Ing. Office FTT

Reduced costs in drying Processes

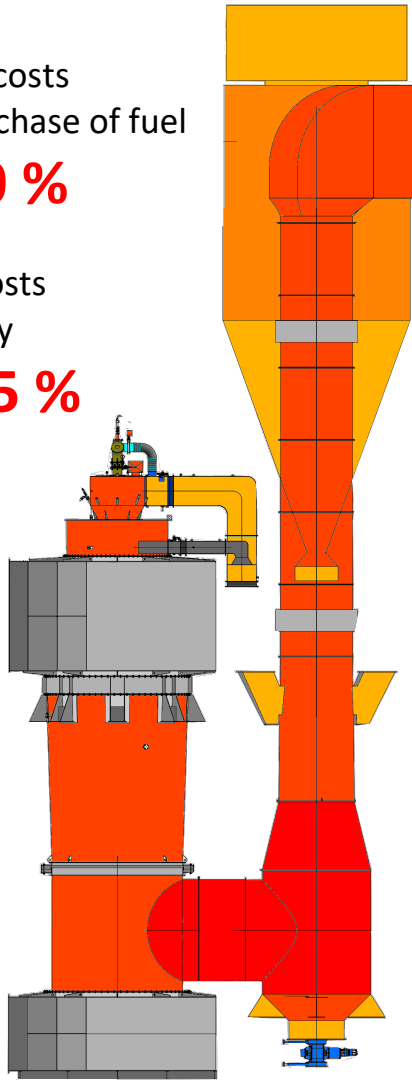
STEP 1 **Modern hot gas generators**
STEP 2 **Equipment for intensification of drying**
STEP 3 **Use the cheapest fuel**
STEP 4 **Use a dry gas cleaning system**

Decrease costs
for the purchase of fuel
50-70 %

Decrease specific
Fuel consumption
10-15 %

Reducing costs
Electricity
10–15 %

Increasing
performance
1,5- 2 time



STEP 1 Gas-tight hot gas generators

installed on drying lines are designed to produce a gaseous heat carrier with an adjustable temperature of 200 - 1100 ° C. The generators burn liquid, gaseous or solid pulverized fuel, mix the combustion products with air or recirculating gases.

The generator is the main device for controlling the drying process, the automatic control of the drying process is integrated into the generator automation, the fuel supply and other parameters of the generator are related to the performance of the drying equipment. Fast regulation of temperature and quantity of hot gases is provided to control the drying process.

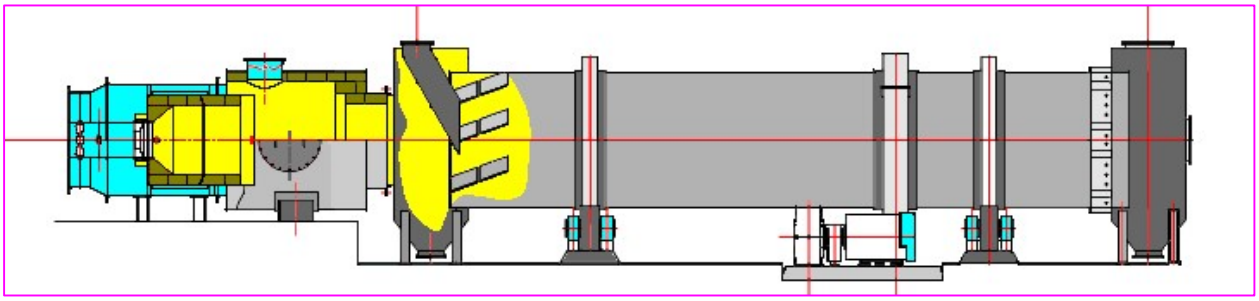
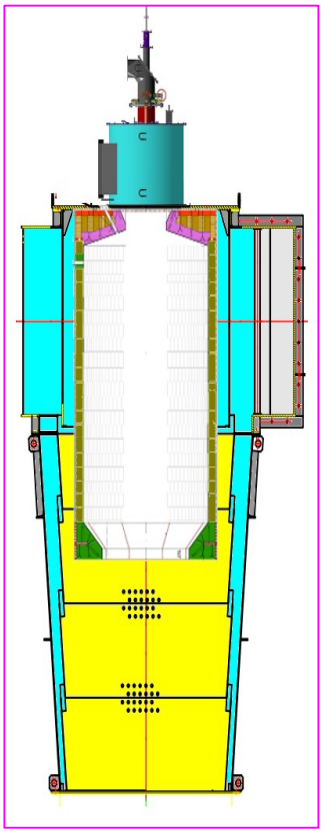


Fig. Installing a hot gas generator to a rotary dryer

The installation of the Generator includes a burner device, a combustion chamber, a mixing chamber, an outer casing with supports, systems for preparing and regulating fuel consumption, and ventilating equipment.

Main design characteristics
Hot gas generators have a solid, reliable design, designed for long-term operation in metallurgical or chemical plants, whether installed indoors or outdoors.
The generators have a gas-tight design, which eliminates the emission of gases into the production area.
Any preset pressure or vacuum is provided
in the dryer and the combustion chamber of the generator.



