

Dust-Gas Emissions Cleaning of Open Ferroalloy Furnaces during Manganese Ferroalloy Melting

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UkrSSEC "Energostal" develops and implements high-performance dry gas cleanings with bag filters BFIR-7000 of reconstructed ferroalloy furnaces RKO-25 at "Tarazsky Iron & Steel Works". In view of realized at present and planned in future transfer of large quantity of close ferroalloy furnaces into open mode operation and also construction of new ferroalloy furnaces UkrSSEC "Energostal" experience of work package for development and implementation of dry gas cleanings of furnaces RKO-25 with bag filters BFIR-7000 at "Tarazsky Iron & Steel Works" is important and essential.

Keywords: OPEN FERROALLOY FURNACES, LOW HOODS, BAG FILTERS BFIR-7000, IMPULSE REGENERATION, SMOKE SUCKERS, DUST REMOVAL SYSTEM, SUCTION VALVES, AUTOMATION

Introduction

Smelting manganese ferroalloys in open ferroalloy furnaces is connected with an intense release of toxic manganese dust.

UkrSSEC "Energostal" (hereinafter the Center) has developed and implemented in the industrial production of a number of dry gas cleaning bag filters with pulsed regeneration for open ferroalloy furnaces, smelting different ferroalloys at Serov, Aksusssk, Chelyabinsk, Zaporozhye, Stakhanov ferroalloy plants, which work effectively at the present time [1-3]. The final implementation of the Centre's gas purification of open ferroalloy furnaces is implemented in the 2011 range of activities for the development, delivery and commissioning of gas cleaning bag filters FRIR-7000 with two reconstructed ferroalloy furnaces RKO-25 at "Tarazsky Iron & Steel Works" ("TISW").

Results and Discussion

Closed phosphorus furnaces RKZ-48F in shop № 3 at "TISW" were reconstructed into open furnaces with low-type hoods RKO-25 for the production of ferromanganese and ferrosilicomanganese. The reconstructed furnaces RKO-25 number 3 and number 4 with gas purification were constructed and put into operation in May-June 2011. Gases resulting from the smelting of ferroalloy plants in the ferroalloy furnaces are delivered to the hood-cover, from which the mixture

with suction under the hood of air discharged on a dry gas cleaning. Here are the basic input parameters of gases entering the clearing.

The volume of gas before the gas treatment at a temperature of 140 °C, gas, m³/h, including: 500 000

The volume of gas from the furnace taphole, m³/h 80 000

The volume of aspiration of air from the bunkers and stock-conveying, m³/h 20 000

The volume of gases from the aspiration of the shelters molds for casting ferroalloys, m³/h 50 000

Chemical composition of dust, % by weight:

Fe₂O₃ 1.3

MgO 4.3

CaO 0.3

Al₂O₃ 2.5

MnO₂ 48.2

SiO₂ 27.0

Loss after annealing (including carbon) - rest

Fractional composition of dust:

Particle size, microns <1 10–40 >40

Disperse composition of dust, % 49 39 12

For gas purification oven reconstructed ore thermal furnace № 3 and № 4 in the shop № 3 provides the installation of two bag filters with pulsed regeneration FRIR-7000 design and production UkrSSEC "Energostal". To protect the bag filters from high above the allowable temperature gas ducts before the bag filters are installed suckling valves operating automatically.

Each furnace gas cleaning system consists of (Figure):

- gas outlet from the furnace to the ferroalloy bag filter;

- bag filter FRIR-7000 design and delivery UkrSSEC "Energostal" complete with the ACS filter regeneration;

- DN-26FKGM exhaust fans with electric motors $N = 800$ kW; $n = 750$ rpm; $U = 6$ kV;

- dust extraction systems, which include screw and rotary feeders, dust disc valves, telescopic dust extraction devices, vibrators (unloading of dust from the baghouse hoppers made periodically, directly into the vehicle, in accordance with the suggestion of the customer;

- Safety valves to the nursing bag filters (in front of each bag filter shall be established two nursing safety valves - automatically adjustable and quick emergency);

- maintenance control valves before and after the induced-draft fan;

- gas ducts of purified gas and chimney (the chimney is installed in the axial gas-tight partition that separates the flow of purified gas from the furnace number 3 and number 4) ;

- ACS gas cleaning systems.

Bag filters FRIR-7000 set is open, except for the top and bunkers. In the upper part of the filter caps and automatic recovery system installed on a common two-filter, heated tent shelter. Bag filter housings are designed as self-supporting units, which receive technological and climatological load, the load flow of dust and gas, and the tent-cover filters, consist of a support belt with suspended dust bins and fencing panels. Bearing of the housings through the reference filter are on the supporting plate and the pedestal. Bunker of the filter is placed in an unheated stock house. Entrapped in the filter stocks dust is unloaded by means of screw conveyors in the slot bins through the filter disc valves and rotary feeders directly into the vehicle. To prevent arching and "hanging" of dust in the bins baghouse installed vibrators IV-99N.

