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ENVIRONMENTAL PROTECTION

New type of off-gas filter for vacuum steel degassing plants

Large volumes of filter plants and suction ducts are costly remedies, as they involve high investment and operation costs. A flat sleeve filter needs only half the height and half the filter volume compared to the conventional round sleeve filters. Practice-proven in vacuum plants, this sleeve material is subjected to a water and oil repelling Teflon bath treatment.

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The preparation of off-gases from a vacuum steel degassing plant with the aim to protect the vacuum pumps and the environment is feasible for steam ejector vacuum pumps and is compulsory for mechanical vacuum pumps. An element of this gas preparation is the dust abatement by bag filters. Unfortunately, they generate a pressure drop and thus performance loss of the suction capacity at the measuring point inside the metallurgical reaction vessel. To avoid these undesirable side effects the bag filter surface should be chosen to be as large as possible. This results of course in less pressure losses, however, leads to high filter structures, to large plant volumes and to costly suction duct layouts. Conventional bag filters in steel degassing for a filter surface of 400 to 450 m² have a diameter of 3.2 – 3.6 m and need a height of 15 – 16 m in case the bags can be introduced and exchanged from the top through a passable clean gas plenum. The generally used round sized bags of 140 – 160 mm in diameter must have a clearance in between each other of 10 mm per 1 m bag length, but at least 40 mm. In case the bags are long and the strict verticality cannot be assured by the sleeve top flange this clearance must be larger in order to avoid sleeve damages by touching each other. The utilisation of space of these filters is therefore rather limited.

Half height and volume

The flat bag filters have made their proof for dust abatement of electric arc furnaces, in the foundry and cement industry, waste incineration, bio-masse drying and other problematic dust. They need less volume and a drastically reduced height. The companies CLESID/France and NEDERMAN/Sweden therefore have developed a flat sleeve filter for the use in vacuum metallurgy. For an equal filter surface and equal conductance value this filter needs only half the height and half the filter volume compared to the conventional round sleeve filters. The sleeve material, including its water and oil repelling Teflon bath treatment, that has made its proof in vacuum plants using the conventional round sleeves, has been adopted without change.

The sleeve filter design

The special flat sleeve profile, the alignment of sleeves and the cleaning sequence permit a narrow sleeve arrangement and thus an optimal use of space. Cleaning effects are very efficient by the blowing-up of the sleeves with nitrogen generating a change from concave to convex and it is uniform over the full sleeve length. The flat sleeves are relatively short with 1.3 to 2.5 m and they are hold at both ends. The sleeves are introduced by hand in a slot wall and fixed dust tight. The bottoms of the sleeves are protected by steel profiles against erosion by dust particles. Any friction as observed between long round sleeves in conventional filters is avoided with flat

sleeves. The longest sleeves together with their internal cages have a weight of only 5.1 kg, and they are very easy to handle. The mechanical stress on the filter cloth by the sleeve weight is thus uniform and extremely low. The total weight of a 400 m²-filter is reduced against the conventional filters by 33 percent and the volume to be evacuated decreases by 50 percent. Both facts are favourable for manufacturing cost and evacuation time. The filter units are offered by CLESID in four box type sizes from 20 to 50 m² and in three cylindrical sizes for 180, 320 and 400 m². A box type size reaches 530 m³. The sleeves are in general arranged vertically. In a horizontal layout the height of the largest filter is restricted to 7 m.

Advantages

The sleeve cages made of steel wire are protected against corrosion by humidity and the presence of chlorides. After cleaning there are no remainders of dust on the sleeves that might store humidity. In the vacuum version the gas flow is from the sleeve bottom side. Since the sleeve bottoms are protected against the direct contact with particles by a steel profile, the guiding of the gas flow is very simple and the pressure losses owing to gas guiding are extremely low. Collection and extraction of dust has been taken over from conventional round filters without change. However, no erosion resistant steel must be used in order to resist to the wear of high speed dust particles. The target is always to avoid any dust deposits and thus any acoustic or mechanical vibration devices to loose them. Cleaning with nitrogen is according to the proven pulse jet process. Thanks to the special arrangement of the membrane valves inside the nitrogen header the pressure losses are reduced as is the gas consumption. In spite of the fact that owing to the short sleeve length the number of membrane valves is doubled compared to conventional filters, the nitrogen consumption per cleaning cycle is not increased. No Venturi nozzles are needed for the cleaning. The accessibility to the valves and sleeves is easy and simple, since a much lower height is to be overcome. And the prepared units of sleeve and cage can be introduced easily by hand.

Picture: "Fig-2"
Caption: Arrangement of the flat sleeves, their concave shape in stand-by and convex during cleaning, in comparison to the triangular arrangement of round sleeves

Picture: "Fig-3"
Caption: Changing a sleeve in a flat sleeve filter: The sleeves are introduced by hand in a slot wall and fixed dust tight