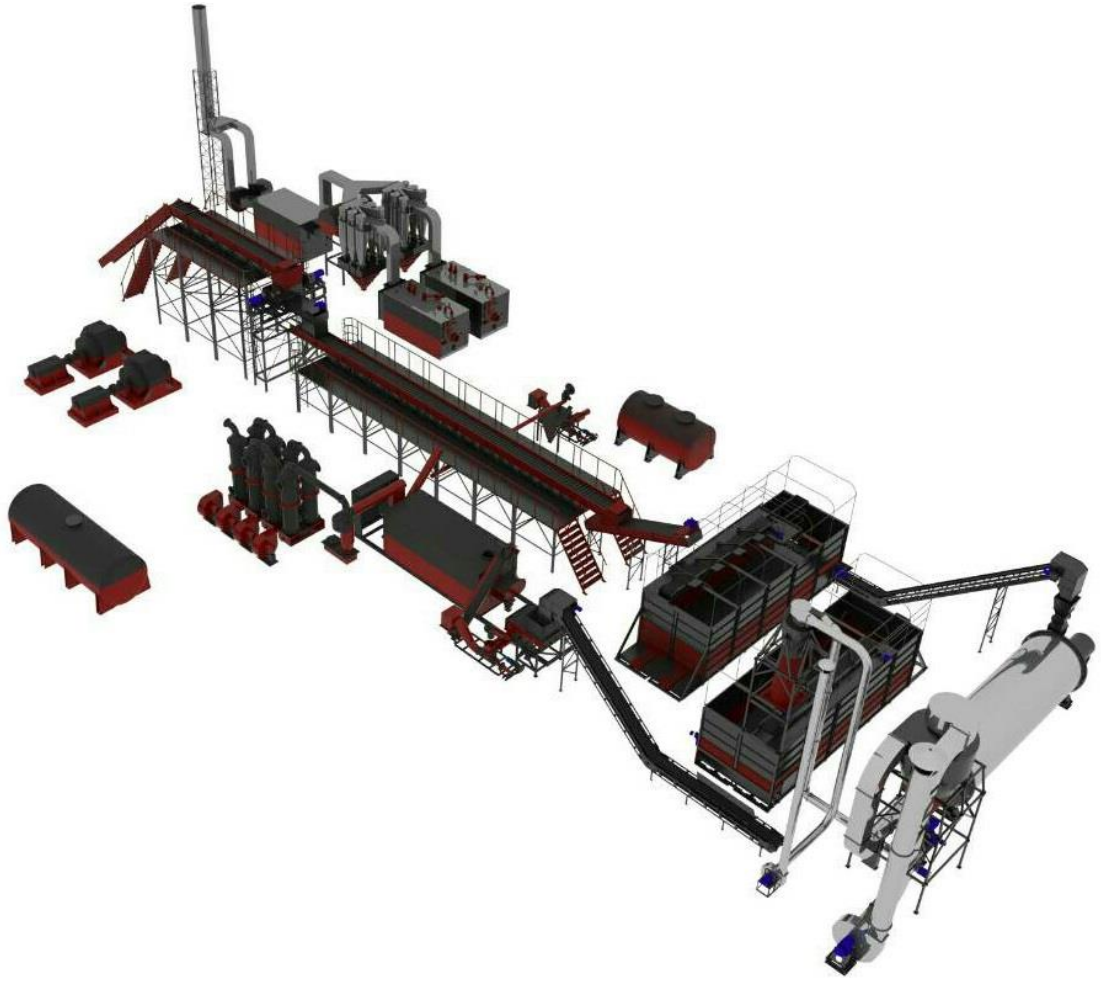
2018

Technical description of the project

«Complex for thermal treating of RDF and production of electrical energy»



CE

Project description:

The project, which is being considered, foresees the creation of a complex for thermal treatment of RDF and electrical energy generation, based on a MSW landfill in the city of Sozopol (Bulgaria).

Technical data on the complex for thermal treatment of RDF and electrical energy generation:

- Raw materials – municipal solid waste/RDF (manual sorting of glass, metals, stones and other inorganics)
- Incoming raw materials capacity – 4 tons/ hour
- Incoming raw materials moisture contents – no more than 40%
- Incoming raw materials fractional composition, mm – no more than – 50 – 500
- Final product from raw materials processing – electricity – 6.4 MW / hour
- Installed electrical capacity of the complex, kW – 445 kW

This project will include:

- MSW sorting unit, consisting of the following main elements:

  - Sorting line;

  - Unsorted MSW receiving device;

  - Building frame with utility rooms;

  - Adjacent territory.

