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PROCESS FOR INCINERATING WASTE PRODUCTS

The invention relates to a process for incinerating waste products on a fired grate, in which process the waste products are first dried and ignited, whereupon the main combustion process is carried out and thereafter the resultant slag is discharged.

In past years the fuel refuse or waste has constantly changed in composition to the extent that the proportion of volatile constituents has increased, which is essentially introduced via plastics. In parallel to this, the supply of carbon for combustion directly on the fired grate has decreased. As a result of this development the temperature of the fuel bed and the slag bed on the fired grate has also decreased.

Both phenomena make it more difficult to achieve very good waste slag burnup quality.

By means of certain measures during firing on the fired grate, attempts have already been made to increase again the bed temperature on the fired grate. The most important of these measures are reducing the excess air in the primary combustion on the fired grate, intensifying the fuel bed circulation on the fired grate, for example by increasing the grate stroke rate per unit time, and increasing the primary air temperature. However, there are narrow limits set to a reduction in the excess primary air, since an air feed which is no longer sufficient locally increases the proportion of unburnt solids. Increasing the grate stroke rate, if there is no desire to increase the transport rate of the material stream on the fired grate particularly greatly, is only possible using a reciprocating grate and can lead to an unwanted increase in dust discharge with the combustion exhaust gases. Increasing the primary air temperature, if fuel fractions having particularly high heating values are charged onto the grate, can always lead to unwanted vigorous ignition reactions, resulting in combustion, sometimes uncontrolled. These measures

which have been employed previously to achieve improved slag quality have therefore only led to partial success.

It is an object of the invention to provide a process by means of which the combustion processes on the fired grate can be controlled in such a manner that the quality of the resultant slag is improved with respect to its reuse or ability to be landfilled, without the abovementioned disadvantages needing to be accepted.

This object is achieved according to the invention starting from a process of the type described at the outset by virtue of the fact that, at the end of the main combustion process, where burnable fractions are still present in addition to slag components which are already forming, the burnup rate or burnup intensity is retarded in selectable sequential time sections and is increased in the intermediate time sections.

In the course of the combustion process, the combustion bed, at the end of the main combustion process, passes into a state in which the degree of burnup of the fuel bed is substantially complete and the slag which forms begins to cool. This transition takes place fluidly and frequently changes its position on the fired grate depending on the fuel quality. In this region, zones having wastes which are still to be burnt up and zones having slag which is already beginning to cool exist next to one another in the manner of islands. Since the surface of the fired grate is no longer uniformly covered there with fuel which is still burning, the fuel bed temperature already begins to fall and the slag resulting there can no longer achieve the highest possible quality.

By means of the inventive measure, that is to say the decrease in burnup rate or burnup intensity at times in this advanced state of the main combustion process, the carbon present in the fuel burns slower there and thus during this period in the transition region to slag formation more carbon collects than if a retardation in the burnup rate were not to occur. Thus for the following time section, in which the burnup rate or burnup intensity increases again, sufficient carbon is present in order to increase the

combustion bed temperature to the extent that the slag forming in this process has the required quality. The combustion bed temperatures achieved by this procedure are higher than the combustion bed temperatures which can be achieved in the case of
5 uniform combustion sequence operation, because of the deficient carbon supply in the transition region of the fired grate.

By means of the inventive procedure, the combustion bed temperature at the end of the main combustion process is still as
10 high as possible, as stable as possible and has the most even distribution possible over the area on which the main combustion process decreases in intensity. These are the most essential preconditions which must be sought after in order to achieve good slag quality and which are achieved by the inventive process,
15 since, owing to the repeated variation in burnup rate or burnup intensity, increased accumulation of carbon repeatedly occurs owing to the decrease in burnup rate or burnup intensity and a temperature increase following this process is achieved by increasing the burnup rate or burnup intensity in the region in
20 which, hitherto, owing to the altered quality of the fuel, the combustion bed temperature was no longer sufficient to form the desired slag quality. Repeated enrichment of carbon-rich combustion material thus occurs in the region which previously featured too low a combustion bed temperature, in order by burning
25 this repeatedly increased carbon content to increase the combustion bed temperature in the region of slag formation and also to stabilize it and to distribute it evenly.

A preferred measure according to the invention is that the
30 retardation and acceleration of the burnup rate or burnup intensity at the end of the main combustion process are achieved by repeated variation of the primary air rate in the respective time sections in the burnup stage critical for slag quality.

35 The primary air rate can be varied by decreasing the primary air rate below a standard measure and subsequently increasing the primary air rate to the standard measure. Although, to increase the burnup rate, the primary air rate is preferably increased again to the usual standard measure, the burnup rate or burnup

intensity is increased because of the accumulated increased carbon content. Increasing the primary air rate above the standard measure is not required in most cases here. A particularly expedient process sequence is characterized in that the time sections having a quantitatively decreased primary air rate and the time sections having a primary air rate which is standard for this fired grate region alternate constantly in a selectable ratio to one another. Preferably, the two time sections are in the ratio of 1:1.

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The sought-after carbon enrichment in the fuel bed at the end of the main combustion process depends not only on the reduction in burnup intensity or burnup rate and thus, for example, on the reduction in primary air rate, but also significantly on the grate movement, that is to say on the fuel advance and the fuel transport rate. It is therefore advantageous if the time section having a decreased burnup intensity or reduced primary air rate is in a preselectable ratio to the number of double grate strokes. To influence the desired carbon enrichment, it is also advantageous if the number of double grate strokes per time section can be controlled.

In practice, it has proved to be advantageous if a time section of decreased burnup intensity or reduced primary air rate is 3 to 6 minutes. It is expedient if the reduced primary air rate is 50 to 70% of the standard primary air rate. An advantageous development of the invention is that the variation in primary air rate at the end of the main combustion process, based on the total combustion process, is quantitatively neutral, that is to say the total amount of primary air is not significantly changed by the inventive procedure compared with a previous standard operation.