Vertical or horizontal installation
Hot gas generators with thermal power up to 10-15 MW are manufactured in horizontal or vertical design.

With a thermal power of more than 15 MW, generators are usually installed vertically. This provides greater reliability
refractory lining.

With the use of our generators, more than 200 drying lines operate at Almalyk, Balkhash, Krasnouralsk, Norilsk, Uchalinsk, Gaysk Combines, Sredneuralsk Metallurgical Plant and other enterprises.

Installation of generators ensures effective control of drying processes, obtaining a high-quality product with given moisture content, and reducing specific fuel consumption for drying.

Thermal power of the generator, MW	2,5	6	12	25	40	60
Drying plant capacity, t / hour	20	50	100	200	300	400
Evaporated moisture, t / hour	2	5,2	10,5	21	32	42
The amount of hot gases, nm3 / hour	10.000	20.000	40.000	80.000	100.000	150.000

The use of modern automated hot gas generators provides accurate regulation of the drying process, reducing fuel and energy consumption for drying.

Special designs of generators allow burning unconventional fuels, including combustion of low-calorific waste gases, blast furnace gas, coke oven gas, coal mine methane, waste oils, organic waste.

STEP 2 Use efficient drying equipment

The main equipment installed on 90% of drying lines for materials with an initial moisture content of 10-15% are drying drums with a rotating outer casing equipped with internal transfer blades. The heat stress of the internal volume of such drying drums for evaporated moisture is 40 - 70 kg / m3.h. Equipping the drying drums with efficient hot gas generators and optimized internals allows the heating voltage to be increased to 100 kg / m3.h.

An increase in the heat stress of the volume of the drying apparatus for evaporated moisture provides an increase in productivity, a decrease in the unit cost of drying equipment, a reduction in production areas or an increase in the productivity of apparatus in existing drying shops.

SRT Vertical High Speed Dryers

with a capacity of 20-200 tons / hour are characterized by the heat stress of the working volume on average about 500 kg / m3.h, at the initial section the heat stress is 1000 kg / m3.h and more.

Vertical high-speed devices SRT increase the efficiency of the drying process by 5-10 times compared to drying drums, reduce heat loss with exhaust gases, reduce specific fuel consumption for drying and power consumption.

The increased thermal efficiency, the absence of rotating parts, the ability to operate at hot gas temperatures of 900-1100 ° C makes it possible to effectively use SRT vertical speed devices instead of drying drums to increase the productivity of drying lines.

Installation of SRT units to replace existing dryers, or installation in addition to drying drums in existing workshops:

Drying: copper, zinc, pyrite, molybdenum, fluorite, titanium, barite, nickel, iron ore and other concentrates; industrial salts, bentonite clays, sand and other materials.

Drying of explosive and fire hazardous materials in a hot gas with a low oxygen content for example coals, organic raw materials for wood building materials, renewable wood fuel.