- Complex for processing of sorted waste into RDF – 2000 – 4000 kg / hour, consisting of the following main elements:

  - Shredding equipment (shredder, hammer crusher),

  - Drum dryer,

  - Storage hopper – storage spaces (accumulators) with total volume – 200 m^3

  - Conveyor equipment.

- RDF УУО-60Т ТУ У 28.9-1948501951 processing facility, consisting of the following main elements:

  - Continuous pyrolysis reactor with a capacity of 60 ton/day,

  - Waste supply/feeding system,

  - Dry residue unloading system,

  - Gas purifying and cooling system

- Block steam boiler with 8-12 tons/hour capacity, consisting of the following main elements:

- Steam module with a steam capacity of 4-6 tons/pours– 2 sets,
- Water treatment system,
- Exhaust gas purification system.

▪ **Power station,** consisting of the following main elements:

- A rotary-piston steam engine ТУ У 28.1-39874247-001:2018 – 2 sets,
- Alternator – 2 sets.

Location of the Complex for thermal treatment of RDF and production of electrical energy

The equipment of the complex is planned to be placed on the basis of the sorting station for processing of municipal solid waste, directly in the sorting unit and on the adjoining territory.

A landfill for solid household waste is located on the territory, adjoining the sorting station.

Location – Sozopol, Bulgaria.

Description of work of the Complex for thermal treatment of RDF and production of electrical energy

The complex operates as follows (see Appendix No. 1):

Waste receiving and RDF production site:

In this area, unsorted waste is received and converted into RDF.

Municipal solid waste is loaded onto the receiving belt conveyor 1, fed to the sorting line 2, where manual separation of glass, stones, metal and other inorganics takes place.

After manual sorting, the sorted waste falls into the primary shredder 3, where the waste is ground to a fraction of 20-50 mm. After that, the crushed wastes are moved along with the belt conveyor 4, and then via belt conveyor 5; they enter the hopper-accumulator/storage 6. The volume of the hopper is 100 cubic meters. The hopper is equipped with a "living bottom" – it is designed for reception, temporary storage, and further dosage supply of raw materials through the system. Afterwards the raw material enter the belt conveyor 7, which directly supplies raw materials to the drying drum 8. A drying process takes place in there. The moisture content of raw materials is reduced from 40% to 10-15%.

The coolant for the drying drum is a mixture of air with heated flue gases. The flue gases are sent to the dryer drum mixer through the pipeline from the furnace of the waste recycling plant 17 (pyrolysis reactor).

The coolant for the drying drum is a mixture of air with heated exhaust gases. The exhaust gases are sent to the dryer drum mixer through the pipeline from the furnace of the waste recycling plant 17 (pyrolysis reactor).

From the drying drum, the dried waste is transported by aspiration to the main cyclone 9, which separates the dried mass from the exhaust gases, air and moisture released during the drying process. From the main cyclone, the dried waste falls into the hammer crusher 10, in which grinding and re-grinding of the sorted waste is carried out, until obtaining a certain homogeneous mass takes place. The incoming fraction of raw material is 20-50 mm. Fraction after grinding 5-10 mm. From the hammer crusher, the waste enters the dry material transportation unit 11.

Purpose: selection of crushed material from under the hammer crusher for further transportation. Transportation is carried out by means of a transport fan in the cyclone 12 via aspiration pipelines entering the unit, equipped with a dispenser.

From the cyclone 12, the dried pulverized raw material enters the second hopper 15.

The volume of the bunker is 100 cubic meters. The bunker is equipped with a «living bottom» – it is designed for reception, temporary storage and further dosed supply of raw materials to the system. The raw materials are then fed to the belt conveyor 16, which directly feeds the raw materials to the RDF processing unit (pyrolysis reactor) 17.

RDF thermal treatment section:

At this stage, the resulting RDF undergoes heat treatment to produce intermediate fuel products.

The RDF processing plant 17 consists of an RDF feeding system, a continuous RDF pyrolysis reactor, a solid residue discharge system, a pyrolysis gas purification system and a liquid fraction condensation system.

The waste treatment plant works as follows:

RDF after the conveyor belt 16 are loaded into the receiving hopper, where they are unloaded by a screw conveyor into a screw feeder. Screw feeder is equipped with a system of closures for hermetic supply of waste to the reactor. From the screw feeder, RDF is loaded via screw conveyor directly into the continuous pyrolysis reactor. The continuous pyrolysis reactor is equipped with a special system for stirring and moving the RDF inside the reactor.

