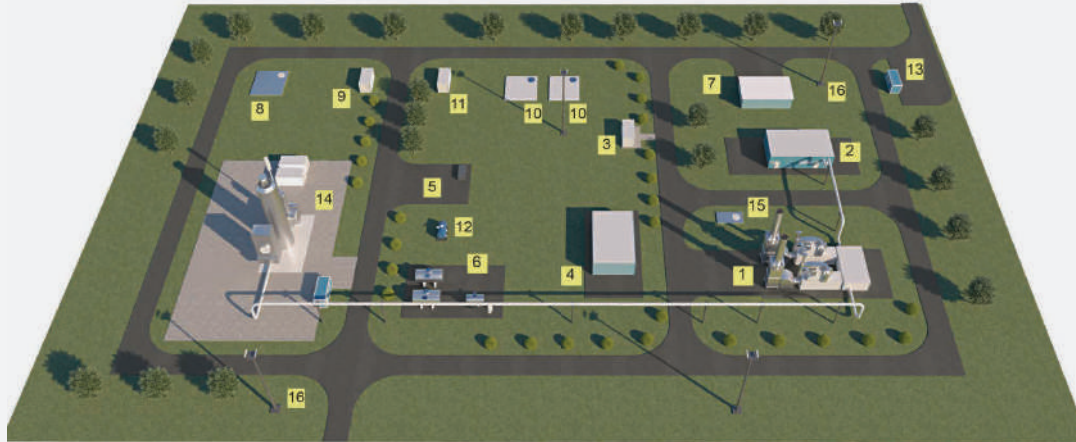
Waste with humidity content up to 75% may be used

- **Palm oil**
- **Recycled motor oil**
- **Agricultural waste:**
 - Manure
 - Litter
 - Straw of any type
 - Rice husk
 - Coconut wastes
 - Etc.

Processing amount	2 tons/hour
Time of facility operation	8,000 hours/year
Solid wastes	Caked up
Liquid wastes	Fed with a pump

- * **there are test reports**
- * **there are expert opinions of the ROSNEFT oil company about testing**

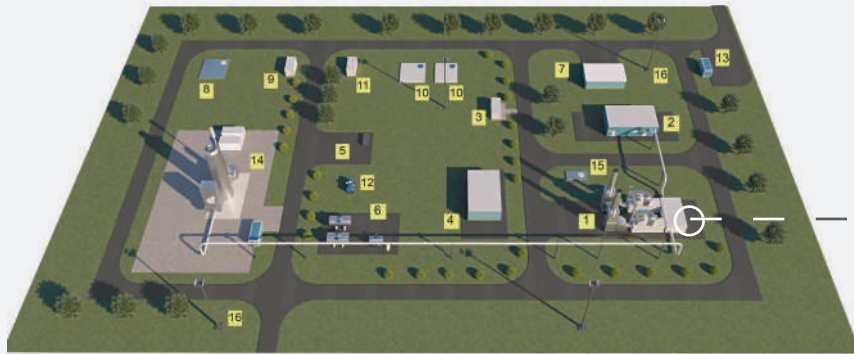
FACILITIES LAYOUT



No.	Name
1	Power module
2	Heat Exchange Module
3	Black start and reserve diesel genset
4	Building of the fuel and oil pump house
5	Draining device
6	Diesel Tank
7	Repair and storage unit
8	Rainwater storage tank

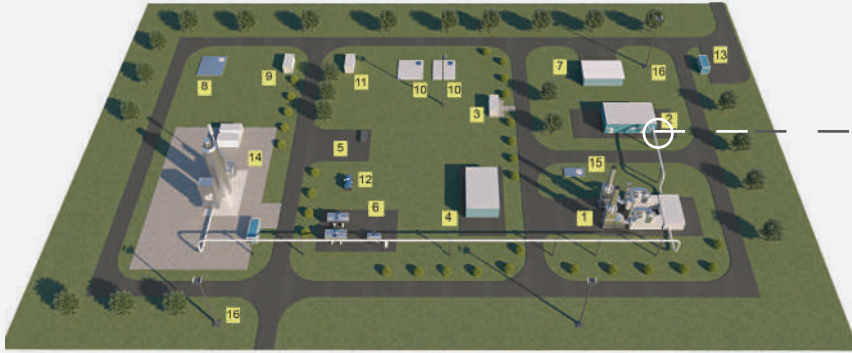
No.	Name
9	Rainfall drain sewage pumping station
10	Fire water tank
11	Block firefighting pump house
12	Process tank
13	Checkpoint
14	Gasification installation with a solid fuel storage site
15	Septic tank
16	Floodlight masts

The total area of the site is 20,000 sq. m.



