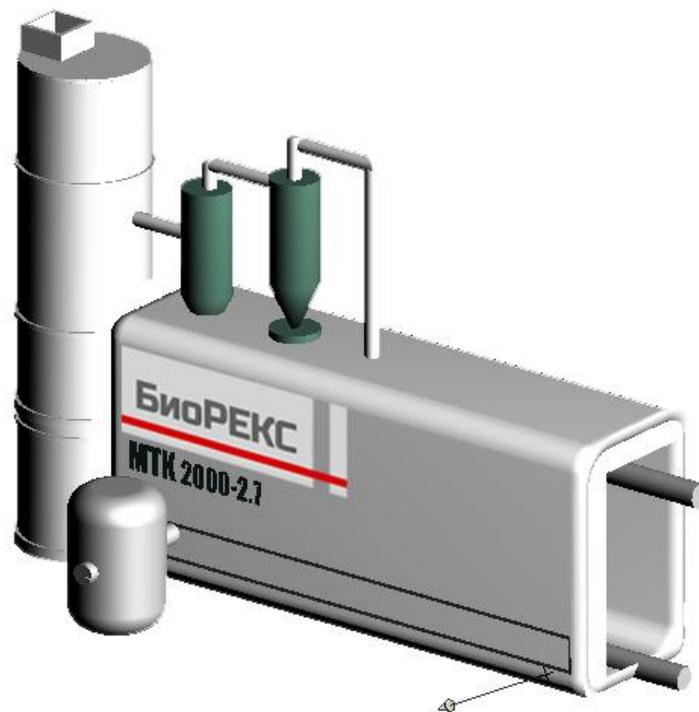


Thermochemical conversion of carbon containing materials and power production with Bioreks™ technology

## Local Energy

### «МТК2000-2.7»



**Main equipment:** Gasifier system,

**Main indicators:**

- Productivity, 1600nm<sup>3</sup> gas/h
- Feedstock consumption: 600 kg/hour, 14,4 t/day (24 hrs), 5.256 t/year

**Supplier:** LLC БиоРЕКС™

---

LLC «BIOREKS»

Russia, Krasnodar, Yuzhnaya str. 25  
tel: +7 (861)244 40 23  
www.bioreks.ru

## 1. INTRODUCTION

Utilization of a household waste, fir-tree precipitation of the sewage, the fulfilled car tires, waste of a woodworking, oil refining, agricultural and medical waste – a big problem.

Methods of recycling applied still – burial and burning – showed the frailty and gave a number of the countries on a side of an ecological disaster.

At the same time, solving property of the specified materials – the content of carbon – the main source of energy of a modern civilization, - unequivocally defines an acceptable way of their processing.

For the last 20 years, in parallel with a rise in prices for fossil hydrocarbons, prompt development the technology of the gasification, allowing to make from a waste received synthetic or generating gas – a mix WITH and H<sub>2</sub> – alternative of natural gas, fuel oil and coal in steam coppers, diesel fuel in a diesel engine generators, universal raw materials for production of products of organic chemistry.

## 2. TECHNOLOGY

The BIOREKS™ technology represents idea of the weighed interaction with the nature when recycling and developing minerals, and also a way of association of several productions to the highly effective technological line in cycle completely without waste, according to the most strict requirements of the nature protection legislation – the Local power complex (LEK).

Applied unique technical solutions allowed to create the technological line with the zero emission, processing the wide list of materials. Independent, modular installations don't demand connection to engineering networks.

The modularity of installation allows to change consumer properties of a product at will of the customer at the moment of its acquisition and to increase, or to change its possibilities in use.

The design of LEK provides a triple guarantee of uninterrupted operation of work of the Complex: a daily stock of fuel, duplication of the main units with possibility of alternate shutdown for prevention and the equipment of a gas-holder or an account receiver for storage of reserve fuel it is optional.

- Completely independent modules demand only a timely supply of raw materials, work at own energy balance and don't demand external connections;
- The modular design allows to increase capacity of complexes in compliance with growing requirements and it is easy to transport the equipment to new place of production;
- LEK are the ideal decision for the organization of system of the distributed power supply of inhabited residential districts, processing a municipal waste and a fir-tree

precipitation of sewage, and providing all necessary energy carriers locally for needs of the area;

- The equipment choice for heat utilization when burning gas isn't limited to a steam or water boiler, use of gas turbines and a diesel engine - generating installations is also possible;
- The offered scheme of processing is easier entered in available industrial infrastructure, for example, gas can move in an available fire chamber for complete or partial replacement of nowadays used fuel;
- High power efficiency of conversion. One kg of raw materials gives 1 kW of electric and 2 kW of thermal energy;
- Absence of harmful emissions in the atmosphere;
- The simplified requirements to structure and raw materials preparation. LEK can process a waste in a mix. On the instructions of the Customer the knot of reception of a medical waste is provided.

