

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, supply into the combustion chamber being effected in at least two planes situated one above the other in which spray nozzles are arranged, to which the treating agent can be admitted either alternately or together.

The chemicals introduced in order to reduce the nitrogen oxide content in the exhaust gases are 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. The reactions taking place between these chemicals and nitrogen oxides in the waste gas stream are reduction reactions, in which the nitrogen monoxide present in the waste gas is reduced to pure nitrogen. These reactions require relatively high ambient temperatures in order to progress in an optimum and rapid manner. These temperatures are between 750°C and 1100°C depending on the chemicals or on the chemical mixture. It is generally true for these chemicals, within certain limits, that higher temperatures also ensure more effective reaction conditions. For this reason, in the known process according to US-A-4 115 515, the treating agents are supplied in several planes by means of nozzles, the treating agent being admitted to the individual nozzles in accordance with the respective favourable temperature conditions. E.g. thermoelements which determine the temperature distribution and automatically effect switching between the individual nozzle planes serve to this end.

In spite of this expenditure, the method does not always

proceed in a satisfactory manner. Increases have even been established in the overall nitrogen oxide content in the waste gas, this being due to destruction by combustion of the chemicals introduced if they contain nitrogen.

The aim of the invention is to provide a method in which a reduction of the nitrogen oxide concentration in the waste gas is ensured.

This problem is solved according to the invention departing from the method mentioned at the outset in that, if a flame is present in one or more nozzle planes, this nozzle plane is completely cut off from the supply of treating agent, so that switching from one nozzle plane to the next nozzle plane is effected as a function of the presence of a flame in the region of the respective nozzle plane.

This proposed solution is based on the knowledge that the chemicals introduced are always destroyed when they come into contact with a flame. Consequently, this invention no longer bases the control process as hitherto on a specific temperature profile, but solely on the presence of a flame or the absence of a flame.

The quantity of treating agent required to set a desired nitrogen oxide content in the waste gas can be injected irrespective of the height of the respective flame front within the combustion chamber in association with sensitive monitoring of the flame in the combustion chamber by means of flame detectors, especially optical pyrometers, thermographic cameras, video cameras, photocells, etc.. The aforementioned flame detectors operate very rapidly, so that switching from

one nozzle plane to the next nozzle plane can be effected very rapidly, thereby preventing destruction as a result of chemical decomposition of the chemicals supplied.

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

Fig. 1 is a diagrammatic view of the device for supplying the treating agent, and

Fig. 2 is a diagrammatic view of the flow diagram for the method in association with a control system.

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, e.g. in the pulverulent state in this vessel. 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 measuring point 19 are provided within the delivery line. A further pressure measuring point 20 monitors the pressure in the spray nozzles 10. A flame detector 21 is provided in the vicinity of the spray nozzles 10 of the lower row of nozzles and, if a flame is present in the region of the lower spray nozzle 10, shuts off a valve 22 in the pressure supply line 13 for the treating agent via a control system not shown in this drawing. If desired, the carrier medium can also be shut off from or throttled with respect to the spray nozzle 10 by means of a valve 23 if the operating conditions in the combustion chamber allow. A certain supply of carrier medium may still be desired, even if the treating agent is shut off, in order to effect cooling of the spray nozzle.

The control system with the aid of which the supply of the treating agent is controlled in general and moreover as a function of the flame development in the combustion chamber, 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 24 designates the boiler in general, to which feed water is supplied via a line 25. The reference numeral 26 designates the main steam line, while the reference numeral 27 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 28. Control is effected as a function of the NO_x concentration in the waste gas of the waste gas offtake 27, 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 29 to the control system 28. The desired value of the NO_x content 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 30. 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 29 and the value predetermined by the set-point generator 30. Furthermore, the control system 28 can control the quantity of treating agent supplied or additionally as a function of the waste gas volumetric flow rate, this value being measured in the waste gas offtake 27 and the corresponding signal being fed to the control system 28 via the line 31.

This measured value relating to the volumetric flow rate of the waste gas is also fed via the line 31 to a further control system 32 provided to set the spray pressure. A set-point generator 33 for the spray pressure gives a constant corresponding to the nozzle configuration, or the spray pressure can be set 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 31, while the measured value relating to the boiler load is fed via the line 34. The reference numeral 35 designates a signal line which feeds the actual prevailing spray pressure to the control system 32.

A flame detector 21 is provided below the lower spray nozzle 10 closer to the furnace and, if a flame is present in this region, sends a signal via a line 36 to a control system 37 which advances a corresponding control command via a control line 38 to the valve 22 which monitors the supply of treating agent to the spray nozzle of the lower nozzle plane.

If no flame is detected by the detector 21, both carrier medium and treating agent are supplied to the spray nozzles in all planes by means of the pumps 15 and 9, the quantity of treating agent supplied being set by means of the control system 28 as a function of the NO_x content or as a function of the exhaust gas volumetric flow rate. As soon as the detector 21 detects a flame in the region of the lower nozzle plane, the valve 22 is closed in order to prevent decomposition of the chemical introduced and treating agent is admitted only to the upper row of spray nozzles 10, more treating agent being supplied to the upper row of nozzles after the exclusion of the lower row if nothing has changed with respect to the waste gas concentration. Moreover, treating agent is admitted to these nozzles of the upper row via the control system 28 in accordance with the requirement for treating agent.

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, supply into the combustion chamber being effected in at least two planes situated one above the other in which spray nozzles are arranged, to which the treating agent can be admitted either alternately or together, characterised in that, if a flame is present in one or more nozzle planes, the respective nozzle plane is completely cut off from the supply of treating agent, so that switching from one nozzle plane to the next nozzle plane is effected as a function of the presence of a flame in the region of the respective nozzle plane.
2. Method according to claim 1, characterised in that flame detectors, especially optical pyrometers, thermographic cameras, video cameras, photocells, etc., are used to monitor the flame.



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