

DESCRIPTION

The invention relates to a method of cleaning an adsorption medium which contains carbon and which has been used for flue gas cleaning in a flue gas treatment reactor and discharged from the flue gas treatment reactor, wherein the discharged adsorption medium is subjected to a desorption process for dividing out and decomposition of noxious substances in a separate thermal regeneration apparatus and the desorption gas loaded with noxious substances undergoes an aftertreatment. Further, the invention relates to an arrangement for the carrying out of this method.

With the increase in number and capacity of flue gas cleaning plants operated by adsorption media containing carbon the quantity of adsorption media - which quantity is in part heavily loaded with noxious substance - consumed in cleaning plants of that kind also grows. A combustion of the carbon-containing adsorption medium is not possible or is possible only with substantial cost, wherein, in particular, occurring heavy metals or dioxins could not be adequately disposed of hitherto.

There is known from US-PS 4 500 501 a method in which a separating out of SO_2 and NO_x is effected by catalytic adsorption in two diffusing bed reactors connected one behind the other. The carbon-containing adsorption medium discharged from the last diffusing bed reactor is prepared in a downstream regenerator, partly replaced and led back into the first flue gas treatment reactor. In this known process it does indeed succeed to reactivate the adsorption means; on the other hand, the loading of the reused adsorption medium with toxic substances, especially dioxins, furanes and heavy metals, particularly Hg, can increase.

In these circumstances supplements must frequently be added, with corresponding expenditure of costs, to the adsorption substance quantities which are enriched with noxious substance and consumed in the flue gas cleaning.

A process for desorption of a carbon-containing adsorption medium is known from DE-A-3 426 059, in which temperatures of 1000°C are held to be necessary; moreover, the risk exists of an oxygen intake into the desorber.

The invention is based on the task of disposing, with comparatively low expenditure of costs and in environmentally-friendly manner, of the carbon-containing adsorption medium which is consumed in flue gas cleaning and is strongly loaded with noxious substance.

According to the method this task is solved in accordance with the invention thereby that heavy metals are evaporated and the remaining noxious substances liberated or decomposed in the desorption process at temperatures of 350 to 650°C and the aftertreatment of the desorption gas loaded with noxious substances is carried out in an adsorption apparatus with separation out of heavy metals, and that the exhaust gas, substantially free of Hg, of the adsorption apparatus is conducted for further treatment, especially is fed back for flue gas cleaning.

The temperature is sufficient for the decomposition of the dioxins and furanes, the evaporation of highly-volatile metals and the liberation of compounded SO_2 , HCl, HF or the like. The intake of oxygen is avoided by the indirect heating.

The arrangement for carrying out this method is distinguished, in accordance with the invention, thereby that connected downstream of the adsorption medium outlet of the flue gas treatment reactor is a thermal desorption apparatus, which is provided with means for indirectly heating the adsorption medium, a discharge for discharging the treated adsorption medium and a gas and steam outlet for taking off the desorption gas loaded with noxious substances, and that the gas and steam outlet of the desorption apparatus is connected with an adsorption apparatus, which is constructed to be suitable for the separating out of Hg from the desorption gas.

In the case of the invention the adsorption medium loaded to greater or lesser degree with noxious substance is largely freed of noxious substance in a desorption process taking place with heat feed. The adsorption medium thus treated can be combusted without great effort or also regenerated for reuse. The residues of the previously cleaned adsorption medium are (after the combustion) to be disposed of without problem and, in particular, occur in only small quantities.

The treatment temperature and the treatment duration are oriented according to the noxious substances occurring and the desired degree of efficiency of the desorption process. The treatment temperature, in a preferred development, lies in the temperature range between 450 and 550°C.

In the case of comparatively economic carbon-containing adsorption means, thus for example in the case of activated charcoal, the cost of an adsorption medium preparation does not, as a rule count. Such an adsorption medium can therefore be combusted after desorption thereof.

In the case of use of coal pellets as adsorption medium, however, it can be expedient to feed the consumed adsorption medium, after treatment in the thermal desorption apparatus, back into the flue gas cleaning process and - optionally after replacement of losses - to reuse for the flue gas cleaning.

Expedient developments of the invention are characterised in the subclaims.

The invention is more closely explained in the following on the basis of an example of embodiment schematically illustrated in the drawing.

The single figure shows an example of embodiment of the components participating in the performance of the method according to the invention, inclusive of a flue gas treatment reactor.

An adsorption medium reactor 1 schematically illustrated in the drawing (flue gas treatment reactor) serves, in the described example, for the separation of sulfur oxides (SO_2/SO_3) hydrogen chlorides (HCl), hydrogen fluorides (HF), chloro-organic components (especially dioxins and furanes) and heavy metals from flue gases. It is incorporated at an appropriate location, usually behind a flue gas cleaning plant 20, in the flue gas line 2. The illustrated adsorption medium reactor 1 stands for a desired number of adsorption and/or reduction stages, which can be incorporated into the flue gas flow in series and/or in parallel. In the illustrated example the adsorption medium reactor is constructed as a so-called cross-flow unit, in which the flue gas flow is conducted in the direction of the arrow 3 transversely through a catalytically acting, carbon-containing adsorption medium bed 4. The particulate, lumpy or granulate-like adsorption medium is coated by a delivery device 5 at the head end, distributed as uniformly as possible over the reactor cross-section from above onto the adsorption medium bed 4. The adsorption medium trickles vertically downwardly from above. Consumed adsorption medium is discharged from the reactor 1 at the base side by way of a discharge consisting of one or several take-off pipes 7. The take-off pipes are closable by suitable means, so that the discharge of consumed adsorption medium can take place either continuously or discontinuously or in batches.