## 2.1. Description of technological process

In drawing 2 is shown the scheme of configuration of module MTK2000 2,7, processing about 14,4 tons of an unsorted waste at an o'clock or 5 256 tons per year.

If module work on previously sorted MSW, the line of sorting isn't provided. At will of the Customer, the module of reception and processing of large-sized garbage, automobile tires or a medical waste is in addition provided.

The dump truck garbage truck calls in on the weight platform located in front of the reception hatch. The system automatically makes weighing. A municipal waste from a dump truck garbage truck is unloaded in the reception bunker of the sorting line (1). The height of the reception bunker is regulated by the operator of the Complex depending on car brand. After raw materials loading the bunker is closed, submitting raw materials on the conveyor of semi-automatic sorting (1). The conveyor is equipped with systems of a breaking of packages and a garbage tedding. The line of sorting is equipped with six posts of manual sorting and magnetic separators. When sorting nonflammable materials are selected: stone, ceramics, glass, non-ferrous and ferrous metals.

According to average morphological structure of a firm household waste the maintenance of nonflammable components in initial MSW makes about 13 %, of them: ferrous metals – 4 %; non-ferrous metals – 0,7 %; glass – 7 %; stones, ceramics – 1,5 %.

Nonflammable fractions contains from 10 to 15 %, for further processing 85-90 % of a combustible waste arrive.

The sorted materials arrive in accumulative bunkers, are pressed and go on sale.

The design of the line of sorting provided all requirements for safety of work and implementation of sanitary standards.

The sorted combustible waste arrives in Schröder for crushing on a class-15±30 mm.

Further, a waste on the tape conveyor gets to the block of drying of the raw materials (2), representing one or several drum-type dryers. The number of dryers depends on quantity and humidity of an initial waste. The being formed filtrate goes on neutralization to the module of water purification (6).

After humidity fall to 10-15 % a waste gets to the bunker of ready raw materials (3), volume 70 m<sup>3</sup> which is a daily stock of raw materials. In the bunker (3) a waste gradually moves to the conveyor on which the weight arrives in the reactor of thermochemical conversion (4) for production of combustible gas.

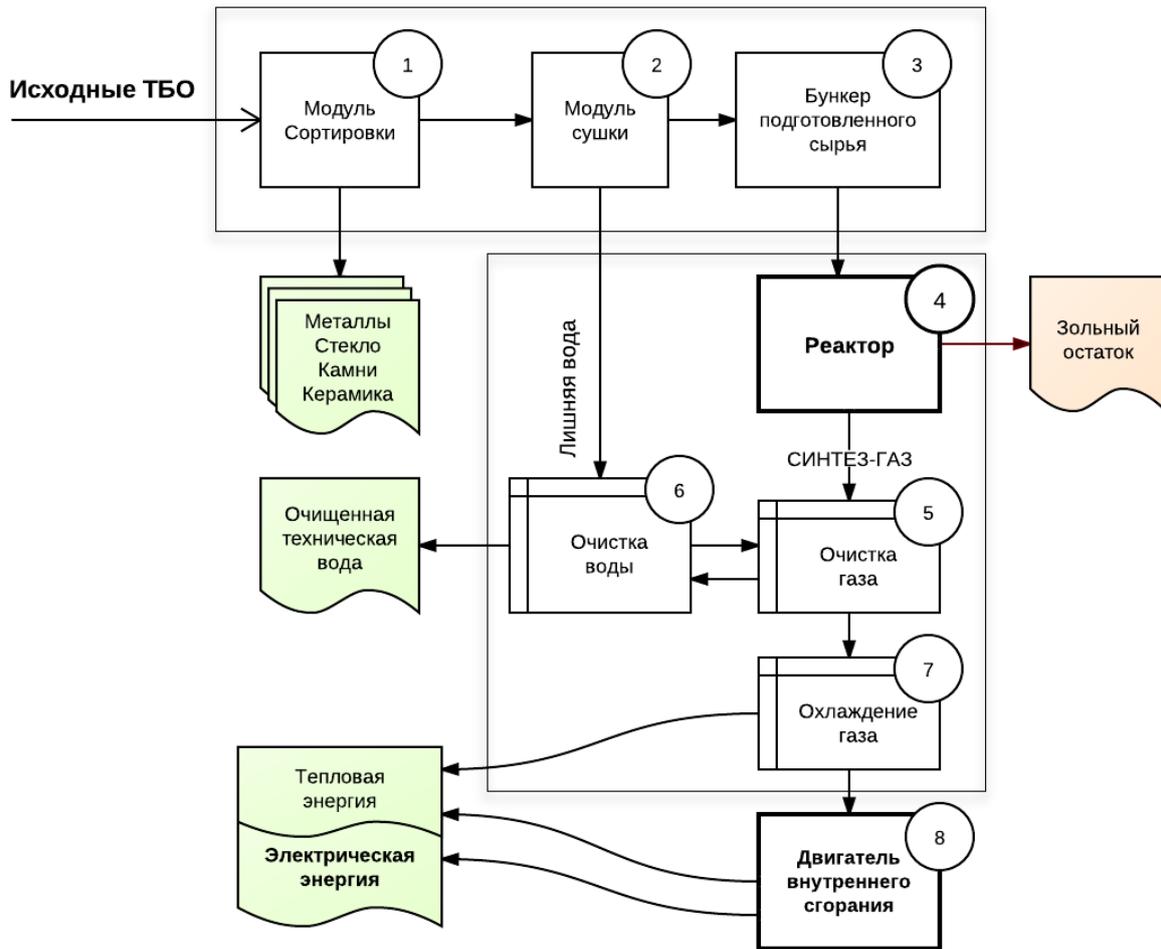
From reactors the steam-gas mix consistently arrives:

