

The invention relates to a method of supplying a treating agent in the form of chemicals into the exhaust gas stream in combustion processes by means of a carrier medium through a spray nozzle in order to reduce the nitrogen oxide concentration.

In order to reduce nitrogen oxide emissions, it is known to introduce chemicals, generally ammonia, sal ammoniac, urea or lime-nitrogen, which, in some cases, can be mixed with various hydrocarbon compounds as what are referred to as reinforcing chemicals, into the hot exhaust gas stream. They are introduced at temperatures of at least 600°C, the best and most uniform possible distribution of the chemicals being crucially important for the optimum progress of the chemical reactions for absorbing or reducing the nitrogen oxides. According to the present state of the art, uniform distribution over the entire waste gas stream is achieved, on the one hand, by arranging several nozzles over the cross section of the waste gas offtake and, on the other hand, and this is generally considered to be particularly important, by using two-component nozzles, as are known, e.g. from WO-A-89/07982, to which steam or compressed air is supplied as a spray medium. However, precisely the use of a special spray medium has several disadvantages. Compressed air or steam are relatively expensive media as they always require high quantities of energy, and in the case of the use of steam, conditioned boiler feed water. The lines for guiding these media to the individual nozzles are expensive as either heat-insulated pipes have to be used in the case of steam and/or relatively large pipe cross sections have to be used in order to reduce the pressure loss in the system. The expansion of the media at the nozzle outlet or the flow of the media in the lines generates a relatively

high noise level, frequently even necessitating sound insulation. Furthermore, it must also be accepted that undesired rarefaction of the waste gases by air or steam will reduce the efficiency of the steam production or possibly of the exhaust gas purification system.

The use of two-component nozzles also has the disadvantage that the carrier medium which serves to spray the treating agent, i.e. the chemicals, has to be used in a large quantity, as spraying is effected as a result of kinetic energy of the carrier medium. This results in high rarefaction of the waste gases, even when there are only relatively small quantities to be sprayed.

The aim of the invention is to allow for the supply of a treating agent, i.e. specific chemicals, into the waste gas with high efficiency, low expenditure of energy and low construction costs.

This problem is solved according to the invention, departing from a method of the type specified at the outset, in that the carrier medium is brought to a pressure level required for spraying and is supplied to a spray nozzle having a single nozzle opening, and that the treating agent is supplied to the spray nozzle, said treating agent being mixed with the carrier medium in any desired ratio immediately before it emerges from the nozzle opening, the treating agent being brought to the pressure level of the carrier medium prior to the mixing process.

By virtue of this method, it is possible to supply any desired quantity of treating agent into the waste gas without having to

operate the nozzle at different pressures and flow rates, so that the nozzle always operates with optimum efficiency. The quantity of treating agent to be supplied is varied by variously adjusting the ratio of carrier medium and treating agent prior to the spray process. In contrast to two-component nozzles, in which, when the quantity of treating agent is reduced, the carrier medium must also be reduced, and in which, when the treating agent is increased, the carrier medium must also necessarily be increased, in this case, when using a single-component nozzle, it is possible to always operate under the same conditions. Moreover, in the case of a single-component nozzle, spraying of the treating agent is effected not as a result of kinetic energy which must be applied by means of the carrier medium, but as a result of the change in pressure in front of and behind the nozzle opening, this leading to a considerable reduction of the carrier medium. This is necessary in order to operate the nozzle at a specific flow rate, irrespective of the proportion and quantity of the treating agent. Furthermore, the carrier medium can also serve to cool the spray nozzle if spraying of the treating agent has been completely set. In this case, the nozzle would be subjected to influences as a result of the heating action in the combustion chamber, these being avoided by the spraying of the carrier medium.

According to a development of the invention, the quantity of treating agent added can be adjusted as a function of the NO_x gas concentration in the treated waste gas stream. The NO_x gas concentration is therefore measured in a region in which the treating agent is already situated and the corresponding chemical reaction has taken place.

However, the quantity of treating agent can also be adjusted as a function of the waste gas quantity.

Furthermore, according to an advantageous embodiment of the invention, the spray pressure can be adjusted as a function of the waste gas quantity.

In order to prevent excess pressure fluctuations in the entire system when supplying the treating agent, it is advisable in a development of the invention to supply the treating agent to the spray nozzle in concentrated form, the concentration being adjustable as a function of the quantity required. In general, concentration can be effected up to the respective solution limit of the treating agent.

E.g. ammonia, sal ammoniac, urea or lime-nitrate can be used as the treating agent. In the case of this treating agent, it is advisable to use water as the carrier medium.

The invention will now be described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic flow diagram for the carrier medium and the treating agent;

Fig. 2 is a schematic view of the flow diagram for the method according to Fig. 1 in association with the control system, and

Fig. 3 is a section through a spray nozzle for use with the method according to the invention.