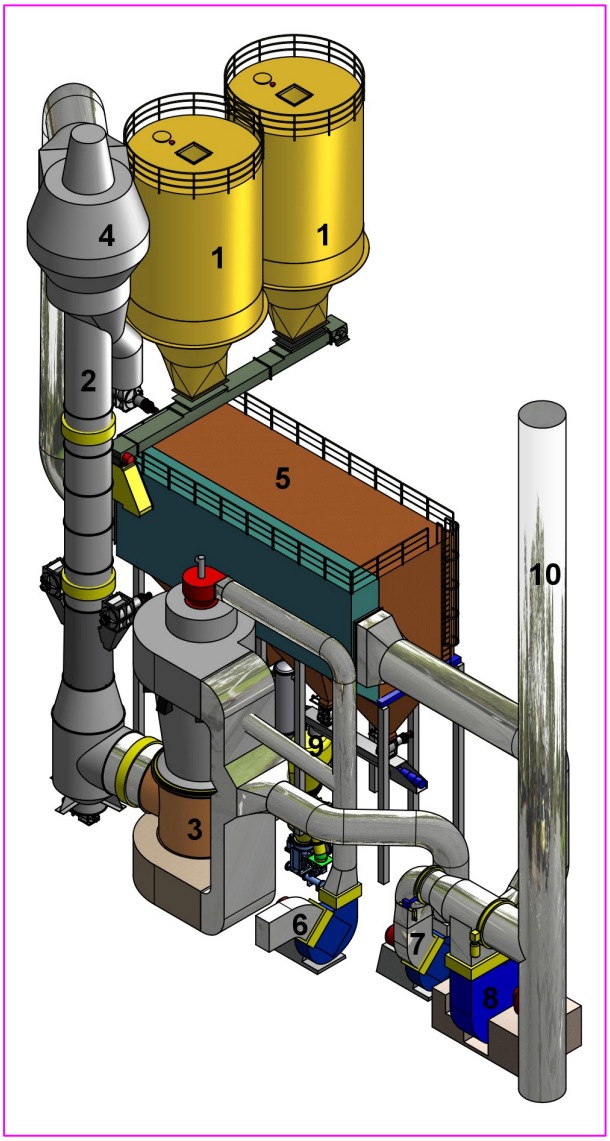


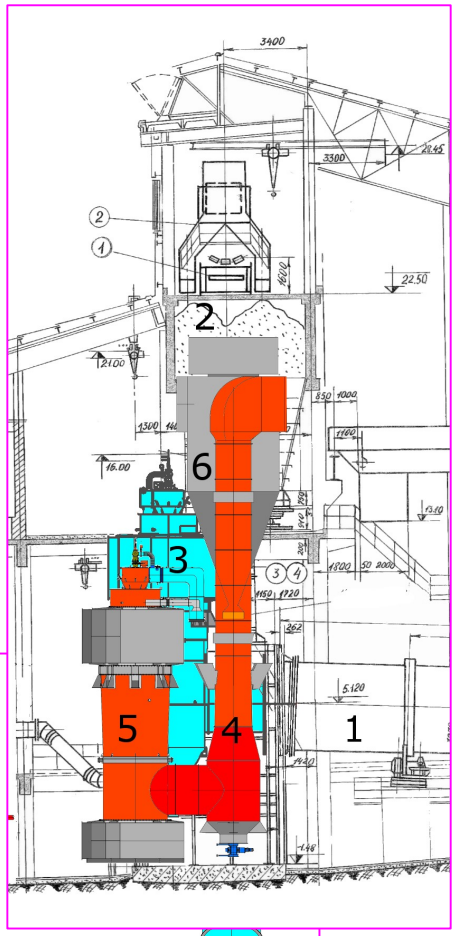
Figure: The technological complex of the SRT 2000 pipe-dryer with a capacity of 200 t / h for drying metal ore concentrates includes:
1 - raw material hopper, 2 - SRT vertical dryer, 3 - hot gas generator, 4 - unloading separator, 5 - bag filter, 6 - combustion air fan, 7 - mixing air fan, 8 - main exhaust fan, 9 - dispenser for supplying coal dust to the burner, 10 - chimney.
Installation dimensions
L x B x H = 34 mx 14 mx 30 m

SRT dryer with ceramic abrasion protection are used for drying granulated slag (slag sand) with particle sizes of 0.1 - 3 mm and an initial moisture content of 8-15%.

Special designs of loading devices allow drying sludge with a moisture content of 30-40% in SRT devices.
Installation of spray nozzles allows for high intensity drying of suspensions, emulsions, salt solutions and the like. In this case, the SRT is a good replacement for spray dryers, pelletizing towers and the like.

The high intensity of the drying process in the SRT apparatus allows this apparatus with a generator to be located within two 2 x 6 m spans of the existing workshop.

Fig. Installing a new hot gas generator (blue) to the tumble dryer compared to the installation of an SRT with a high temperature hot gas generator.
1. Drying drum.
2. Hopper of wet material.
3. New generator for tumble dryer.
4. High-speed SRT dryer.
5. High temperature generator for SRT.
6. Unloading cyclone of the SRT apparatus.



Using the SRT Start Site (with a heat stress of more than 1000 kg / m3.hour for evaporated moisture), as a drying intensifier, together with a drying drum, provides a significant increase in the productivity of existing drying lines.