In the module of purification of gas (5) where it is cleared of heavy particles, impurity of steam, particles of ashes and oils. The impurity selected from gas gather and come back to the bunker of ready raw materials.

Further the cleared gas arrives in the module of cooling of gas (7) where it is cooled from 150oC to 30-40os. Then the cooled and cleared gas arrives in a diesel engine generators (8) for electricity generation. Exhaust gases a diesel engine generator with temperature 600oC gather and go on the heatexchange device for heat allocation.

The ashes which is forming in the course of thermochemical conversion, are taken from the reactor automatically at temperature 100-120os and arrive in the bunker of storage of the cindery rest. The cindery rest has now the weight only 10 % from initial MSW. Further the rest can be directed on the range for burial, or on utilization in the module of utilization of the cindery rest developed by our company – for allocation from composition of ashes of oxides of heavy metals.

The complex is equipped with an automated control system and is under continuous control of the operator.



**Fig. 1. Schematic diagram LEK-4000-2,7 on processing of a municipal waste and development of electric and thermal energy**

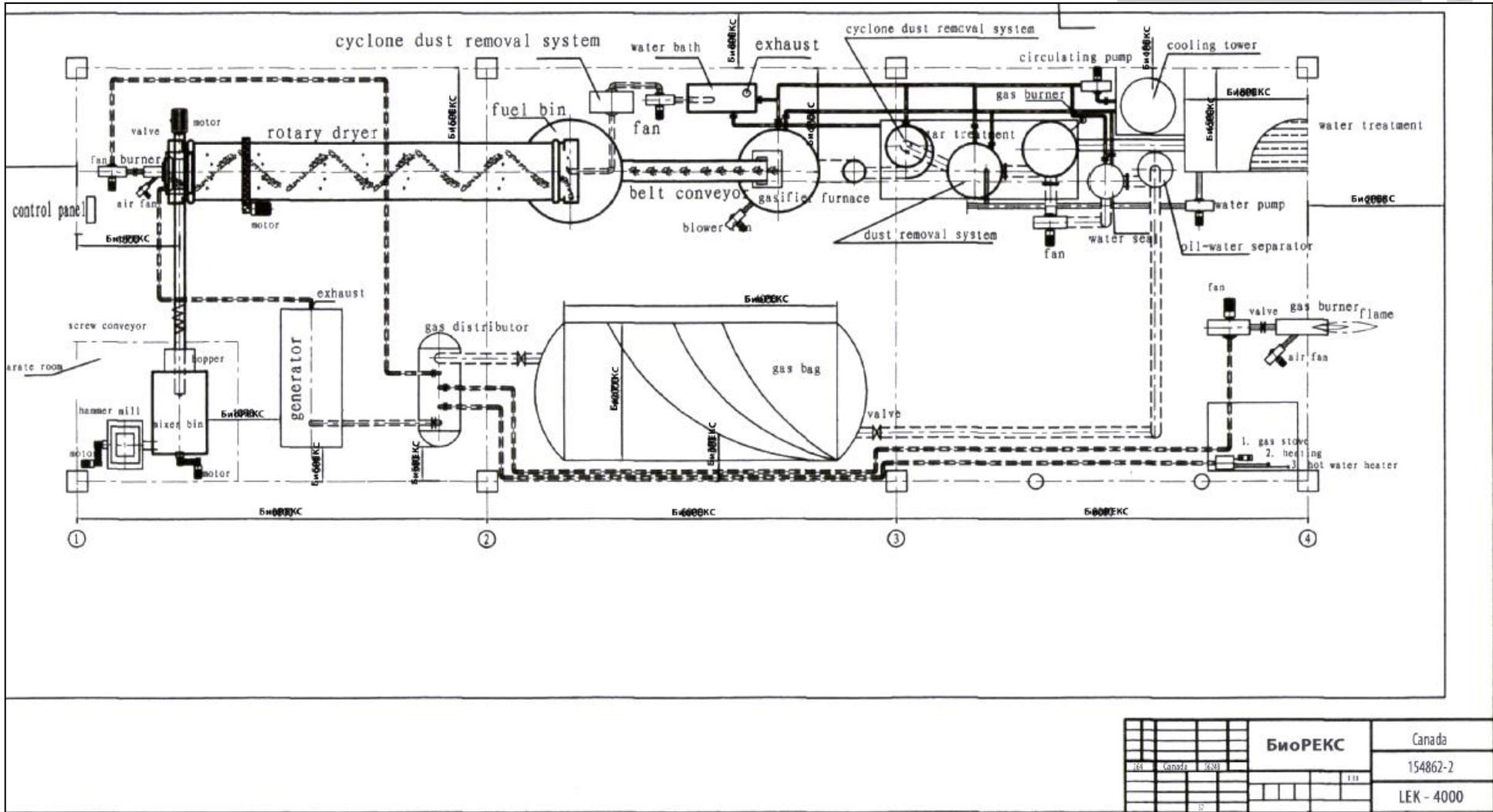


Fig. 2. Scheme of configuration of Complex LEK-4000-2,7

LLC «БиОРЕКС»

Russia, Krasnodar, Yuzhnaya str. 25  
 tel: +7 (861)244 40 23  
 www.bioreks.ru

		<b>БиОРЕКС</b>		Canada
				154862-2
				LEK - 4000

## 2.2. Main technical characteristics of module MTK2000-2,7

Описание	Значение
Name	MTK2000-2,7
Productivity	600 kg/h, 14,4t/d (24 h), 5256 t/y (8000 h)