Fig. 1 shows the schematic flow diagram for the carrier medium and the treating agent. According to this figure, the reference numeral 1 designates a storage vessel for the chemical to be supplied to the combustion chamber, this being found in the pulverulent state in this vessel in this example. The chemical is advanced via a sluice 2 to a recipient vessel 3 into which water for dissolving the chemical is introduced via a valve 4. The solution or suspension formed is circulated constantly by means of an agitator 5 in order to prevent separation. The reference numeral 6 designates a level monitoring system which ensures the supply of chemicals from the storage vessel 1 when the minimum level is passed. A float 7 monitors the fluid level in the recipient vessel 3 and acts upon the valve 4 for supplying water to the recipient vessel 3. The treating agent is supplied to several spray nozzles 10 by means of a pump 9 via a line 8, these spray nozzles being distributed in several planes in the wall 11 of a combustion chamber 12. A non-return valve 14 is provided in the delivery line 13 which leads from the pump 9 to the spray nozzles 10 in order to prevent the carrier medium from flowing back into the recipient vessel 3. The carrier medium, which in this example is water, is supplied by means of pumps 15 via valves 16 to a delivery line 17 which leads to the spray nozzles 10. A non-return valve 18 and a pressure monitoring point 19 are provided within the delivery line. A further pressure measuring point 20 monitors the pressure in the spray nozzles 10.

The control system with the aid of which the supply of the treating agent is controlled will now be described with reference to Fig. 2. The same reference numerals are used for components already described in Fig. 1. Treating agent and carrier medium are led by means of the pumps 9 and 15 to the

spray nozzles 10 which open into the combustion chamber 12. The reference numeral 21 designates the boiler in general, to which feed water is supplied via a line 22. The reference numeral 23 designates the main steam line, while the reference numeral 24 designates the waste gas offtake.

The quantity of the treating agent, i.e. the chemical, provided for supply to the combustion chamber 12 is set by means of a control system 25. Control is effected as a function of the NO_x gas concentration in the waste gas 24, this gas concentration being measured at a point at which already treated waste gas, i.e. waste gas subjected to the treating agent, is situated. This signal is fed via the line 26 to the control system 25. The desired value of the NO_x content in the waste gas which, when exceeded, initiates the supply of treating agent to the combustion chamber in order to treat the waste gas, is set by means of a set-point generator 27. The supply of the treating agent is therefore controlled as a function of the difference between the actual NO_x content fed via the line 26 and the value predetermined by the set-point generator 27. Furthermore, the control system 25 can also control the quantity of treating agent supplied as a function of the waste gas volumetric flow rate, this value being measured in the waste gas offtake 24 and being fed to the control system 25 via the line 28.

This measured value relating to the volumetric flow rate of the waste gas is also fed via the line 28 to a further control system 29 provided to set the spray pressure. A set-point generator 30 for the spray pressure gives a constant corresponding to the nozzle configuration, or the spray pressure can be adjusted as a function of the waste gas

volumetric flow rate or the boiler load. The measured value relating to the waste gas volumetric flow rate is fed via the line 28, while the measured value relating to the boiler load is fed via the line 31. The reference numeral 32 designates a signal line which feeds the actual prevailing spray pressure to the control system 29.

Fig. 3 is a schematic section through a spray nozzle 10. This has a nozzle body 33 which comprises, on the one hand, supply lines 34 and 35 and, on the other hand, a mixing chamber 36. The supply lines 34 and 35 open into the mixing chamber 36 and are connected at their other ends to the supply line 13 for the treating agent and to the supply line 17 for the carrier medium. Directly following the mixing chamber 36 in which the carrier medium and the treating agent are mixed together there is a nozzle head 37 which can be screwed on to the nozzle body 33 and has a spray bore 38 from which the mixture of carrier medium and treating agent emerges under pressure and is finely sprayed as a result of the prevailing pressure difference inside and outside the spray nozzle.



CLAIMS

1. Method of supplying a treating agent in the form of chemicals into the exhaust gas stream in combustion processes by means of a carrier medium through a spray nozzle in order to reduce the nitrogen oxide concentration, in which the carrier medium is brought to a pressure level required for spraying and is supplied to a spray nozzle having a single nozzle opening, to which the treating agent is also supplied, said treating agent being mixed with the carrier medium in any desired ratio immediately before it emerges from the nozzle opening, the treating agent being brought to the pressure level of the carrier medium prior to the mixing process.
2. Method according to claim 1, characterised in that the quantity of treating agent is adjusted as a function of the NO_x gas concentration in the treated waste gas stream.
3. Method according to claim 1, characterised in that the quantity of treating agent is adjusted as a function of the waste gas quantity.
4. Method according to one of claims 1 to 3, characterised in that the spray pressure is adjusted as a function of the waste gas quantity.
5. Method according to one of claims 1 to 3, characterised in that the spray pressure is adjusted as a function of the boiler load.



-9-

6. Method according to one of claims 1 to 5, characterised in that the treating agent is supplied to the spray nozzle in concentrated form, the concentration being adjustable as a function of the quantity required.
7. Method according to one of claims 1 to 6, characterised in that ammonia, sal ammoniac, urea or lime-nitrate is used as the treating agent.
8. Method according to one of claims 1 to 7, characterised in that water is used as the carrier medium.