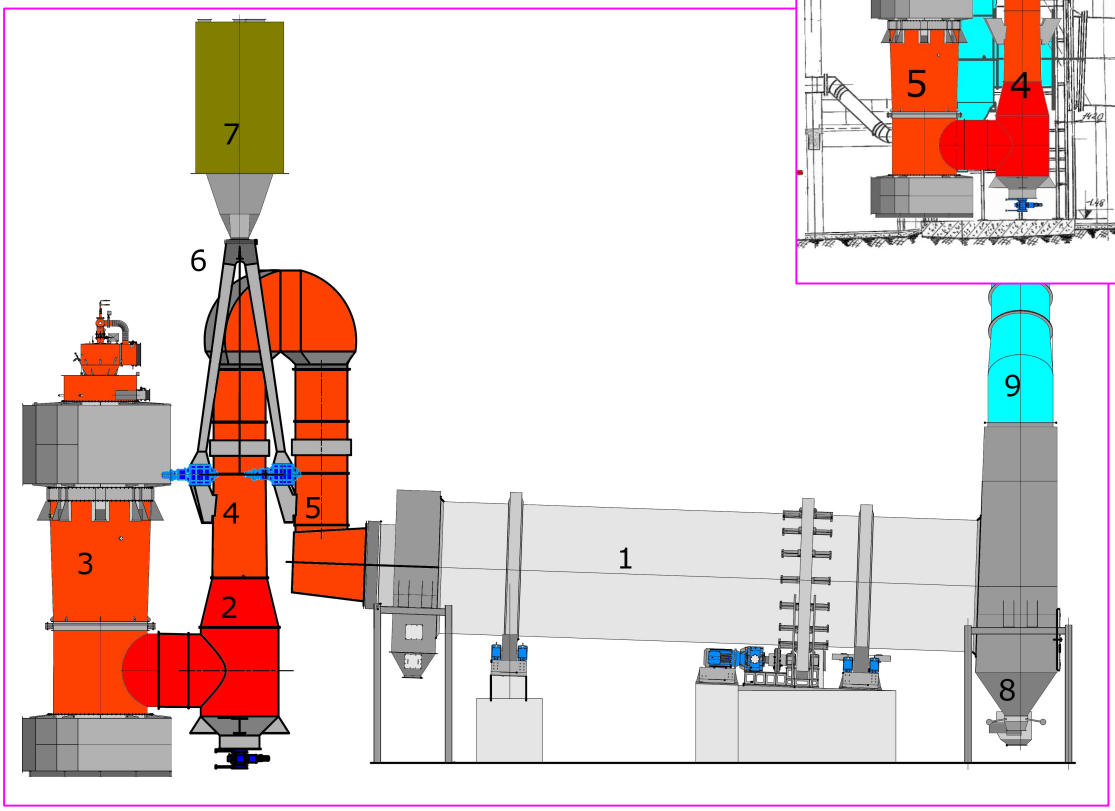


Figure: Installing the SRT drying intensifier to the drying drum
1. Drying drum. 2. Intensive dryer SRT. 3. High temperature generator. 4. Loading wet material into the SRT lifting channel. 5. Loading wet material downlink SRT. 6. Material feed points. 7. Supply hopper of wet material**.**

Hot gases with a temperature of 900-1100 ° C and a high velocity are fed to the SRT inlet, ensuring a high drying rate. The dried material and hot gases with a temperature of 400-600 ° C are fed into the drying drum from the descent channel of the SRT apparatus. In the drying drum, the material is finally dried for 15-20 minutes to the required final moisture content.

The drying intensifier ensures the removal of 50-60% moisture from the material within 1-2 seconds, the total productivity of the drying drum can be increased to 150-180%. The phenomena of deposits of wet material, the smearing of the filling blades, the phenomenon of material rolling in the drying drum are excluded.

STEP 3 Reduce fuel costs

Technologies for drying, granulating, burning industrial materials - can be carried out on the basis of burning any organic fuel.
The cost of fuel consumed for drying during the enrichment of mineral raw materials is 20-30% of the cost of metal ore concentrates.
The use of coal dust as a fuel at industrial enterprises instead of natural gas or fuel oil can reduce fuel costs by 3-5 times.

Table. Heat energy cost = economic efficiency

Comparison of the cost of thermal energy using the main fuels. 2017

Fuel	Fuel oil 10.000 kcal / kg 10.000 rubl/ton	Natural gas 8.000 kcal / m3 5.500 rubl / 1000 m3	Brown coal 4200 kcal / kg 1000 rubl / ton
Thermal power of the drying unit, MW	10	10	10
Heat from fuel combustion with efficiency. 90%, rubles / MW per hour	955	657	227
Working time, hour / year	6000	6000	6000
Fuel cost, rubles / year	57.323.015	39.409.573	13.648.337
Reducing fuel costs when switching to coal, rubles / year	43.674.678	25.761.236	
dollars / year	766.222	451.952	
Cost of equipment for switching to coal dust, USD			
Drying plant	900.000	900.000	
Payback, year	**1,17**	**1,99**	
Asphalt plant	400.000	400.000	
Payback, year	**0,52**	**0,89**	

The ash remaining in the off-gases after coal combustion is captured by the gas cleaning system of the drying line. When drying concentrates of non-ferrous metal ores or iron ore concentrate, the change in the content of the target metal in the concentrate due to dilution with ash is 0.08-0.12%, depending on the quality of the burned coal. Minerals that make up ash have a positive effect on processes

smelting of metal concentrates, contain active compounds characteristic of cement and lime.

Coal dust preparation and combustion
The most effective is the "block" preparation of pulverized coal (PFC):
one pulverized coal preparation unit for each drying unit.
The combustion of coal dust is performed in vertical hot gas generators that fit well into any drying line. Generators are equipped two fuel burners (pulverized coal and reserve fuel).

The simplest and safest is the **direct or semi-direct combustion of coal dust immediately after coal grinding**, without the accumulation of large volumes of pulverized fuel in the silos. This is how coal dust is burned at coal-fired thermal power plants. This ensures the greatest operational safety at the lowest equipment costs.