Consumed adsorption medium is conducted out of the reactor 1 and into a thermal desorption apparatus 10 by way of a conveyor device here illustrated as a simple line. In the apparatus 10 the adsorption medium loaded with noxious substance is heat-treated over a suitable treatment duration, and in fact at such a temperature that a desorption process takes place in which the noxious substance is separated from the adsorption medium, especially dioxins decomposed, gaseous components such as SO_2 , HCl , HF or the like liberated and highly-volatile heavy metals, especially Hg , evaporated. The heat feed to the thermal desorption apparatus, also designated in the following "desorber", takes place by way of a heating circuit 11, the heat energy of which is usually derived from a combustion unit individual to the plant, i.e. the combustion waste gas of the combustion unit is not used directly for the heating of the adsorption medium.

The desorber has, at the base side, a discharge 12, from which adsorption medium low in noxious substance is discharged for further treatment or combustion, and a gas or vapour take-off 13 for leading off the desorption gas rich in noxious substance. The take-off 13 is connected with an adsorption apparatus 14, which serves above all to separate the Hg vapour from the desorption gas. Only thereafter can the desorption gas, largely freed of Hg but otherwise rich in noxious substance, be fed back by way of a line 15 into the flue gas flow ahead of the flue gas cleaning plant 20. The Hg separation in the adsorption apparatus 14 has the advantage that the desorption gas freed of Hg cannot increasingly enrich the adsorption medium in the reactor 1.

The adsorption medium, which is freed of noxious substance and is available at the discharge 12 of the desorber 10, is usually combusted in a vessel, which is not illustrated in the drawing. In the case of high-grade charcoal-containing adsorption medium, for example in the form of charcoal pellets, at least a part of the adsorption medium quantity treated in the desorber 10 can be fed back into the flue gas cleaning circuit, in a given case after a filtering 16 and after further regeneration and replacement of the losses. Provided for the feedback of the thermally regenerated carbon-containing adsorption medium is a conveying plant 17, which feeds the particulate or granulate-like adsorption means particles back from above to the delivery device 5 of the reactor 1.

The invention can be used with in principle the same advantages in all adsorption and reduction stages which work with a carbon-containing adsorption medium. The exact construction of the conveying devices 8 and 17 as well as delivery and discharge means determining the adsorption medium throughput are neither illustrated in the drawing nor of critical significance for the invention. However, it is important that the temperature and treatment duration in the desorber 10 are so set that the desorption process elapses acceptably and the noxious substance loading of the adsorption medium is largely broken down.



CLAIMS

1. Method of cleaning an adsorption medium which contains carbon and which has been used for flue gas cleaning in a flue gas treatment reactor and discharged from the flue gas treatment reactor, wherein the discharged adsorption medium is subjected to a desorption process for dividing out and decomposition of noxious substances in a separate thermal regeneration apparatus and the desorption gas loaded with noxious substances undergoes an aftertreatment, characterised thereby that heavy metals are evaporated and the remaining noxious substances liberated or decomposed in the desorption process at temperatures of 350 to 650°C and without direct feed of fuel gas and the aftertreatment of the desorption gas loaded with noxious substances is carried out in an adsorption apparatus with separation out of heavy metals, and that the exhaust gas, substantially free of Hg, of the adsorption apparatus is conducted for further treatment, especially is fed back for flue gas cleaning.
2. Method according to claim 1, characterised thereby that the adsorption medium is combusted after the desorption in the thermal desorption apparatus.
3. Method according to claim 1, characterised thereby that the adsorption medium is fed back into the flue gas treatment reactor after the desorption.
4. Method according to claim 3, characterised thereby that the losses of adsorption medium are replaced in the feedback branch and/or directly in the flue gas treatment reactor.
5. Arrangement for carrying out the method according to one of claims 1 to 4, characterised thereby that connected downstream of the adsorption medium outlet (7) of the flue gas treatment reactor (1) is a thermal desorption apparatus (10), which is provided with means (11) for heating the adsorption medium without direct feed of



fuel gas, a discharge (12) for discharging the treated adsorption medium and a gas and steam outlet (13) for taking off the desorption gas loaded with noxious substances, and that the gas and steam outlet (13) of the desorption apparatus (10) is connected with an adsorption apparatus (14), which is constructed to be suitable for the separating out of Hg from the desorption gas.

6. Arrangement according to claim 5, characterised thereby that the exit of the adsorption apparatus (14) is connected by way of a return feed (15) with the flue gas flow (2) upstream of the flue gas treatment reactor (1).

7. Arrangement according to claim 5 or 6, characterised thereby that a combustion installation is arranged downstream of the adsorption medium discharge (12) of the desorption apparatus (10).

8. Arrangement according to claim 5 or 6, characterised thereby that a conveyor installation (17) for feeding back at least a part of the adsorption medium to the flue gas treatment reactor (1) is provided.

9. Arrangement according to one of claims 5 to 8, characterised thereby that the discharge (12) for discharging the treated adsorption medium is arranged at the desorption apparatus (10) at the base side thereof.