Dust loading telescopic devices are equipped with aspiration suction devices to prevent dusting

during discharge of dust from the baghouse hoppers. In setting the ceiling at around dust loading telescopic device includes openings with removable shields to control the process dust loading. The site discharge of dust from the baghouse hoppers at the level of $\pm 0,000$ is made open, with a fence around the perimeter of the grid. In 3-shift operation of furnaces the dust is discharged once per shift. Simplified system of dust loading directly from the bins of filters in vehicles with the exception of pipelines and prefabricated tank is reliable and fully justified itself in terms of shop № 3 at "Tarazsky Iron & Steel Works".

After the bag filters cleaned gases are fed to the exhaust fans single inlet DN-26 FKGM production of "Sibenergomash" (Russia). Exhaust fans mounted open, two exhauster in a bag filter. After the smoke exhausts the purified gas enters the chimney and then into the atmosphere. Control of the residual dust content of the purified gas in the bag filters is performed through periodic measurement tool. The following table shows the technical characteristics of gas-cleaning RKO-25.

The adopted level of automation of gas purification corresponds to state of the art in this field. Total instrumentation and automation allow for each gas treatment to implement:

- Automatic temperature control of gases valves before the baghouse air leaks;

- Control of gas temperature after the furnace hood;

- Monitoring and alarm system of the smoke exhausters temperature bearings and electric motors;

- Control of rarefaction before the baghouse;

- Control of rarefaction after the bag filter;

- Monitoring and alarm system of pressure drop across the baghouse;

- Monitoring and alarm system of pressure and flow rate of the dried compressed air for regeneration of bag filter;

- Monitoring and alarm system of compressed air pressure to purge and shut-off valves.

Operational control, alarm and management of gas cleaning is carried out by automated process control system, designed, set and adjusted specialist UkrSSEC "Energostal".

Gas-cleaning furnaces RKO-25 № 3, 4, were put into operation together with the furnace in May-June 2011. In carrying out commissioning work on the gas purification the furnace worked for 13 MW of power, performance of gas cleaning furnaces № 3 and 4, respectively, amounted to 345 000 m³/h and 300 000 m³/h, dust content before the bag filters 1.15 g/cm³, after treatment the residual dust content was 8.11 mg/m³, the efficiency of bag filters 99%. Gas purification of two furnaces RKO-

Table 1. Technical characteristics of gas-cleaning furnace RKO-25

Parameter	Unit of measurement	Quantity
2	3	4
The volume of gases before the gas cleaning (bag filter) at full design capacity of furnace RKO-25	m ³ /h	500 000
Gas temperature before the bag filter, max.	°C	Up to 145
Type of bag filter		FRIR-7000
Area of filtration	m ²	6883
Specific gas load on the filter material	m ³ /m ² · min	1.21
Mass concentration of dust on the filter input	g/m ³	Up to 2
Rarefaction before the filter	Pa	Up to 2000
Rarefaction after the filter: - working - maximal (when working in cold air exhauster)	Pa Pa	4500 8000
Pressure of compressed air for regeneration of valves	mPa	0.6
Compressed air consumption	nm ³ /h	1000
Bulk density of dust	t/m ³	0.52
Number of filter sleeves	unit	2880
Size of filter sleeves: - length - diameter	mm	6000 133
Number of sleeves in section	unit	120
Number of sections	unit	24
Total amount of shut-off valves	unit	24
Number of purge valves on one section	unit	8
Total amount of blowdown valves	unit	192
Number of valves in one row	unit	15
Type of smoke exhauster		ДН-26ФКГМ
Number of smoke exhausters	unit	2
Volume of gases before the smoke exhausters	m ³ /h	550 000
Gas temperature	°C	Up to 140
Pressure in the exhauster at t = 140° C	Pa	5700
Type of motor		ДА30-560-800/750/6Y1
Installed capacity of electric motor of the exhauster	kW	800
Frequency of rotation	rpm	750
Voltage	B	6000
Residual dust content of gases after treatment	mg/m ³	15

25, commissioned in 2011 after UkrSSEC "Energostal" complex commissioning, are efficient, reliable and provide a residual dust emission of 15 mg/m³.

Conclusions

In connection with the transfer of a large number of closed ferroalloy furnaces at operation in the open mode, and the construction of new ferroalloy furnaces the experience of UkrSSEC "Energostal" based on a range of work involving the development and injection of dry gas

cleaning of furnaces RKO-25 before the bag filters FRIR-7000 at "Tarazsky Iron & Steel Works " is of great interest nowadays.