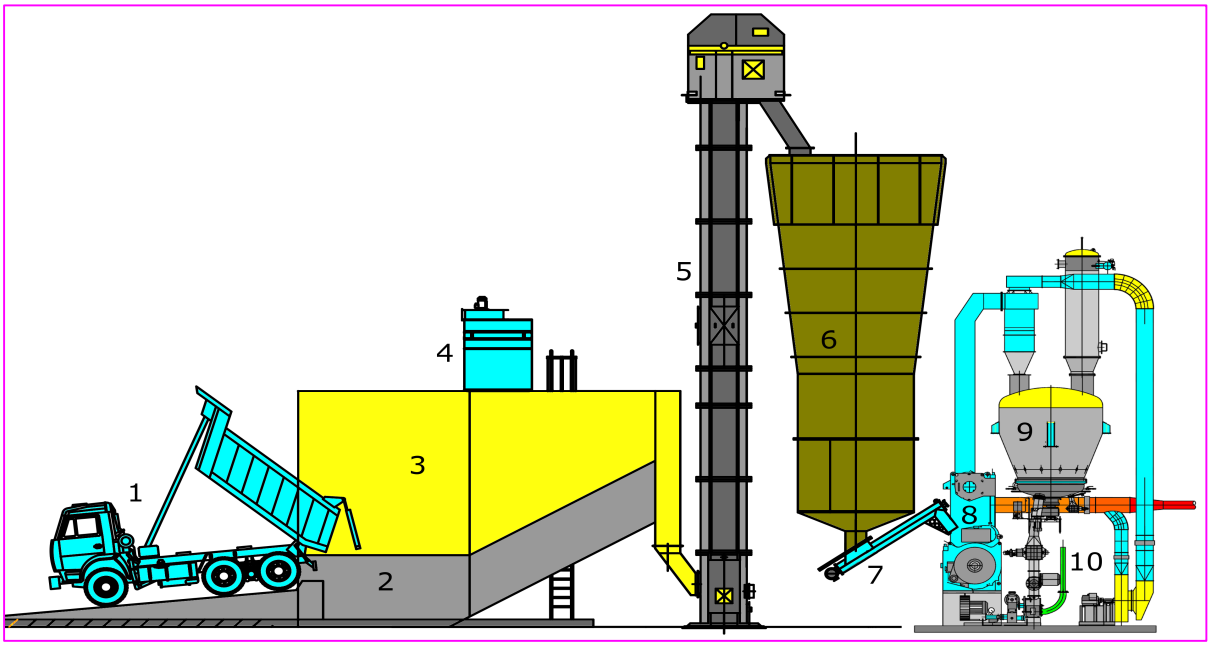


Fig. The work of the installation for the preparation of coal dust with coal charging.
1. Unloading of lump coal. 2. Apron conveyor. 3. Box for receiving coal. 4. Filter.
5. Elevator. 6. Supply hopper of coal. 7. Coal feeder. 8. Coal mill. 9. Coal dust supply hopper.
10. Supply of coal dust to the burner.

For drying lines operating continuously in three shifts for many months, it is convenient to use a supply hopper of lump coal for 30-50 tons.
The particle size of coal dust, ready for combustion, is 70-90 microns, controlled by an air separator located at the exit of the mill. Small particles pass through the separator, large ones are returned for re-grinding.
Coal dust is captured by cyclones and accumulates in a small feed bin designed for 1-2 hours of operation of the drying line. This allows maintaining a high concentration of coal dust at the burner inlet, which is especially important when burning the cheapest coals of poor quality.
The feeder installed under the feed hopper is automatically controlled drying line, doses the coal dust to the pulverized coal burner.

The hot gases supplied to the coal mill for drying the coal are taken at the outlet of the hot gas generator of the drying line.
The starting time of the drying plant at the pulverized coal slurry with the output at the rated power is 20-30 minutes. The initial start, when there is no ready pulverized coal fuel in the fuel system, is performed using reserve fuel. Subsequent starts are performed immediately on pulverized coal. For the start, a supply of pulverized coal is left in the supply hopper for about an hour of operation.

Modernization of the drying line using pulverized coal fuel PUT includes design binding, delivery and installation of the following units:

Equipment for loading lump coal (apron feeder, elevator, feed hopper)
Coal mill with coal dust feed hopper, metering and pneumatic conveying devices
Hot gas generator with dual-fuel burner (PUT - natural gas, PUT - liquid fuel).

The transition to a pulverized coal fuel will reduce the cost of purchasing fuel by **50-70%** compared to using natural gas or fuel oil.

STEP 4 Using a dry gas cleaning system

The use of wet gas cleaning causes an increase in the specific fuel consumption for drying, necessitates the use of additional pumping equipment for pumping wastewater into sedimentation tanks, the loss of ore dressing products with wastewater with an open system of technical water supply.
The solids content in the gases behind the wet gas cleaning system is 30-50 mg / m3.
When sulfur-containing fuels, such as fuel oil or some types of coal, are burned in wet gas cleaning devices, sulfuric acid is formed, which causes intensive corrosion of equipment, gas ducts, chimneys.

A wet gas cleaning system requires the installation of a dry cyclonic or multi-cyclone cleaning in front of it, which is subjected to intense abrasive wear, necessitating frequent replacement of the cyclonic elements.
The increase in fuel consumption due to the use of a wet gas cleaning system is 3-3.5%.

This is due to the need to return the sludge from the water treatment clarifiers to mechanical dewatering and then to drying. The sludge circulates in a parasitic circle: drying - wet gas cleaning - thickeners - mechanical dewatering - drying, going through mechanical dewatering and drying again and again, which causes an increase in fuel and energy consumption.