Raw materials	Углеродсодержащее сырье, в т.ч. бытовые отходы
Quantity of raw materials on own power supply	10%
Humidity of raw materials	Any. Require module of preparing
Raw materials ash-content	Up to 40%
Work number of hours in a year	8 000
Productivity on synthetic gas	1100 nm <sup>3</sup> /h
Gas temperature on an exit from a gazifikator	100-150 °C
Gas temperature after cleaning and cooling	40-30 °C
Capacity electric	0
Capacity thermal cogeneration	1,6 MW
Power consumption	50 KWe
Water consumption	10 tons one time
<b>The occupied space</b> 2500 sq.m it is taken away under reactor system, gas storage, generators, a dispatching office 1500 sq.m it is taken away under preparation, raw materials storage, system of purification of turnaround water	50 sq. m
Dimensions L*W	10 * 5
Infrastructure	Giving of raw materials and production shipment
Gross weight	20 t
<b>Sanitary zone</b> the complex is rather safe, can settle down both in city line, and in the suburb	500 m
<b>Emissions</b>	within norms

## The main characteristics of the reactor

- The reactor converts 600 kg of raw material per hour with moisture content up to 15%. By reducing the moisture content of raw performance of the reactor can be up to 800-1000 kg of raw material per hour.
- The module includes a set of four reactors with total capacity of 2400 kg / h of prepared raw materials, which produce 1600 Nm<sup>3</sup> / h of fuel gas per hour with a calorie Kkal/nm<sup>3</sup> 2300-2500.
- Synthesis gas produced by the reactors BioREKS™, suitable for use in diesel-generator, modified to run on gas, as well as combustion or boiler.
- The elementary composition of the gas