Fully radial gas turbine units OPRA

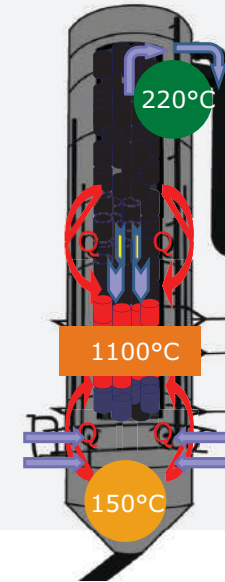
- made in the Netherlands
- the highest reliability due to the unique design
- fuel flexibility and multifuel capability (switching fuels at full load)
- high degree of prefabrication
- high efficiency of heat and electricity production
- extremely low emissions
- low maintenance costs and worldwide service support (42,500 hours to overhaul, maintenance after every 8,500 hours)
- proven efficiency (over 100 installations worldwide)



Efficient operation of the complex requires approximately 500 kg of steam per hour. The temperature of the GTU exhaust gases is about 570 C. Two OPRA GTUs allow producing about 12 tons of steam per hour (120 C, 12 bar). The remaining heat may be used for supplying heat to users with the steam and hot water, or used for direct drying of the industrial raw materials or semi-finished products (e.g., ceramics).

The unit may include:

- steam boilers,
- hot water boilers,
- adsorption chillers,
- ORC modules.



The following processes occur in the reactor:

- pyrolysis
- coking
- combustion reactions and gasification with water vapor

Temperature zones:

- Heating zone - 0-200 °C
- Pyrolysis zone - 200-600 °C
- Semi-coking and coking zone - 600-900 °C
- Combustion and hot coke contact with water vapor zone - 900-1200 °C,
- Air heating zone 100-900 °C
- Discharge area - 50-100 °C,

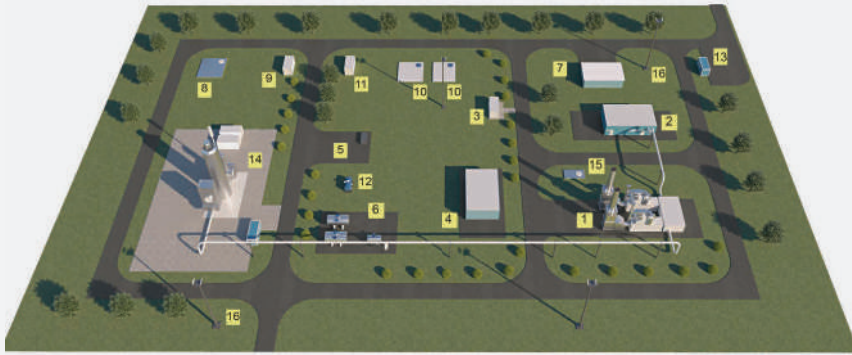
During operation, the following is obtained:

- Gas-and-vapor mixture, which is divided into:
- The product gas (the synthesis gas)
- Liquid organics (diesel fuel)
- Water vapor
- Ash (hazard class IV) 4-7%

For operation, the gasification plant requires:

- Water - 1 cubic meter/h
- Electric power - 60 kW/h

AUXILIARY EQUIPMENT AT THE SITE



Auxiliary objects that ensure viability of the energy complex with its uninterrupted operation.

Tanks with liquid fuel are provided, which allows operation during routine and emergency maintenance, and acceptance of diesel fuel, if necessary.

A warehouse with repair kits is envisaged, which allows performing repair of any complexity within 3 days.

