



Safety of the railways  
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## There is no more frightening than incineration

These slogans constantly appears on the pages of environmental publications, along with interesting (although for the most part semi-fantastic from an economic point of view) alternative solutions to the waste management challenge.

Incinerator is the reliable truck that transports a good half of the challenges associated with the disposal of sorted waste, especially in the case of the presence of medical or biological components. Incineration technology has long developed, its main assemblies and boundaries of process parameters were fixed in legislation in Europe and in Russia, but its improvement continues in the direction of even greater energy efficiency and limiting the negative impact on the environment.

Nevertheless, while the science beaver-like develops environmentally friendly and cost-effective method for processing all types of waste directly into a valuable material, the waste continues to accumulate, and an urgent need for treatment occurs daily.

Among the leaders of Russian developers and manufacturers of incineration equipment *Safe Technologies* can be called out. In a short time, the company has come a long way from the simple reproduction of the process equipment to the manufacture of modern high-tech fully automated facilities based on its own developments and experience of leading foreign companies. Among the implemented projects is waste thermal treatment facility *KTO-500* made for the *Yaroslavl branch of Russian Railways*.

## KTO-500

The facility *KTO-500* is incinerator based on rotary kiln and equipped with modern flue gas cleaning system. In addition, the plant includes a heat recovery and energy production systems.

The facility is designed for a wide range of waste of III-V hazard classes treatment.

The main types of waste intended for utilization are solid waste, such as sand, sawdust, waste coal, contaminated by oil. In addition, other oily waste is a subject to neutralization: sludge, tar, solvents, wastes of diesel fuel and others. It is worth noting that the equipment is capable to dispose complex types of waste such as paint, fats and waxes from mineral oils and much more.



Within the project, excess heat of flue gases is recovered for the needs of the enterprise. Recovery of thermal energy is possible due to operation of steam turbine unit that will provide heating, hot water and electricity to industrial and household premises onsite. In addition, the heat generated will be spent on heating the sludge entering dehydration unit. During the summer, thermal energy will be spent exclusively for the sludge heating and electricity generation in a steam turbine plant.

## Waste thermal treatment facility includes several technological lines:

- Thermal treatment *KTO-500* line. Capacity - 500 kg/h. It should be noted that performance might vary slightly as this figure depends on the calorific value of feedstock.
- Sludge dewatering unit. Capacity - 9 m<sup>3</sup>/h.
- Steam turbine unit with a capacity of 150 kW to generate electricity for the needs of the enterprise.

Thermal neutralization of waste occurs at the facility *KTO-500* at several stages: preparation and loading of waste, incineration, multi-stage flue gas cleaning.

Solid waste is fed by automated loading device into the combustion chamber, where the nozzles spray liquid waste flowing from the tank. Additionally, nozzles are set for spraying the urea solution intended for neutralization of nitrogen oxides in flue gases in afterburner chamber. Burner can operate on different fuels: diesel or natural gas.

The flue gases enter the afterburning chamber where the decomposition of dioxins produced during the combustion of waste occurs. Also, urea solution is injected in the upper part of the chamber. This technology, developed by the Russian Gubkin Institute of Oil and Gas, ensures subsequent suppression of nitrogen oxides in flue gases. Chamber design provides the necessary dwell time for flue gases. Discharging of ashes from the chamber is carried out by screw. The ash and slag are transported by small mobile carts. The ash formed in a plant is a low-toxic component (IV hazard class) and can be landfilled.

Flue gas with a temperature of 1200 °C, coming out from afterburner enters the steam generation unit. Thermal capacity of the recovery boiler is 1680 kW. Part of the superheated steam from the recovery boiler, after a few stages, enters the counterpressure turbine.

Electric power generated by the turbine is 150 kW and consumed for auxiliary needs of the enterprise. Backup source of heat, gas boiler, is provided to ensure reliable and stable operation of the heating system of the enterprise. Lowering its temperature in the heat exchange unit to the values that exceed the upper limit stage of the secondary dioxins generation, the flue gases enter the gas cleaning system.

### Gas cleaning system - an integral part of any incinerator

Its scope of supply can vary, but generally always dictated by environmental requirements of specific territory. The cost of modern gas cleaning system is comparable with the cost of the facility itself, and the main objections of environmentalists against incineration are thought to be based on attempts of operators (and sometimes design engineers) to cheap out on this vital process assembly.

The multi-stage gas cleaning system of *KTO-500* begins at post-combustion chamber, where the dioxins are destructed and the urea solution is injected. Further, the flue gases pass the following stages of treatment:

- alkaline solution is supplied to scrubber to neutralize the sulfur oxides;
- removal of dioxins and other pollutants produced by injection of activated carbon in a stream of flue gases;
- final gas cleaning from mechanical impurities and reagent purification is carried out in a bag filter before being discharged into the atmosphere.

Sludge separation unit based on decanter is intended to reduce the sludge volume, and thereby increase the efficiency of the process. The facility is also designed for the disposal of contaminated soil, for which screening equipment is provided.

It should be noted that *KTO-500* is not alone on-site, it is part of a complex consisting of two more furnaces (capacity of 150 kg/h and 50 kg/h), which together cover almost the entire spectrum of waste produced in the region. These furnaces are modernized and equipped with modern control systems and capable to utilize medical and biological waste and VOC slurry.

### The entire complex is fully automated

Modern control system displays all the process parameters on the touch screen, which clearly shows all technological units and their current settings. All operations are held in the automatic mode, although it is possible to set the parameters manually directly from the control screen. The visibility of control quickly and effectively educates the personnel, and does not require from them a depth of expertise.

Waste thermal treatment facility of *JSC Russian Railways* is only one to date, although the company is not a beginner at waste management field. *Environmental Strategy of Russian Railways* defines the activity in the field of ecology for the period until 2017 and perspective up to 2030, the document was dated May 21, 2014. As part of this strategy, which provides, in particular, the transition to new energy-saving technologies and reduction the impact on the environment *the project in Yaroslavl* was completed.

Another unique facility made within the same program, was built at *Tagul station*. The project was dedicated to used sleepers treatment.



*'I want to stress that it is the Russian technology, and the most modern equipment for the emissions control was used. There is absolute certainty that this plant will not only destroy harmful substances, but also will not produce more,' Vladimir Yakunin, the Head of Russian Railways, highlighted at the press briefing.*

*Safe Technologies Industrial Group*, which does not shy away from non-standard tasks, became the contractor of the project. Automatic loading of monolithic sleepers into the furnace avoided installation of expensive grinding equipment in the technological line. The project included powerful gas cleaning

system needed to remove the products of toxic sleepers impregnating combustion compound from the flue gases.

*Safe Technologies Industrial Group* not only carries out its own research, but also deals with porting of Western technologies to Russian conditions and regulatory requirements. Thus, the arsenal of experts combines experience of the best patterns of domestic and foreign industry. Under the Russian government program of import substitution, this becomes a decisive factor in the assessment of various developments and technologies.

