AIR PROTECTION FROM POWER INDUSTRY EMISSIONS

1.2. Ash collecting at TPPs

1.2.2. Fly ash collecting technologies at TPPs

1.2.2.4. Fabric dust collectors

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In fabric filters filtering is performed through a flexible fabric, made from thin filaments with diameter of 100 ... 300 mm. The filters have a cylindrical shape and are called bag ones. At application of fabric filters a high dust collection efficiency - up to 99,9% can be reached. Their use is associated with a number of conditions. Velocity of gas flow through the fabric must be very low: u = 0,01 ... 0,02 m/s. Hydraulic resistance is high: 0.5 ... 1.5 kPa. The greatest operational difficulty is removing of ash settled on the fabric. To remove ash, mechanical shaking or air blowing in the opposite direction is applied. Thus, for this period, a section under cleaning, as a rule, should be separated from the gas flow by gates.

Fabric filters should be made of material, withstanding operation at a sufficiently high temperature of flue gases. Filter material must be resistant to the increased moisture and the effect of chemical compounds. Wool, wool felt and polyester are applied as the filtering materials at flue gas temperature up to 130°C. Before 260°C fiberglass and fiberglass with graphite are used. Oksalin can be also applied (up to 250°C). Life time of the fiber varies from 1 to 3 years. Design and function of the fiber bag filter are shown in Fig. 1.30.

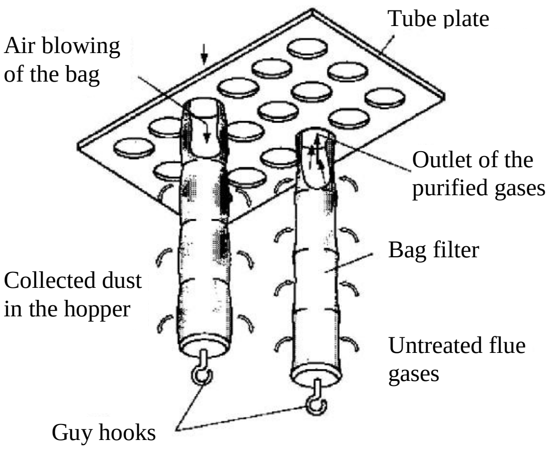

Fig. 1.30. Design and function of fabric bag filter with supply of the dusty flow from periphery to the bag

In Fig. 1.31 a schematic design of the bag filter is shown. The filter is made in multiple versions. A number of bags in the same chamber can be from several dozens to 100 or even more. Flue gases pass from the bottom into bags, dust particles are precipitated at the inner wall surface of the bag. In process of regeneration, a valve disconnects one of the chambers from flue gas supply and dust layers, stuck to the fabric, are removed by shaking or vibration of bags. In addition, compressed air stream, directed up the flow of cleaned flue gases, contributes in dust separation. The separated dust falls into the dust collector, which is under the bags, and is removed with a screw from the filter room.

Filters with shaking regeneration have special beaters, located at the inclined frames, which are attached to bags. Disadvantages of this method include rapid wear of fabric bags. For this reason, especially when using glass fiber,

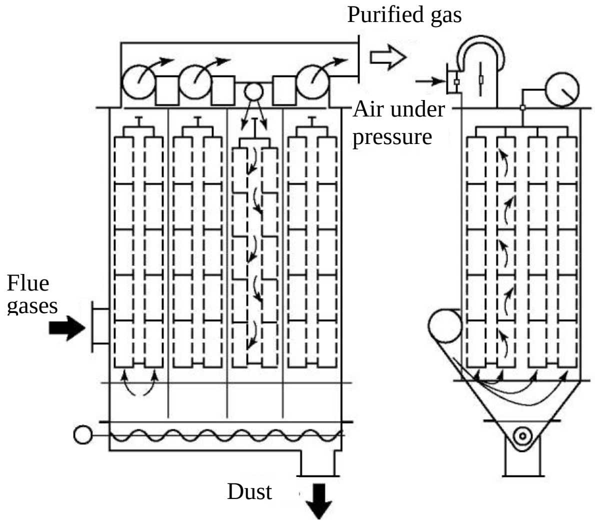

Fig. 1.31. Multi-chamber bag filter with supply of the dusty flow into the bags

vibrators that perform horizontal shaking motion or slop movement of bags, are applied for filter regeneration.