References

1. Shvets M.N., Stalinskii D.V., Pirogov A.Yu. Ochistka gazov otkrytykh ferrosplavnykh pecheyei, Ekologiya i promyshlennost, 2006, № 2, P. 20–26.*
2. Stalinskii D.V., Shvets M.N. Ochistka otrabotannykh gazov otkrytykh ferrosplavnykh pecheyei, Metallurg. i gornorud. Prom-st, 2010, № 6, P. 107–110.*
3. Stalinskii D.V., Shvets M.N. Innovatsionnye

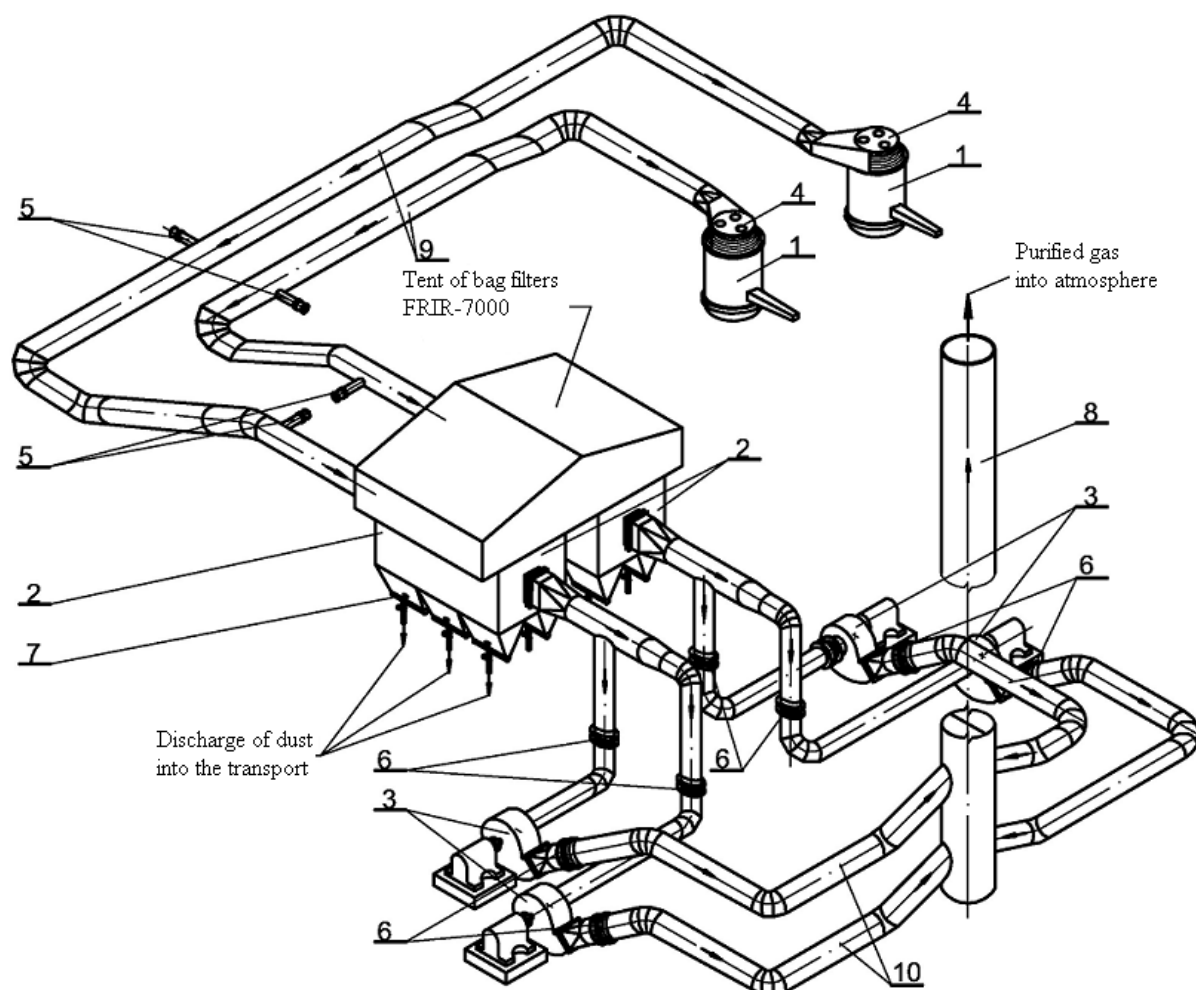


Figure. Scheme of gas treatment of open ferroalloy furnaces RKO-25 in the shop № 3 of "Tarazsky Iron & Steel Works": 1 - ferroalloy furnace RKO-25; 2 - baghouse FRIR-7000; 3 - exhauster DN-26FKGM; 4 - low hood of the ferroalloy furnace; 5 - suckling valve; 6 - disconnecting valve; 7 - screw conveyor in a bunker of the bag filter; 8 - chimney shaft; 9 - dirty gas flues; 10 - flues of clean gas

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Очистка пылегазовыделений открытых ферросплавных печей при выплавке марганцевых ферросплавов

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УкрГНТЦ «Энергосталь» разработаны и внедрены высокоэффективные сухие газоочистки с рукавными фильтрами ФРИР-7000 реконструированных ферросплавных печей РКО-25 на ТОО «Таразский металлургический завод».

В связи с осуществляемым в настоящее время и планируемым в перспективе переводом большого количества закрытых ферросплавных печей на работу в открытом режиме, а также строительством новых ферросплавных печей опыт «Энергосталь» по комплексу работ направленных на разработку и внедрение сухих газоочисток печей РКО-25 является актуальным и востребованным.