



PROCESS FOR THE TREATMENT OF COMBUSTION RESIDUES,
IN PARTICULAR SLAG FROM WASTE INCINERATION PLANTS

The invention relates to a process for the
5 treatment of incineration residues in which the
incineration residues are carbonated.

Incineration residues, as are produced, for
example, in refuse incineration or in gasification
processes, have heavy metals which, when such incinera-
10 tion residues are deposited in landfills, lead to
problems with respect to ground water fouling. The slags
produced in refuse incineration and sometimes also dusts
from gaseous emission control systems are discharged by
wet deslaggers. The ageing carried out hitherto has
15 disclosed that, via the reaction of slag constituents
with atmospheric carbon dioxide, a carbonation occurs
which leads to a considerable improvement of slag
quality, since the heavy metals present are bound, i.e.
immobilized by the formation of carbonates.

20 FR-A-2 750 197 discloses carbonating the slags
produced in a combustion in the wet separator by intro-
ducing exhaust gas into the quench water. The use of
exhaust gas is considered an economically expedient
source of carbon dioxide. This direct introduction of
25 exhaust gas into the deslagger is associated with great
processing problems. In the deslagger, enormous mechani-
cal stresses occur due to the discharge of highly
inhomogeneous and sometimes bulky constituents of the
refuse incineration slag. Every type of nozzles or other
30 components for the fine distribution of the exhaust gas
in the quench water cannot be used expediently in this
environment, since they block, do not withstand the
mechanical stresses or prevent problem-free slag dis-
charge. In addition, the exhaust gas comprises only from
35 9 to 14% of carbon dioxide, i.e. from 86 to 91% of the
exhaust gas exits again from the deslagger into the
furnace compartment and increases the exhaust gas volume

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in the fired plant and thus in the units downstream of this fired plant, which leads to a substantial enlargement of these downstream units and thus to a considerable increase in cost of the overall plant.

5 The object of the invention is to provide a process for the treatment of combustion residues, in particular for the treatment of slags produced in refuse incineration plants, using which the treatment and sought-after carbonation may be achieved at low
10 constructional costs and with low process engineering resources, in which case an incorporation as well as possible of the heavy metals into the residues or the slag is to be achievable.

 This object is achieved in a process of the type
15 described at the outset according to the invention by the means that the carbonation is carried out by supplying a carrier medium which comprises carbonic acid in its forms H_2CO_3 and/or HCO_3^- and/or CO_3^{2-} in dissolved or suspended form.

20 The basic concept is the use of a carrier medium which is present in liquid form in the reaction phase and thus can be brought into contact with the combustion residues in a simpler engineering manner, in which case, additionally, owing to the liquid phase of the carrier
25 medium, the action of the carbonic acid on the slag, and thus the carbonation, is promoted.

 Preferably, the carrier medium is water in liquid form. However, it is also possible that the carrier medium water is fed in solid frozen form to the
30 incineration residues which have a temperature above 0°C . As a result of the melt process inevitably occurring, the reaction again takes place in the liquid phase.

 A preferred carrier medium for the carbonation
35 of incineration residues is an aqueous solution of a hydrogen carbonate compound of the alkali metal group or alkaline earth metal group. Preferred elements from these groups are calcium, sodium and magnesium.

Since carbonation at relatively low temperatures gives a better yield, the hot incineration residues are quenched in a waterbath, and, for the carbonation, the aqueous carrier medium is supplied to the waterbath
5 which comprises the incineration residues. A waterbath of this type can, in the case of refuse incineration plants, be the customarily provided wet deslagger, or, in the case of other incineration processes in which no wet deslagger is used, a waterbath of this type can be
10 present in a vessel especially provided therefor.

Regardless of whether an incineration plant has a wet deslagger or not, in a further development of the invention it is expedient to transport the incineration residues in a separate carbonation vessel and treat them
15 there with a carrier medium with agitation. In a separate carbonation vessel of this type, by agitation, a particularly intimate contact of the incineration residues with the carrier medium can be induced.

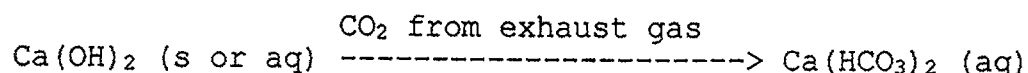
The hydrogen carbonate solution can be prepared
20 by reacting an alkali metal hydroxide or alkaline earth metal hydroxide with carbon dioxide in aqueous solution, or the hydrogen carbonate can be prepared by reacting an alkali metal carbonate or alkaline earth metal carbonate with carbon dioxide in aqueous solution. It is particu-
25 larly advantageous here from the economic aspect if the carbon dioxide necessary for preparing the hydrogen carbonate originates by introduction of exhaust gas from the incineration process in which the incineration residues to be treated are produced.