Component	Content, %
CO	18-20
H <sub>2</sub>	10-13
CH <sub>4</sub>	2-4
C <sub>m</sub> H <sub>n</sub>	0.8
CO <sub>2</sub>	13
O <sub>2</sub>	1
N <sub>2</sub>	46

- The high efficiency of conversion of carbon - up to 95%, allows to process materials with low content of combustible components - with ash up to 40%;
- High energy efficiency;
- Due to the low temperature gas sampled and reversed the process of gasification of the formation of oxides of nitrogen, sulfur, chlorine or fluorine is not active and the content of harmful substances is within the norms;
- Sulfur is present in the gas recovered in the non-volatile forms (H<sub>2</sub>S, COS), which are easier to swallow than the SO<sub>2</sub>;
- The conversion of partial decomposition of nitrogen-containing organic compounds in oxygen-free environment, which gives a smaller number of nitrogen oxides in flue gases;
- The ash is unloaded from the reactor has a lower temperature to 200 0 C, and contains almost no carbon residue.

The reactor was completely sealed. Supply of raw materials is at the top. Raw material is drying and gasification zone.

For the supply of heat to the reactor using air blast. The coolant is fed into the work zone with a radial fan lance through the ranks, supporting the autothermal reaction is the conversion of raw materials with a limited amount of oxygen. To maintain the reaction consumes no more than 10% of raw materials.

Before entering the reactor, heat exchanger and the air is heated to a temperature of 400 ° C, which increases the reaction rate and reduces the formation of dioxins.

The main working area of the reactor has an operating temperature of 1300 - 1400oS that allows you to select the carbon with an efficiency of 95% and process certain types of hazardous waste.

Characteristics of gas emission confirmed the high purity of the environmental process the combustion of solid waste: the concentration of dioxins in the flue gases without cleaning them does not exceed 0.1 ng/m<sup>3</sup>.

The most dangerous mobile forms of heavy metals contained in waste, the thermochemical processing of the fuel in the reactor is converted to fixed metal oxides, turning into ashes.

## **2.7. Air supply system**

Air flow is the flow-radial fan. Before entering the reactor the air passes through the heat exchanger is heated to a temperature of 400oC. Prepared air mixture enters the working zone of the reactor through the ranks of lances.

## **2.8. Block cleaning and cooling the synthesis gas**

Requirements for clean synthesis gas vary depending on the composition of the feedstock. Before serving, the synthesis gas in a diesel generator, gas is cooled to 150 ° C to 30-40oC. Used for gas cleaning scrubber and the vortex separator unit environments that select couples, oil and soot, and mass-transfer apparatus which cleans the gas from acidic compounds.

If you are replacing natural gas, fuel oil or diesel fuel to heat boilers in the synthesis gas is used a simplified gas cleaning. Gas used in hot water or steam boiler burns completely.



**The composition of system of cleaning and cooling the synthesis gas:**

Description	Size	Functions
Cyclone dust remove system	∅ 1000*H3800mm	remove the ash from the gas
Water seal dust remove system	2000*1000*3800mm	cooling, remove the ash of the gas
No.1 separator	∅ 1000*H3800mm	remove the tar from the gas
No.2 separator	∅ 1000*H3800mm	remove the tar from the gas
Oil-water separator	2000*1000*3800mm	heat exchanger, and oil-water separation

LLC «BioREKS»

Russia, Krasnodar, Yuzhnaya str. 25  
 tel: +7 (861)244 40 23  
 www.bioreks.ru

No.3 separator	∅ 1000*H3800mm	remove the tar of the gas
Gas cleaner	∅ 1000*H3800mm	purify gas
Vacuum pump		creates gas suction through gasifier and cleaning system and supplies pressure to gas bag
Water seal	∅ 1000*H3800mm	hydraulic seal type arrester for gas storage bag
Oil-water separator	2000*1000*3800mm	separates oil and water
Soft-type gas bag		storage of the gas
Purifier	∅ 1000*H2800mm	purify the oil and water from the gas
Gas distributor	∅ 1000*L1500mm	distributing gas and output
Cooling tower		cools the gasifier cooling water for recycle back to gasifier
Sewage treatment		cleans gas cleaning water for recycle

Studies on the presence of dioxins, dibenzofurans, benzopyrene in gases showed that the gasification and combustion of the future produced in the generator gas burner or the combustion engine, the content in the flue gases, even fewer standards adopted in Europe.