Gas cleaning system modernization is carried out with the replacement of the double system (cyclones + wet scrubber) for one-stage cleaning in a baghouse filter. The bag filter is placed on the existing sites, the main fan of the drying line and the chimney are retained. **The particulate matter content of gases behind bag filters is less than 10 mg / m3.**

The use of bag filters has an unexpected feature: in the case of cleaning gases from drying lines from abrasive particles, for example, particles of iron ore concentrate or concentrates of non-ferrous metal ores, the filter cloth of filter bags resists abrasive wear better than steel.

The filter bags behind such drying lines are replaced every 3-5 years, and the durability of the steel elements of the multi-cyclone cleaning is about six months. This is due to the fact that a layer of fine particles of the captured product forms on the fabric of the bag filter during the first minutes of its use, which is not removed when the filter is blown back.
Subsequent captured particles do not touch the filter cloth, but are deposited on the first layer of material that protects the cloth.
The durability of the fabric of the bag filters is mainly determined by the quality of the sewing of the bags and the observance of the temperature regime of the drying line operation - the control of the temperature of the exhaust gases before the gas cleaning system.

Possible results of reconstruction of the drying line at your enterprise based on modern technical solutions and efficient equipment:

The use of modern automated gas-tight hot gas generators provides effective control of the drying process, the sealing of the drying drum, the gas cleaning system allows to reduce air suction, reduces power consumption by **10-15%.**

The use of high-temperature generators of hot gases, vertical SRT dryers allows to reduce specific fuel consumption for drying by **10-15%.**

The use of simultaneously high-temperature generators of hot gases and vertical SRT dryers allows increasing the productivity of drying lines by **1,5-2 time** while reducing specific fuel consumption.

The use of drying intensifiers based on SRT dryers in conjunction with a drying device can significantly increase the productivity of such a tandem. This eliminates the phenomenon of smearing the blades of the drying drum or pelleting material, such as zinc concentrates.
The limitation of productivity is mainly the mechanical strength of the supports and the drive power of the drying drum.

The use of the cheapest fuel - pulverized coal fuel (CPF) provides a **50-70%** reduction in the cost of purchasing fuel for drying lines.

The use of bag filters makes it possible to switch to a one-stage gas cleaning system, reduces the loss of dry product, reduces the specific fuel consumption for drying, and increases the equipment run-time.

The new construction of drying lines based on SRT dryers can significantly reduce the area occupied by the equipment, and the costs of building drying rooms are reduced.

The recoupment of costs for the technical reconstruction of operating drying shops in items 1-4 does not exceed **1,5-2 years**.