30 An expedient process sequence is advantageously obtained by preparing hydrogen carbonate at a pH of from 7 to 9.

To enable the preparation process for providing a hydrogen carbonate solution to be particularly simple
35 and economical, according to the invention it is provided that to prepare a hydrogen carbonate solution the quench water is taken off from the waterbath and admixed with carbon dioxide in a reaction vessel. This method of preparation exploits the fact that the quench

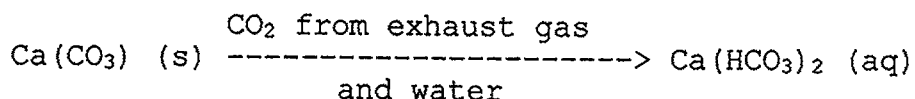
water of incineration residues or of slags has a high alkalinity in the form of dissolved calcium hydroxide and, in the case of a high pH, primarily, also suspended calcium hydroxide. If the quench water, or in the case
5 of a refuse incineration plant, the slag water taken off from the deslagger, has insufficient contents of alkali metal hydroxides or alkaline earth metal hydroxides or alkali metal carbonates or alkaline earth metal carbonates, an alkali metal hydroxide or alkaline earth
10 metal hydroxide or an alkali metal carbonate or alkaline earth metal carbonate can be fed to the quench water or to the slag water in the reaction vessel, in order to allow the desired chemical reactions to proceed according to the formula below at a pH of 7 to 9:

15



or

20



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In the apportionment of alkali metal hydroxides or alkaline earth metal hydroxides or alkali metal carbonates or alkaline earth metal carbonates to the quench water, in a further embodiment of the invention, care is taken to ensure that the amount of the
30 substances mentioned is apportioned to the quench water as a function of its contents of one of the substances, alkali metal hydroxides or alkaline earth metal hydroxides or alkali metal carbonates or alkaline earth metal carbonates, the amount apportioned decreasing with
35 increasing contents of the substances in the quench water.

If the carbonation is to be carried out in the waterbath in which the combustion residues are quenched, i.e. in the case of refuse incineration plants in the
40 wet deslagger, in a further development of the invention

it is provided that the amount of hydrogen carbonate solution is apportioned to the incineration residues in the waterbath as a function of the content of one of the substances, alkali metal carbonates or alkaline earth metal carbonates or alkali metal hydroxides or alkaline earth metal hydroxides in the quench water, the amount apportioned decreasing with increasing content of these substances.

In the preparation of a hydrogen carbonate solution with use of quench water or, in the case of a refuse incineration plant, with use of slag water from the wet deslagger, it is particularly advantageous if the quench water is taken off from the waterbath from a region having the highest content of suspended fines having a high content of hydroxides and carbonates. This is because the suspended fines of the quench water or slag water have a high content of those substances which are required for preparing hydrogen carbonate solutions, so that, depending on content of these substances, further addition of hydroxides or carbonates to the quench water can be dispensed with in the preparation of hydrogen carbonate solutions.

Since, in the preparation of a hydrogen carbonate solution with use of quench water or, in the case of a refuse incineration plant with use of slag water, this quench water or the slag water can have an elevated temperature, it is advantageous that the quench water used for the preparation of hydrogen carbonate solution is cooled, in order that the process of eliminating carbon dioxide from the hydrogen carbonate solution is not initiated as soon as in the reaction vessel in which the preparation takes place.

In order to influence the carbonation in an expedient manner, it is advantageous that the carbonation is performed in a temperature range from 10°C to 60°C.

In a refuse incineration plant having a combustion grate and a downstream deslagger which is filled

with liquid and has a feed shaft and a discharge device,
and into which deslagger at the end of the combustion
process the slag produced falls, the carrier medium is
delivered in the feed shaft from the top onto the slag
5 for the treatment or carbonation of the same. On account
of this mode of operation, according to the invention,
the difficulties explained at the outset which arise
with feeding gaseous carbon dioxide in the wet deslagger
are avoided, since the carrier medium is present in
10 liquid form and therefore can be delivered to the slag
from the top. In the case of intensively cooled ice
cubes, also, a simple feed of the carrier medium
results, since these ice cubes can likewise be delivered
from the top onto the slag, whereupon in the melting
15 process which occurs, the melt water mixes with the slag
and thus induces the carbonation process.

In order to increase the residence time of slag
in the deslagger and thus improve the slag treatment,
the slag can be delayed in the feed shaft by appropriate
20 control of the discharge apparatus. In the case of a wet
deslagger equipped with discharge piston, for this
purpose the piston speed is decreased, the piston stroke
is shortened and, if appropriate, idle pauses are
introduced.

