Gas filtration through fabric is accompanied by electrostatic phenomena and adhesion. This significantly affects the hydraulic characteristics and effectiveness of the filter and also the regeneration conditions [1]. In the present work, on the basis of research during the debugging of industrial filters at open ferroalloy furnaces, we consider the influence of electrostatic phenomena on filtration and regeneration at bag filters.

The static charges arising in gas filtration through fabric may have negative and positive effects. Positive effects include more efficient filtration and the agglomeration and adhesion of dust particles at the filter fabric. Negative effects include slowing of regeneration and the retention of dust at the fabric surface. That calls for more intense regeneration [2].

In the operation of bag filters, the fabric is charged as a result of the passage of gas and the deposition of charged dust particles. In the opinion of some researchers, the role of the fabric is dominant here [3]. The intensity of charge generation depends on the type of fabric and on its structure and condition. Other conditions being equal, higher charge will be generated by coarse fabric (such as wool) with a rough surface, fabric with a slightly twisted nap, and fleecy fabric than by material with a smooth surface, such as materials with filaments (continuous fibers).

Another important characteristic is the rate at which the fabric loses its static charge. This mainly depends on its resistivity, according to [3]:

<table>
<thead>
<tr>
<th>Resistivity, $\Omega\cdot$cm</th>
<th>Charge dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt;10^{13}$</td>
<td>Zero</td>
</tr>
<tr>
<td>$10^{12} - 10^{13}$</td>
<td>Poor</td>
</tr>
<tr>
<td>$10^{11} - 10^{12}$</td>
<td>Mean</td>
</tr>
<tr>
<td>$10^{10} - 10^{11}$</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>$&lt;10^{10}$</td>
<td>Good</td>
</tr>
</tbody>
</table>

In addition, each fabric is characterized by the magnitude of the static charge and occupies a specific position in the triboelectric series [1]: running from positive to negative, we have woolen felt, wool, glass fiber, nylon, and cotton. Note that, in the same conditions, fabric of the same material with different structure will lose its static charge at different rates. For example, filamentary calendared polyester fabric loses its static charge much more rapidly than polyester fabric with a rough surface [4]. Hence, to reduce the influence of electrostatic phenomena on filtration, we should use dense, smooth fabric, after preliminary heat treatment (singeing, thermal fixing, or calendering). The electrostatic field may also be reduced by using special filter fabrics with antistatic properties, such as carbon fabrics [5]; fabrics with braided metallic wires (Lurex) [6]; and nonfabric materials sprayed with metals [7].

There has been no systematic research into the influence of electrostatic phenomena on the filtration of industrial gases. The development of antistatic filter materials is within the scope of laboratory research, but to date such research has been contradictory or commercial [5–9]. Antistatic materials are rarely employed, since they are expensive and require special production technology. Therefore, bag filters are based on synthetic fibers such as polypropylene and polyamine, but most often on polyester fiber.

We know that methods of addressing static electricity in fibers and fabric may be divided into two groups.

(1) Preventive measures create conditions in which charges do not appear or do not present significant interference. Such measures include increasing the moisture content of the gas, treating the filter bags with antistatic preparations, and grounding. Increasing the relative humidity of the air (gas) to 90% gives...
satisfactory results, but only for hydrophobic tissues. Treatment with antistatic preparations is effective up to 105°C. The antistatic preparation, by absorbing moisture, creates a conducting layer of water molecules at the surface of the fabric. Above 105°C, the water evaporates, and the antistatic action ceases. Grounding does not prevent the appearance of charges but assists in their dissipation.

Active methods eliminate or neutralize the existing static charges. Such methods include the ionization of air, the action of high frequency, UV radiation, and so on.

Comparison shows that preventive measures are more promising for industrial use.

The influence of electrostatic charge on the filtration and regeneration of bag filters was studied at Chelyabinsk Electrometallurgical Works in the startup and debugging of gas purification by means of bag filters, with regeneration by inverse blowing, since the intended performance proved unattainable.

The gas-purification system at Chelyabinsk Electrometallurgical Works is aimed at dust removal, including an exhaust pump, bag filters, regeneration equipment, a system for collection and transportation of the trapped dust, and auxiliary equipment. The exhaust pump is installed in the dusty gas; a single fan is used for inverse blowing in regeneration. All the equipment is located within a building; the bag filters are at the roof. In Fig. 1, we show the gas-purification system for an open ferroalloy furnace.

The bag filter consists of a metal frame protecting the bags from atmospheric precipitation. In the upper part (under the roof), grilles permit the exit of purified gas from the filter. Below that, we see the attachments from which the filter bags are suspended. The lower part of the frame contains the bunkers in the filter sections, with pipes for bag attachment (Fig. 2).

Filter bags (diameter 300 mm; length 9.6 m) with reinforcing rings are employed (96 rings in each of ten filter sections). The upper part of the bag includes a seal. The bag is suspended from the grilles by means of spring shock absorbers and clamped to the lower bag-attachment tubes. Filter operation is regulated from a KEP-12U control board. Automatic filtration and regeneration are set up at the debugging stage.

The filter characteristics are as follows: productivity 370000 m³/h; purified-gas temperature no more than 150°C; filtration speed 0.7 m/min; hydraulic drag 2.6–2.9 kPa; pressure in the inverse-blowing system 4.0 kPa initially and 1.0 kPa finally; dust concentration in purified gas no more than 20 mg/m³.

To maintain the required temperature of the purified gas, valves draw cooling air into the gas line. The filters are made of FT-200-Ch filamentary polyester fabric (Technical Specifications TU 17 RSFSR-62-10131–81), with resistivity $1.12 \times 10^{11} \, \Omega \, \text{cm}$. 

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**Fig. 1.** Gas-purification system for an open ferroalloy furnace with bag filters of pressurized type: (1) ferroalloy furnace; (2) furnace cover; (3) furnace shaft; (4) gas line; (5) air-intake valve to cool the gas supplied to the filter; (6) service area; (7) exhaust pump; (8) gas line of inverse-blowing system; (9) conveyer for the removal of the trapped dust from the filter; (10) inverse-blowing fan; (11) pressurized collector of filter; (12) bag filter with regeneration by inverse blowing.

**Fig. 2.** Bag filter of pressurized type with regeneration by inverse blowing: (1) gas line from the hood of the ferroalloy furnace; (2) air-intake valve to cool the gas supplied to the filter; (3) service area; (4) exhaust pump; (5) trapped-dust bunker; (6) conveyer for the removal of the trapped dust from the filter; (7) gate valve; (8) pressurized collector; (9) choke valve; (10) gas line of inverse-blowing system; (11) choke valve of inverse-blowing system; (12) bunker of filter section; (13) lower bag-attachment tube; (14) filter bag; (15) reinforcing ring; (16) filter frame; (17) upper bag-attachment point; (18) grille; (19) roof of filter frame.