In the active part of the continuous pyrolysis reactor, thermal treatment of RDF takes place, with the separation of the gas-condensate mixture, after passing through the active part of the reactor, RDF is converted to a carbonized solid residue - pyrocarbon. The solid residue is transported to the hopper by a slag accumulator, from which it is unloaded by the auger. The temperature in the continuous pyrolysis reactor is maintained in the range of 650 C to 700 C. In this temperature range, in an oxygen-free environment inside the reactor, complete thermal decomposition of the material takes place and there are no conditions for the formation of harmful compounds such as dioxins, furans, etc.

The resulting pyrolysis gas passes through a rough cleaning in a cyclone and then is sent to the condensation and purification system for pyrolysis gas 18. The condensation and purification system consists of gas heat exchangers that are cooled by air, condensate reception tanks, and separation elements. In the condensation and purification system, the pyrolysis gas is mechanically cleaned from droplets, dust of other particles, as well as cooled before feeding to the boiler burner.

The condensate from the condensate reception tanks is pumped to the liquid fuel tanks 19.

Pyrolysis gas, after separation of condensate, cleaning from soot and tar, is directed through the gas pipeline to consumers, in particular, pyrolysis gas is supplied to the burners of the steam boiler 20, to the burner of the continuous pyrolysis reactor, and, in case of emergency, to a "spark" of gas afterglow.

The solid residue is a high-calorie material with a fraction of up to 1-2 mm – with a carbon content of up to 90%. The solid residue is used in the burner for the steam boiler 20 as fuel. From the continuous pyrolysis reactor, the solid residue is transported via screw conveyor to the hopper-storage, from where it is sent to the boiler's burner. After the combustion of the solid residue in the boiler burner, ash is formed, which collects in the ash collector, from where it is periodically removed.

The liquid fraction obtained in the pyrolysis gas purification and condensation system accumulates in the liquid fuel tanks, from where it is pumped to the consumers, in particular, the liquid fuel is piped to the boiler fuel burner supply tank, as well as to the burner device of the continuous pyrolysis reactor.

Steam production area:

The composition of the complex for heat treatment of RDF and production of electric energy includes two steam boilers with a capacity of 4-6 tons of steam per hour.

Burner devices of boilers are designed for burning three types of fuels:

- Solid carbon product,
- Pyrolysis gas,
- Liquid fuel.

As a result of high-efficiency combustion of all fuel products in the boiler, steam is generated to operate the steam engine.

Steam from the boilers enters the steam line directly into the steam engine, which converts steam energy into rotation. After that, the steam enters the condenser, in which the vapor condenses to form water (condensate). Then the condensate is sent to the deaerator, in which water is purified from gaseous impurities. From the deaerator, water flows back to the boilers. For uninterrupted operation of boilers in the scheme, a storage capacity of water is provided 23. The operation scheme of a steam boiler with a steam engine is closed one.

Electricity generation area:

To generate electricity, the complex includes two power plants 24 with a capacity of 6 450 kW each.

The power plant consists of the following elements:

- Steam engine,
- Alternator.

The steam engine is installed on one frame with an alternator, through a coupler coupling.

Steam engine operation requires steam with the following parameters:

- Steam pressure – 8-10 bars,
- Steam temperature – 175 - 185 ° C.

Exhaust gas purification area:

During the operation of the complex for thermal treatment of RDF, exhaust gases inevitably form, which are released into the atmosphere through chimneys.

To avoid harmful particles entering the atmosphere in an amount exceeding the maximum allowable concentration, the complex is equipped with an exhaust gas cleaning systems. In addition, the design of the continuous pyrolysis reactor, as well as the operating temperature of the reactor, minimizes the formation of harmful substances even during the thermal decomposition of RDF.

The exhaust gas purification scheme is implemented as follows:

- Exhaust gases are formed in the boiler burners when burning fuel products, obtained as a result of heat treatment of RDF.

  Exhaust gases undergo a coarse and medium purification in the multicyclone block 21, then they are sent to the gas purification filter 22, in which the exhaust gases undergo further purification from solid impurities, the amount of CO_2, CH, carbon monoxide decreases.

  Further, the purified exhaust gases are released through the chimney.

- In the furnace of the continuous pyrolysis reactor exhaust gases are also formed as a result of burning of pyrolysis gas and liquid fuel in the burner device.

  Exhaust gases after the furnace are sent to the drying drum as the coolant for drying, after which they are cleaned of the dried raw materials, from dust and other impurities in the main cyclone 9.

  The purified exhaust gases are then released by the exhaust fan 13, through the chimney 14.

Given this, the quality of the emitted gasses is characterized by the following indicators:

- dust – 5 mg/m^3;
- SO_2 – 20 mg/ m^3;
- NOx – 100 mg/ m^3;
- Cl – 4 mg m^3;
- F – 0,1 mg/ m^3.

Appendix №1. Scheme of the Complex for the thermal treatment of RDF and production of electrical energy.