25 A particularly preferred mode of operation in
connection with refuse incineration plants results
according to the invention from the fact that slag water
for preparing the carrier medium is taken off from the
deslagger, which slag water is recirculated back to the
30 deslagger.

When a variant of the process of the invention
is carried out in association with a refuse incineration
plant having a combustion grate and a downstream
deslagger which is liquid-filled and has a feed shaft
35 and a discharge apparatus, into which deslagger, at the
end of the combustion operation, slag which is produced
falls, the slag is transferred from the wet deslagger
into a carbonation vessel and is there treated with a
hydrogen carbonate solution.

However, it can also prove to be expedient initially to pretreat the slag in the deslagger in accordance with the process according to Claims 20 or 21 and then to post-treat it in accordance with the process according to Claim 23. A mode of operation of this type will be used if it should prove that the residence time of the slag in the wet separator is too short and the carbonation process is not yet complete.

Preferably, the carbonation is performed in the deslagger or the carbonation vessel at a pH of from 11 to 13.

The exhaust gas which is partially freed from carbon dioxide after flowing through the reaction vessel and from which carbon dioxide is removed by absorption in the quench water, the carbon dioxide reacting with the quench water or the slag water to form H_2CO_3 and/or HCO_3^- and/or CO_3^{2-} , is recirculated back to the exhaust gas stream of the combustion plant.

Reference is explicitly made to the fact that the term "quench water", in the case of carrying out the process in connection with a refuse incineration plant, is taken to mean the slag water of the wet deslagger, and the expression "waterbath" is taken to mean the wet deslagger containing the slag water.

The invention is described in more detail below with reference to two illustrative examples shown in the drawing. In the drawings:

Figure 1: shows a combustion plant, shown diagrammatically, connected to a slag treatment plant; and

Figure 2: shows a variant of the treatment plant.

As can be seen from Figures 1 and 2, the diagrammatically indicated combustion plant comprises a feed funnel 1 for the waste to be burnt, a combustion grate 2, an exhaust gas flue 3 as well as a wet deslagger 4 which is disposed at the end of the combustion grate 2, which wet deslagger has a feed shaft

5 through which the slag produced falls into a waterbath 6 having a downstream discharge chute 7.

In a first process variant, slag water is taken off from the waterbath 6 via a line 8 into an intermediate vessel 9 in which this slag water is cooled by means of a cooling coil 10 to a lower temperature. From this intermediate vessel, by means of pumps which are not shown, the cooled slag water is brought via a line 11 to a reaction vessel 12 in which the slag water is treated with exhaust gas from the incineration plant. This exhaust gas, which initially passes as untreated gas via a line 14 to a gaseous emission control unit 15, is then fed via a line 16 to the reaction vessel 12. Here, the carbon dioxide present in the exhaust gas reacts with calcium hydroxide or calcium carbonate to form calcium hydrogen carbonate. This calcium hydrogen carbonate serves as carrier medium for carbon dioxide and is delivered in liquid form via a line 17 onto the slag from the top in the feed shaft 5. In order to obtain as long a residence time as possible for the carbonation, the slag is backed up in the slag feed shaft. The exhaust gas no longer required in the reaction vessel 12 is recirculated via a line 18 to the refuse incineration plant or to the gaseous emission control unit.

In the second process variant according to Figure 2, from the waterbath 6 of the deslagger 4, not only is slag water brought to a carbonation vessel 19 via the line 8, but slag discharged via the discharge chute 7 is also transported into this vessel. The transport device necessary for this is indicated diagrammatically by 20. Via a line 21, a hydrogen carbonate solution is fed to the carbonation vessel 19 from the reaction vessel 12 in which this solution is prepared in the same manner as in the process sequence according to Figure 1. The exhaust gas stack for the cleaned-up exhaust gas is designated by 22.

PATENT CLAIMS



1. Process for treating incineration residues in which the incineration residues are carbonated, characterized in that the carbonation is carried out by feeding a carrier medium which comprises carbonic acid in its forms H_2CO_3 and/or HCO_3^- and/or CO_3^{2-} in dissolved or suspended form.
2. Process according to Claim 1, characterized in that the carrier medium is water in liquid form.
3. Process according to Claim 2, characterized in that the carrier medium water is fed in solid frozen form to the incineration residues which have a temperature above 0°C .
4. Process according to Claim 1, characterized in that the carrier medium is an aqueous solution which comprises the dissolved or suspended hydrogen carbonate.
5. Process according to Claim 1 or 4, in which the still-hot incineration residues are quenched in a water-bath, characterized in that the carrier medium is fed to the waterbath which comprises the incineration residues.
6. Process according to Claim 4, characterized in that the incineration residues are transported into a separate carbonation vessel and are there treated with the carrier medium with agitation.
7. Process according to one of Claims 4 to 6, characterized in that the hydrogen carbonate solution is prepared by reacting an alkali metal hydroxide or alkaline earth metal hydroxide with carbon dioxide in aqueous solution.
8. Process according to one of Claims 4 to 6, characterized in that the hydrogen carbonate is prepared by reacting an alkali metal carbonate or alkaline earth metal carbonate with carbon dioxide in aqueous solution.
9. Process according to Claim 7 or 8, characterized