These filters are designed to be multi-chamber with supply of flue gases into bags. Filter regeneration is executed by means of compressed air of low pressure. Air overpressure does not exceed 10 Pa. Such regeneration is sparing; service life of bags is 16 thousand hours. Working time of the filter cloth is defined by appearance of defects in fabric or resistance growth due to agglutination of pores. The bags typically have the following dimensions: 300 mm in diameter, 10 m long. The area of filtration of one bag is 10 m^2.

Bag filters, where regeneration occurs at a high pressure (Fig. 1.32), are wide spread. This was achieved due to using of a needle-felt filter material with high strength. In filters of this type flue gases are always fed into the bag from the outside (from periphery). For filter regeneration the air stream is shortly "shoot" into the bag from top to bottom at a high-pressure at the sound speed. There is a shaking and deformation of the bag, which swells, due to which a layer of dust flows down and is removed (Fig. 1.32). In this case, both separate bags and rows of bags can be recovered. By that, flue gas supply cutting off is not required. Duration of the regeneration process varies from 100 to 300 ms (0,1 ... 0,3 s). Multi-chamber structure is not necessary for such filters. Air pressure in the regeneration tank varies from $0{,}5{\cdot}10^5$ to$7{\cdot}10^5$ Pa.

As for capital and operating costs, fabric filters roughly correspond to electrostatic precipitators, but they are easier to use and more effective.

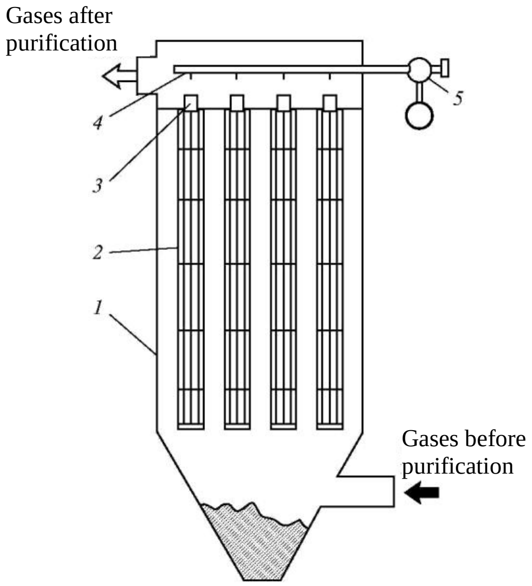

Fig. 1.32. Fabric bag filter with supply of the gas flow outside the bags and with one-side pulsed blowing:
1 – filter body, 2 – bag frame, 3 - ejector nozzle, 4 - air distribution pipe 5 - pneumatic valve

In addition to fabric bag filters, pocket fabric filters are also applied. Compared with bag filters, they are less common. Their filtering fabric is performed in a form of rectangular flat pockets, mounted on special frames. Flue gas flow passes through the outer surface of the cloth to the pocket. Thus, purification of flue gases from ash occurs on the outer side of the cloth.

The advantage of chamber design of filters is possible removal from service of a single chamber without turning off the entire filter system. In addition, it is possible to install accessory chambers. At the same time in the same dimensions of installation in case of bag filter application, a larger filtration surface can be placed than in case of pocket fabric filter application. Typically, chamber filters are applied in small-capacity power installations.

Calculations of fabric filters are conducted according to condition that their resistance doesn't exceed 1.5 kPa. The total filtration area, m^2,

$$W = \frac{V}{u}\,(1 + 1/n)\,, \qquad (1.37)$$

where V is a volume gas flow rate, m^3/s; n is a number of sections.

Residual concentration of ash (dust) after fabric filters may be of 15 ... 50 mg/m^3, which meets the highest standards. Design load per 1 m^2 of fabric should not exceed 12 ... 18 $g/(m^2 \cdot min)$. Gas temperature at the filter outlet should be by 15 ... 30°C higher than the dew point temperature.