Clean air for Moorburg

Diana Völkel

The energy site of Moorburg at the Port of Hamburg hosts one of the most modern hard coal-fired power plants in the world: as one of the leading electricity producers in Europe and operator of the plant, Vattenfall focuses on environmental protection and resource conservation. The flue gas desulphurisation system of the power plant was equipped with wet desulphurisation and innovative technology, in compliance with the provisions for large combustion plants.

An overview: The various processes of flue gas desulphurisation - dry, wet and dry-regenerative

Flue gas desulphurisation consists of three processes, which are divided according to the degree of precipitation of sulphur dioxide: dry (50 %), dry-regenerative (100 %), and wet processes (more than 95 %). Large power plants in Germany are required by law to wash out at least 85 % of the sulphur dioxide from combusted fuel (provision for large combustion plants with a thermal output of more than 300 MW). Therefore, at the Moorburg site the wet flue gas desulphurisation process is applied.

This article highlights the individual process steps of wet desulphurisation after the limestone cleaning process, the individual process stages and related operating conditions (mediums, pressures and temperatures), as well as the types of butterfly valves and materials used.

The "wet" flue gas desulphurisation system of the Moorburg power plant

Here, thanks to a calcium process, the air pollutants resulting from electricity production are filtered from the flue gas and converted to make them eco-friendly. A package with more than 300 butterfly valves was created for the plant. In 2010 the company for industrial fittings and actuator technology in Hagen finalised the project by including shut-off and control valves in nominal sizes from DN 50 to DN 1200 for all process fields.

Wet and cold – The process of flue gas desulphurisation

Flue gas desulphurisation is a part of flue gas cleaning. Solid and liquid pollutants are removed from flue gas during the so-called cold cleaning process. The unclean flue gas (waste gas from the boiler plants) is fed into the lower part of the cleaning tower and sprayed in wet scrubbers with sus-

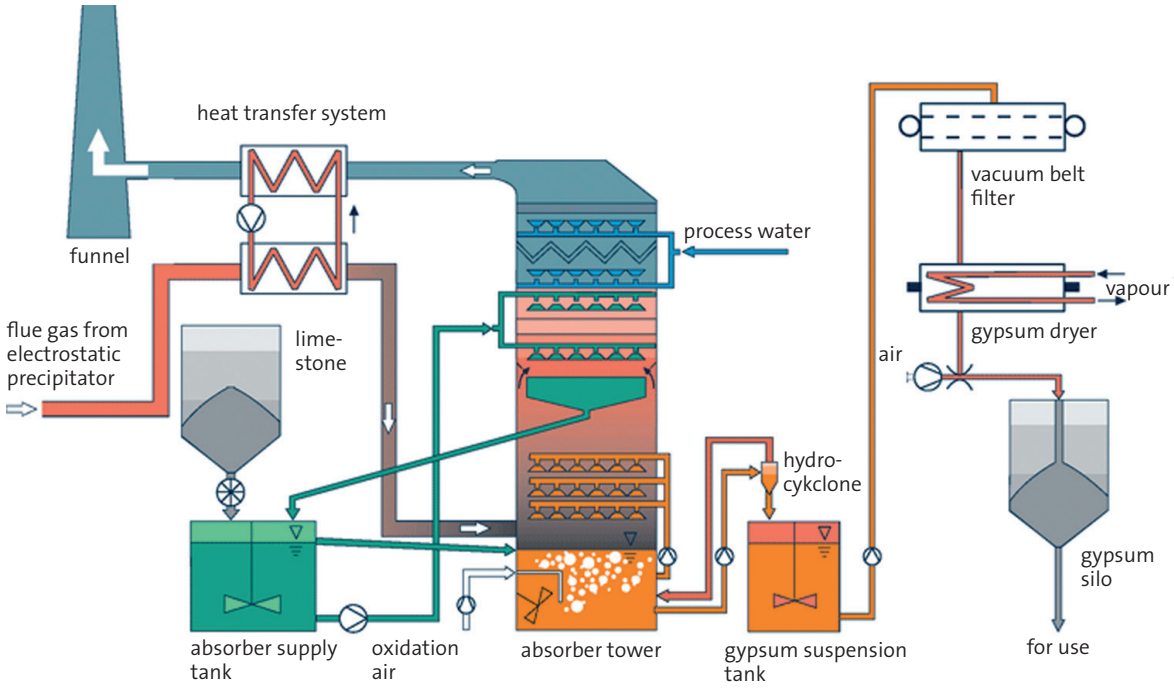

Fig. 1: schematic representation of wet desulphurisation

pensions of finely ground limestone ($CaCo_3$) and water (H_2O). This process produces calcium hydrogen sulphite, which easily oxidises and forms gypsum with air supply (oxygen). The by-product of this reaction is sulphuric acid, which, in turn, reacts with the cleaning liquid, thus forming gypsum. Water is then extracted from the resulting fine crystalline precipitate gypsum in the separator. The moist and pollution-free gypsum cake is 100 % recycled (for example, in the building materials industry). The cleaned flue gas is removed. (Fig. 1: flue gas desulphurisation).