in that the carbon dioxide necessary for preparing the hydrogen carbonate results via introducing exhaust gas from the combustion process in which the incineration residues to be treated are produced.

5 10. Process according to one of Claims 7 to 9, characterized in that hydrogen carbonate is prepared at a pH from 7 to 9.

11. Process according to one of Claims 4 to 10, characterized in that to prepare a hydrogen carbonate
10 solution, the quench water is taken off from the waterbath and admixed with carbon dioxide in a reaction vessel.

12. Process according to Claim 11, characterized in that an alkali metal hydroxide or alkaline earth metal
15 hydroxide is supplied to the quench water in the reaction vessel.

13. Process according to Claim 11, characterized in that an alkali metal carbonate or alkaline earth metal carbonate is supplied to the quench water in the
20 reaction vessel.

14. Process according to Claim 12, characterized in that the amount of alkali metal hydroxide or alkaline metal hydroxide is apportioned to the quench water as a function of its content of one of the substances, alkali
25 metal hydroxide or alkaline earth metal hydroxide, the amount apportioned decreasing with increasing content of the substances in the quench water.

15. Process according to Claim 13, characterized in that the amount of alkali metal carbonate or alkaline
30 metal carbonate is apportioned to the quench water as a function of its content of one of the substances, alkali metal carbonate or alkaline earth metal carbonate, the amount apportioned decreasing with increasing content of the substances in the quench water.

35 16. Process according to one of Claims 4 to 15, characterized in that the amount of hydrogen carbonate solution is apportioned to the combustion residues situated in the waterbath as a function of the content of one of the substances alkali metal carbonate or



alkaline earth metal carbonate or alkali metal hydroxide or alkaline earth metal hydroxide in the quench water, the amount apportioned decreasing with increasing content of these substances.

- 5 17. Process according to one of Claims 1 to 16, characterized in that the quench water is taken off from the waterbath from a region having the highest content of suspended fines having a high content of free lime, hydroxides and carbonates.
- 10 18. Process according to one of Claims 4 to 17, characterized in that the quench water used for preparing hydrogen carbonate solution is cooled.
19. Process according to one of Claims 1 to 18, characterized in that the carbonation is carried out in
- 15 a temperature range from 10°C to 60°C.
20. Process according to one of Claims 1 to 19, characterized in that in a refuse incineration plant having a combustion grate and a downstream deslagger which is liquid-filled and has a feed shaft and a
- 20 discharge device, into which deslagger falls the slag produced at the end of the combustion operation, the carrier medium is fed from the top in the feed shaft onto the slag for the treatment or carbonation of the same.
- 25 21. Process according to Claim 20, characterized in that the slag is backed up in the feed shaft by appropriate control of the discharge apparatus.
22. Process according to Claim 20 or 21, characterized in that slag water is taken off from the
- 30 deslagger for preparing the carrier medium, which slag water is recirculated back to the deslagger.
23. Process according to one of Claims 1 to 19, characterized in that in a refuse incineration plant having a combustion grate and a downstream deslagger
- 35 which is liquid-filled and has a feed shaft and a discharge device, into which deslagger falls the slag produced at the end of the combustion operation, the slag is transferred from the wet deslagger into a

carbonation vessel and treated there with the carrier medium.

24. Process according to one of Claims 20 to 23, characterized in that the slag is firstly pretreated in the deslagger in accordance with the process according to Claims 20 or 21 and is then post-treated in accordance with the process according to Claim 23.

25. Process according to one of Claims 20 to 24, characterized in that the carbonation in the deslagger or in the carbonation vessel is carried out at a pH from 11 to 13.

26. Process according to Claim 9, or one of the following claims, characterized in that the exhaust gas which has been partially freed from carbon dioxide after flowing through the reaction vessel, from which exhaust gas carbon dioxide is taken off by absorption in the quench water, the carbon dioxide reacting with the quench water or slag water to form H_2CO_3 and/or HCO_3^- and/or CO_3^{2-} , is recirculated back to the exhaust gas stream of the combustion plant.