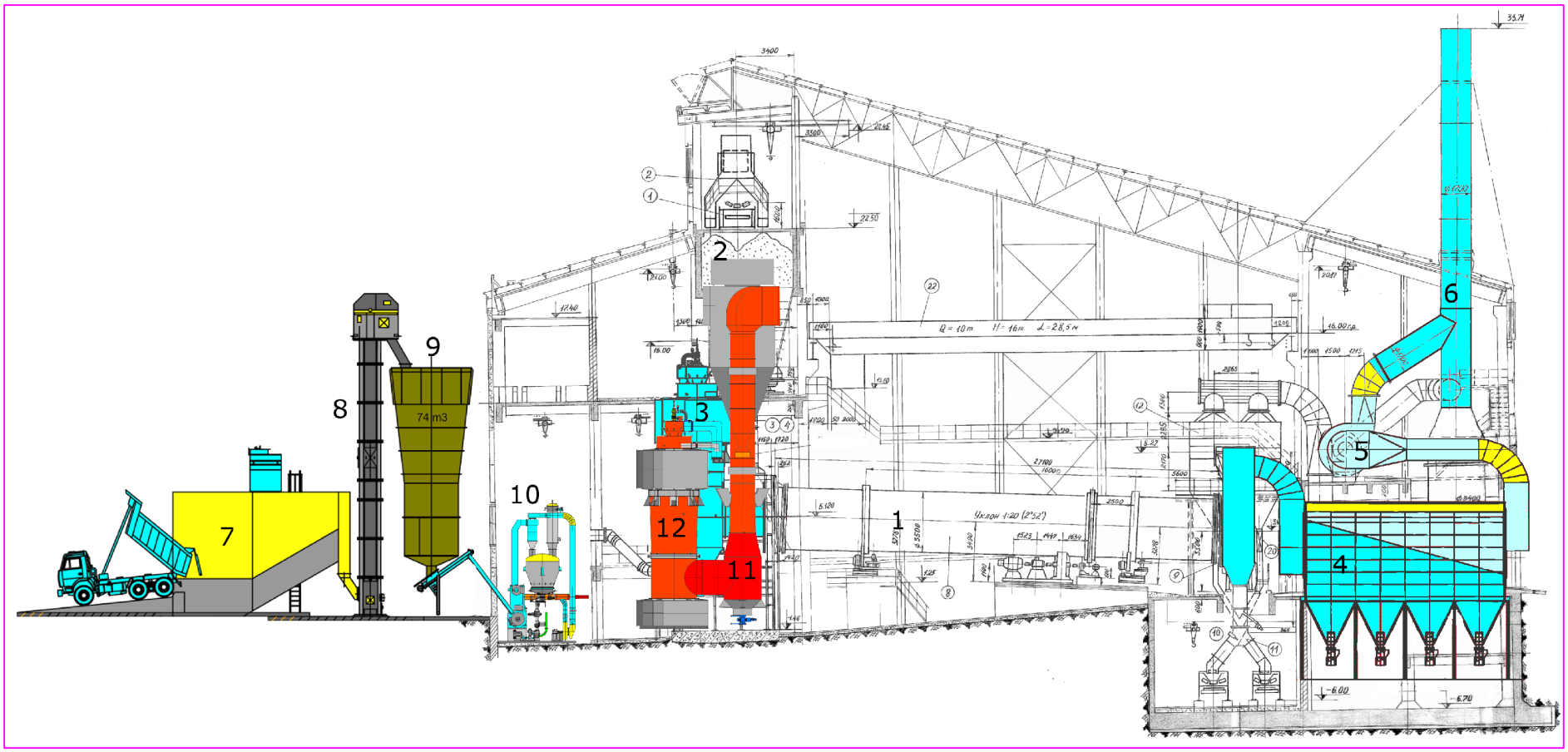
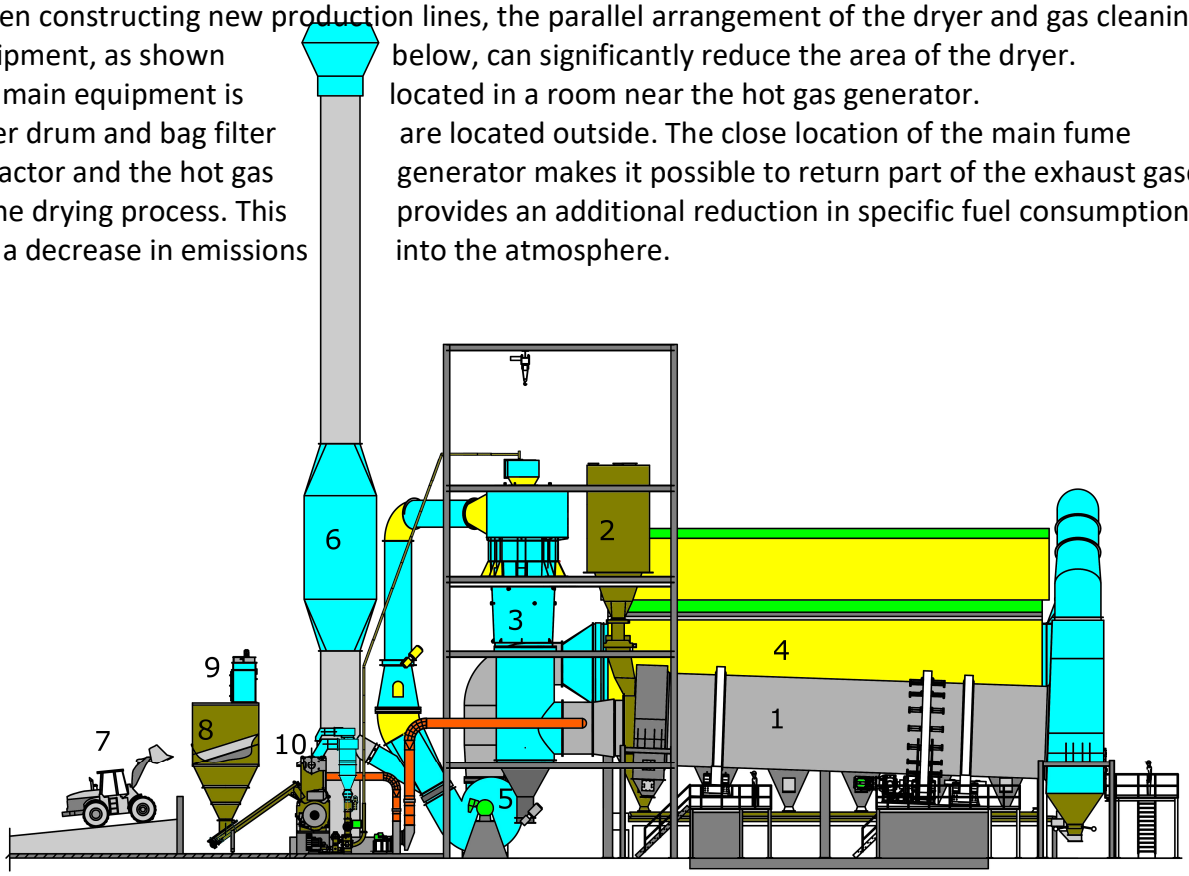


Figure: Modernization of equipment of the existing drying line with a rotating drum 1. Drying drum. 2. Hopper of wet material. 3. New hot gas generator for the tumble dryer. 4. Dry gas cleaning - Bag filter. 5. Smoke exhauster. 6. Chimney. 7. Loading box for lump coal with a lamellar conveyor. 8. Elevator. 9. Supply hopper of lump coal. 10. Coal mill.
Installation of high-speed drying SRT dryer: 11. Apparatus SRT. 12. High temperature hot gas generator.