The butterfly valves for flue gas desulphurisation used at the Vattenfall power plant in Moorburg

There are four major mediums in the technical flue gas desulphurisation process:
– Process water
– Oxidation air
– Limestone suspension (lime milk)
– Gypsum suspension (final product)

The service life of the technical components is subject to high requirements, since the stress on the parts that come into contact with the medium is very high, especially for limestone and gypsum suspensions. Fitting manufacturers, who are in charge of the development of wear-resistant rubber linings and materials, have found, for example, that UHMWPE is a durable and safe alternative to metallic materials.

In the following section, the individual mediums and their related fittings, which are used in the FGD plant in Moorburg, are presented.

1. Process water

The process water supply lines have a cross section of 50 to 300 mm, and are charged with maximum 10 bar. The temperatures are generally around 40°C. The correct choice of materials for the parts that come into contact with the medium (sleeve and valve disc) is determined on the basis of the chloride content in the medium and of the existing PH value. In general, the elastomer EPDM is suitable as a liner. In rare cases, a higher chloride content requires the use of CSM (Hypalon). The valve disc is made of V4a stainless steel (1.4408). As an alternative, 1.4469 (Duplex) is also possible. In principle, lug type butterfly valves are used in the feeder (Fig. 2).

Fig. 2: butterfly valve with a UHMWPE lined disc and electric drive

2. Oxidation air
Depending on the system, oxidation air reaches temperatures above 150 °C. For lower temperatures, EPDM is used. For higher temperatures, metal sealing high-performance valves (Fig. 3) are used, which provide reliable quality and long-term operating safety due to their design. The air is conducted into the absorber through pipes with a maximum diameter of 400 mm, and then activated manually via manual gear.

3. Limestone suspension
Operating conditions with a maximum operating pressure of 10 bar and temperatures around 40 °C are not particularly demanding in this procedural field. However, the limestone suspension is a highly abrasive medium and the materials with which it comes into contact need to be wear resistant. As a result, both the disc and the liner are exposed, through the medium, to high wear risk, which they must be able to withstand. EDPM is therefore used as a material for lining the body. The disc must be made of Duplex or have an appropriate abrasion-resistant coating. UHMWPE has excellent mechanical properties, is anti-adhesive and prevents caking. Due to its excellent sliding properties, impact strength and notched impact strength, this material offers application opportunities especially for suspensions, which are present in power plant technology, and for mediums that require very high chemical resistance. In addition, it is a good alternative to PTFE. Hastelloy also offers equally good properties. The discs of the butterfly valves are therefore coated with UHMWPE or Hastelloy for limestone suspensions and, in this way, they are wear-resistant according to the medium.

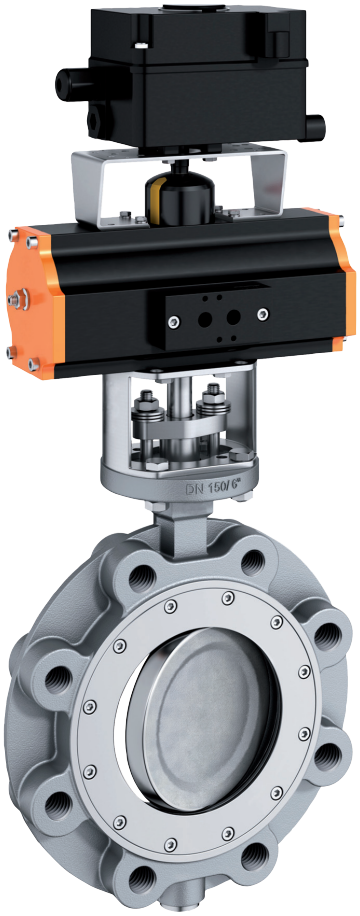

Fig. 3: high performance butterfly valve with pneumatic swivel drive

4. Gypsum suspension
Gypsum suspension has similar characteristics to limestone suspension, however it has a lower pH value ("acid solution") and a high chloride content. Due to the mechanical and chemical properties of the medium, at this point a Hastelloy or UHMWPE lined disc is used. In general – and also in Moorburg – double flanged butterfly valves are mounted on hydrocyclone 4–8 during flue gas desulphurisation.

Vattenfall Europe does not only rely on these valves made in Moorburg: flue gas desulphurisation systems in Boxberg and Schwarze Pumpe were also fitted with these valves, as well as high performance valves. The comprehensive customer service and the high quality of materials, linings and coatings have proved highly convincing in many respects, primarily for their safety and durability.

Author:
Diana Völkel, Certified Business Economist, Public Relations, EBRO ARMATUREN, Gebr. Bröer GmbH, Hagen