PRODUCTION

PROTECTING THE ATMOSPHERE FROM CONTAMINATION

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The law passed on October 27, 1960 by the Supreme Council of the RSFSR makes it obligatory to protect the tremendous natural resources of our country from embezzlement, spoilage and contamination, and, in particular, to prevent the atmosphere becoming contaminated with industrial waste.

The task confronting us is to reduce the dust content in waste gas and air below the maximum permissible by effective dust elimination as soon as possible.

The task is made more difficult by the very high initial dust content in flue gases and aspiration air.

When it has passed through the dust traps, the amount of dust in the flue gases and aspiration air escaping into the atmosphere should be dozens of times smaller than the initial content.

Owing to the fact that flue gases and aspiration air escaping into the atmosphere are not sufficiently cleaned, the amount of dust in the air around some of the refractory plants is extremely great.

Measurements made by Giprotis have shown that at a number of plants they investigated the amount of dust in the air round about was considerably greater than the permissible quota.

The air near the rotary kiln shop at the Nikitovka Dolomite Combine and the proportioning bunker section at the Panteleymonovo Refractory Plant was particularly polluted with dust.

According to data for the "Magnezit" Plant, the cost of magnesite dust escaping into the air with the flue gases from rotary kilns can be reckoned as hundreds of thousands of rubles a year.

Not too long ago the town of Chasov-Yar was strongly contaminated by clay dust carried in the flue gases coming from the drying drums in shop No. 5 at the Chasov-Yar Refractory Combine.

Electric filters were then installed which trap 99.2 - 99.7% of the dust from the flue gases and have reduced the residual dust content to the permissible quota.

The dust trapped by the electrofilters is used as a raw material and provides a saving of about 26,000 rubles a year2) (1).

In 1960 a two-stage unit was installed at the Zaporozh'ye Refractory Plant to catch dust near the rotary kilns; it consists of NIIOGAZ cyclones (first stage) and electrofilters (second stage). An efficiency of 99.1 - 99.6% was attained when the unit was started up. The dust content in the gases after cleaning has been sharply reduced, although the permissible figure has not yet been reached.

It should be possible to adjust and operate the unit in such a way as to improve the cleaning of the gases, reducing the dust content to the set quota.

1) A discussion
2) Here and from now on this means 1961 rubles.

The amount of dust escaping into the atmosphere has been considerably reduced at the chamotte shop at the Krasnogorovka Chamotte-Diaspas Plant by the installation of foam filters. Twelve foam filters installed in the aspiration systems, and three foam filters behind the drying drums trap from 93 to 98.6% of the dust, which amounts to 8 - 12 tons per day. At the Stalnogorsk and Konstantinovka Refractory Plants there are two-stage installations (3) which trap 95% of the dust contained in flue gases from the drying drums.

A great deal of work is being done at the Semiluki Plant to clean flue gases coming from the drying drums (4, 5).

At the Stalnogorsk, Krasnogorovka (2) and Semiluki Plants the trapped dust is used as dross.

Given correct operation of the dust traps and removal of the trapped dust in good time, a high degree of cleanliness of the extracted air (95 - 99%) can be achieved by sleeve filters at shop No. 2 at the Chasov-Yar Combine, and in a number of aspiration systems at the Konstantinovka Refractory Plant, and in the basic refractory shop of the Nikitovka Refractory Combine and a number of other establishments.

These examples of the use of different types of dust traps show that when operated correctly they work reliably, and that the great amount of dust escaping into the atmosphere at a number of refractory establishments is due to poor operation, inefficient assembly and ill-timed removal of trapped dust from dust collectors, and in certain cases to poor choice of dust trap.

In most cases, at places where the great degree of dust contamination is said to be due to inefficient dust traps, it is actually due to the neglected state of the dust elimination system.

More efficient dust elimination in refractory production can be brought about in the following way:

1) repairs to all dust-eliminating devices already installed, and replacement of them in cases where their performance does not come up to standard with respect to the properties of the dust, installation conditions and required efficiency;

2) operation by qualified personnel, daily inspection of the dust eliminating devices and regular removal of trapped dust;

3) careful choice of dust traps being installed, making certain that they suit the given conditions from the point of view of the properties of the dust and ways of evacuating and using it;

4) improvement of the design of existing dust traps and the development of new ones with a view to improving their efficiency.

The dust traps used in the refractory industry can be classed according to their principle of operation.

One of the commonest characteristics is the division into dry dust traps and wet ones trapping the dust by means of water.
The most efficient and most commonly used dust traps, are:

- The dry type: a) electrofilters with an efficiency of 99.0 - 99.9%; b) sleeve filters with a shaking mechanism and back blast, in particular the FV and MFI Type filters with an efficiency of 98.0 - 99.8%; c) NIIOGAZ cyclones with an efficiency depending on the diameter and dust-particle size, ranging from 85.0 to 98.5%.

- The wet type: a) centrifugal VTl-PSI scrubbers and LIOT cyclones with a water film with an efficiency of 99.0 - 99.5%; b) small-size cyclones - SIOT washers with an efficiency of 98.7 - 99.0%; c) foam filters with an efficiency of 95.0 - 99.0%; d) dust traps based on Dovnar’s design with an efficiency of 95%, and certain other types.

This list is not exhaustive.