New construction

When constructing new production lines, the parallel arrangement of the dryer and gas cleaning equipment, as shown below, can significantly reduce the area of the dryer. The main equipment is located in a room near the hot gas generator. Dryer drum and bag filter are located outside. The close location of the main fume extractor and the hot gas generator makes it possible to return part of the exhaust gases to the drying process. This provides an additional reduction in specific fuel consumption and a decrease in emissions into the atmosphere.



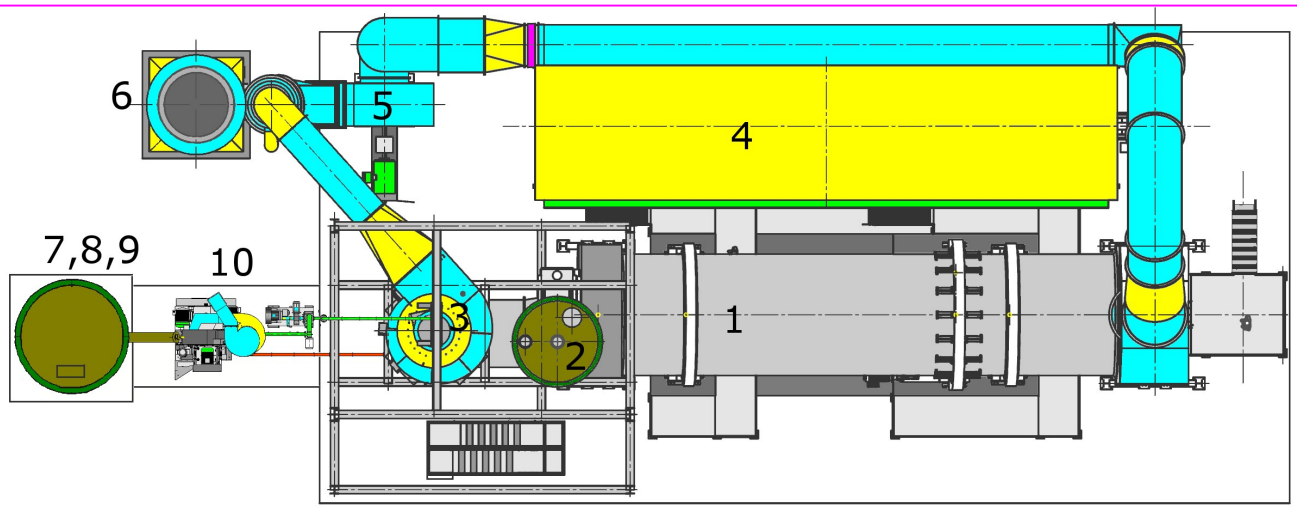


Figure: New construction of a rotary drum drying line

1. Rotary drying drum. 2. Wet material supply hopper. 3. Hot gas generator. 4. Dry gas cleaning - Bag filter. 5. Smoke exhauster. 6. Chimney. 7. Loading lump coal. 8. Supply hopper of lump coal. 9. Bunker filter. 10. Coal mill.

Engineering company FTT - Ing.-Office Combustion and drying technologies.
Development, design, manufacture of equipment and complete plants:

drying: copper, zinc, pyrite, molybdenum, fluorite, titanium, barite, nickel, iron ore and other concentrates; industrial salts, bentonite clays, sand and other materials
granulation of mineral fertilizers
heating of sulfur-containing gases in the system of contact devices of sulfuric acid production, other process gases
evaporation of salt solutions
thermal decomposition of nitrogen oxides behind the furnaces
drying of explosive and fire hazardous materials in an environment with a low oxygen content, coal, organic raw materials for wood building materials, renewable wood fuel
drying and granulating suspensions in spray dryers
direct air heating of production halls
warming up of equipment, thawing of railway cars
firing, sintering of industrial materials
heating of process gases
hot gas generators
vertical high speed tube dryers for coal, coal sludge

installations for the preparation of pulverized coal for industrial enterprises:
- asphalt plants,
- factories for the production of cement clinker,
- metallurgical enterprises,
- chemical enterprises,
- production of mineral fertilizers and other technologies.

We adapt technological equipment to operate on pulverized coal.

Slag sublimation furnaces for the extraction of non-ferrous metals from slags
modern technologies for obtaining metals obtaining semi-coke from brown coal

Contact in Germany:
FTT - Ing.-Büro Feuerungs –
und Trocknungstechnologien
(Combustion and drying technologies)
phone: +49 163 72 55 806
Web Site: www.ftt-ing.de
e-mail: info@ftt-ing.de