WHAT ARE THE BENEFITS

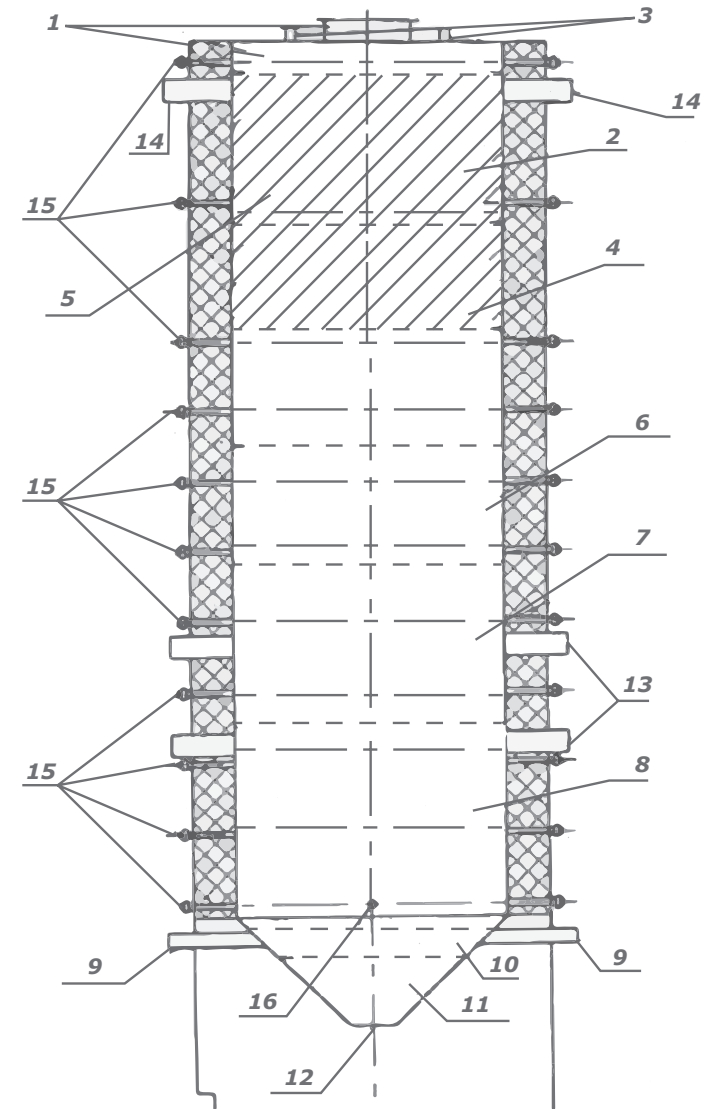
ECOLOGY

Studies of ash (solid residue) obtained after SMW gasification have shown that it classifies as 4 class of danger waste. Temperature control in the combustion zone by supplying water vapor does not allow formation of nitrogen oxides, which is confirmed by their absence in the flue as measured by Health Inspection employees in Tula.

The process flow excludes the possibility of dioxins formation during solid wastes gasification. In zones 1, 2, 4, 5, and 6, the environment is regenerative. Considerable quantities of free hydrogen are present. All oxygen is completely used in zone 7. Moreover, hot coke and semi-coke come in contact with the oxygen (the combustion process) in zone 7. The absence of oxygen above the combustion zone eliminates the mechanistic potential of dioxins formation.

Energy security:

- Local energy resources
- The maximum duration of repair is 3 days
- Fuel tanks for the time of repair
- Raw materials flexibility
- Full operating autonomy



COMPARISON OF THE TECHNOLOGIES

No.	Name	MES Engineering	Pyrolysis	Biogas
1	Recyclable wastes	Wide range	Wide range	Narrow range
2	Interruptible work cycle	yes	no	yes
3	Ecology	No dioxins formed Hazard class IV ash With all types of wastes	The ash contains hydrocarbons	Depends on the type of wastes
4	Operating costs	Low	Low	High
5	Obtaining electricity	Yes	No	Yes
6	Obtaining heat and hot water	Yes	No	Yes
7	Estimated cost of equipment without turbines	starting with EUR 3 million	starting with EUR1 million	starting with EUR 14 million
8	Amount of wastes/electric power	2 tons/3 MW		28 tons/6 MW (2 tons/0.4 MW)
9	Equipment manufacturing time	6 months	4 months	12 months

OPEX based on 10 years of facility operation:

- Salary to the staff (6 persons x 4 shifts per day)
- Routine maintenance and overhauls (the gasification installation and 2 turbines)
- Consumables
- Purchased services
- Insurance

OPEX 720,000 Euros per year

Operating costs per 1 kW/h

- 1 set (3 MW) - EUR 0.03
- 3 sets (9 MW) - EUR 0.02
- 15 sets (45 MW) - EUR 0.01

Products:

- Electric power - 3 MW
- 11 tons of vapor, or the hot water or cold equivalent

Ecology

Used raw materials flexibility, including humidity

Small size of the complex, and low consumption of raw materials

Completely standalone, operation independent from external power sources

Flexible increments in the project scale

High power and economic efficiency

OFFICIAL DISTRIBUTOR



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