The most effective dust traps for cleaning large quantities of gases, as shown by the practice of other branches of industry, the Chasov-Yar Combine and the Zaporozh’ye Refractory Plant, are electrofilters.

They trap 99.5 - 99.9% of the dust at a gas temperature up to 200°C. These electrofilters are large in size and cost a great deal to construct and operate.

The installation of five electrofilters at the Chasov-Yar Combine cost about 0.4 million rubles. The substation is operated by highly qualified personnel, whose wages amount to about 15,000 rubles a year.

The expenditure on the construction and operation of electrofilters is recouped comparatively soon on account of recovery of the trapped dust. Electrofilters are used as the principal unit for cleaning flue gases from rotary and shaft-type kilns and set of drying drums.

The cost of building electrofilters may be cut down by leaving them unenclosed.

The experience of the cement industry as well as that of the Zaporozh’ye Refractory Plant has shown that it is advisable to use electrofilters as the second stage in the cleaning system, following on first-stage cleaning in cyclones.

An effective method of trapping fine dust particles is the self-shaking cloth sleeve filter.

When installed under suitable conditions its efficiency reaches 99.6 - 99.9%.

The Soviet-made sleeve cloth filters work well at a gas temperature not exceeding 60 - 70°C. They do not work properly, however, unless special precautionary measures are taken to prevent the formation of a condensate on the surface of the sleeves, nor if the trapped dust is highly abrasive. To avoid condensation when the moist air or moist dust is fed in, the air is either warmed up or specially-heated air is introduced, the filter is insulated and also the air pipes leading to it, or a coil is installed in the collector to warm the dusty air.

To prevent the formation of condensation and to lubricate the sleeves when cleaning moist air, sleeve filters can only be installed in heated premises.

If the dust is abrasive, sleeve filters can be used as the second stage of the cleaning system after cyclones or other coarse-cleaning traps.

It is extremely important to choose the filter cloth according to the type of dust.

If the operation conditions are observed properly, sleeve filter cloth (woollen cloth) traps soft dust for 6 - 12 months without condensation, and can be used as a single dust separator for abrasive dust for 3 - 6 months, or as a second stage (after the cyclone or aspiration pug) for more than 6 to 12 months. Shop No. 2 at the Chasov-Yar Combine is an example of this.

Twenty-five sleeve filters at the "Magnesit", Zaporozh’ye, Semiluki and Panteleymonovo Plants as well as at the Chasov-Yar, Yamasky and Nikitovka Combines were investigated by Giprotis, and it was found that 60% of them trapped more than 87.8% of the dust, while 40% of the filters trapped from 95 to 99%. To clean gas and air at a temperature above 60 or 70°C, the filters use synthetic fabrics (nitron or lovsan), a mixture of synthetic fiber and wool (orlon), or glass fiber.

The commonest dry dust traps for coarse cleaning of gases are different types of cyclones (NIIOGAZ, LIOT, SIOT) and others. The greatest effect is shown by the NIIOGAZ Tsn-15 cyclone, which is simple to operate and traps from 60 to 95.6% of the dust according to the cyclone diameter and the referred diameter of the dust particles.

The cyclones should be used at places where fine cleaning of gases or air is not required, and also as the first stage in a cleaning system in front of a more efficient dust trap, for example in front of electrofilters, sleeve filters or wet filters.

Wet dust traps - foam filters and film filters (VTl-PSI centrifugal scrubbers, LIOT water-film cyclones and SIOT cyclone-washers) are small in size and very efficient.

The efficiency of foam filters included in the aspiration systems at shop No. 1 at the Krasnogorovka Plant is 95 - 98.5%, and according to data from "Mekhanobr") Institute, which has tested foam filters with apatite dust their efficiency attains 98.7 - 95.0%. The foam filter is a highly effective dust trap, but is complicated to adjust so that the foam is stable.

The VTI-PSI centrifugal scrubbers and water-film cyclones 90 - 99.5% of the dust, according to the scrubber diameter and the dust particle size. Its basic shortcomings are fouling of the nozzles, making it necessary for regular and thorough cleaning of the recirculating water or complete replacement of the water or complete replacement of the circulating water. The nozzles are eroded by acids.

To clean gas and air at a temperature above 60 or 70°C, the filters use synthetic fabrics (nitron or lovsan), a mixture of synthetic fiber and wool (orlon), or glass fiber.

The small size cyclone-washers, according to SIOT and Santekhproyekt Organizations, catch about 96% of the dust. They do not have nozzles which clog easily, and are simple to make and adjust. If there are no nozzle for the cyclone-washers and foam filters, a greater amount of water can be circulated without additional filtration than in the case of scrubbers or water film cyclones.

The installation of wet dust traps makes it necessary to provide for an expensive system of slurry removal and water cleaning, and the water cannot be passed directly into the drainage system after the dust has been trapped.

The possibility of using the slurry obtained by this method is limited at a number of plants.

It should be pointed out that in cleaning aspiration air free of dust the possibility of using a wet dust-elimination system is much greater than in installations for cleaning flue gases, since in the former system the air does not contain sulphur gas and the metal parts are therefore not eroded by acids.

Whereas the twelve foam filters in the aspiration systems in the Krasnogorovka Chamotte Plant work smoothly and efficiently, the three foam filters installed for cleaning flue gases from drying drums heated with coal are quickly eroded on account of the sulphur in the flue gases and the