The target of improving slag quality is also advantageously influenced by the primary air temperature being increased compared with the ambient air temperature. Preferably, the primary air temperature is controlled in the range from 110°C to 180°C.

The burnup rate or burnup intensity can also be changed by varying the O₂ content of the primary air. It is advantageous here if the

O₂ content of the primary air is varied with constant mass flow rate of the primary air.

Advantageously, the O₂ content can be increased compared with that of the ambient air by feeding pure oxygen to the primary air. Accordingly, the O₂ content can be decreased compared with that of the ambient air by feeding nitrogen to the primary air. The O₂ content can also be decreased compared with that of the ambient air by feeding recirculated exhaust gas to the primary air.

The invention is described by way of example below with reference to various diagrams in combination with the associated experimental results. In the accompanying drawings:

Figure 1: shows a diagram relating to the relationship between primary air rate and the number of double grate strokes for a 1-track fired grate having five primary air zones;

Figure 2: shows a diagram corresponding to Figure 1 for a 1-track fired grate having three primary air zones; and

Figure 3: shows a diagram for a 3-track fired grate having five primary air zones.

The grate designated with the letter A in the drawings is in each case a grate having five primary air zones and the grate designated with B is a grate having three primary air zones.

For all of the experiments, the following parameters were kept constant:

- the heat output $98.8 \pm 0.7\%$
- the heating value of the waste materials $2\,350 \pm 6\%$ kcal/kg
- the primary air distribution below the fired grate.

The following parameters were changed:

- the primary air temperature (approximately 125°C and 160°C)
- the preset O₂ (moist) content (6.4% by volume and 7.0% by volume).

Other details are given in the overview table below.

Observations during operation with pulsating primary air:

- 5 • In the region of primary air zone 3 of in total five primary air zones, the slag began to glow dark red in places and small to medium-sized slag clumps formed. The fired grate recirculated these slag clumps very well.
- 10 • Granule-type slag now exited at the deslagger discharge, whereas previously, without pulsating primary air, the slag had been earthy and fine-grained.
- 15 • Slag transport on the shaking chute downstream of the deslagger accelerated and became louder. The shaking chute cleaned itself off completely. Previously, in places, a sandy deposit had adhered.

20 The two experimental series below illustrate the improvement in slag quality in the inventive process.

I. Experiments with pulsating primary air:

O ₂ (moist) % by volume	Primary air temp. °C	Loss on ignition % by wt.	TOC % by wt.	DOC g/kg
6.4	160	1.54	0.62	0.576
6.4	160	1.82	1.27	0.591
6.4	129	1.89	1.40	0.786
7.0	160	1.45	1.31	0.642
Means:		1.68	1.15	0.649

II. Experiments without pulsating primary air:

O ₂ (moist) % by volume	Primary air temp. °C	Loss on ignition % by wt.	TOC % by wt.	DOC g/kg
6.4	121	2.19	4.49	1.011
6.3	160	2.04	3.45	0.711
6.5	160	2.39	2.30	0.726
7.0	160	2.24	1.49	1.479
Means:		2.22	2.93	0.982

Using pulsating primary air achieved the following improvements in
5 slag quality as means of four experiments in each case:

Mean loss on ignition was lowered from 2.22% by weight to 1.68% by
weight, which gave an improvement of 24%.

10 Mean TOC was decreased from 2.93% by weight to 1.15% by weight,
which gave an improvement of 61%.

Mean DOC was reduced from 982 mg/kg to 649 mg/kg, which gave an
improvement of 34%.

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In the experiments, the use of pulsating primary air reduced the
amount of flyash per tonne of waste on average over in each case
three experiments compared with the experiments without pulsating
primary air from 7.5 kg to 6.2 kg per 1 000 kg of starting waste
20 material, which gave a reduction of around 17%.

The abbreviations used are explained below:

O₂ (moist) = oxygen concentration based on the moist gas mixture
 PA = primary air
 PV = preset value
 TOC = total organic carbon
 DOC = diluable organic carbon
 DS = double stroke

Operation with the primary air changed in alternation, that is to
 5 say with pulsating primary air, was only used in the region of
 grate stages 5 to 8. In the case of grate type A, this
 corresponded to primary air zone 3.

For grate stages 5 to 8, in the experiments, for 50% of the time
 10 the standard primary air rate was used, while for the remaining
 50% of the time the primary air rate was reduced by 30 to 50%.

The pulsating primary air is implemented so as to be
 quantitatively neutral for the total primary air fed to a furnace.

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Therefore

- in the case of grates having an even number of grate
 tracks, the primary air is redistributed to and fro as
 follows:

2-track fired grate	zone 3 left	↔	zone 3 right
4-track fired grate	track 1 zone 3	↔	track 2 zone 3
	track 3 zone 3	↔	track 4 zone 3
6-track fired grate	track 1 zone 3	↔	track 2 zone 3
	track 3 zone 3	↔	track 4 zone 3
	track 5 zone 3	↔	track 6 zone 3

- in the case of type A grates having an odd number of grate tracks, the primary air is redistributed to and fro between zones 3 and 4 of the same grate track
- in type B grates, the primary air is redistributed to and fro between grate zones 2 and 3.

The time cycle of the pulsating primary air is made dependent on the sequence of complete double grate strokes:

- During 2 double grate strokes, grate stages 5-8 receive the standard primary air rate.
- During the subsequent 2 double grate strokes, grate stages 5-8 receive the reduced primary air rate.

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The primary air volume is fed to the relevant primary air zones countercyclically as described above.

10 An important precondition for good functioning of the pulsating primary air is that the primary air flap valve pairs which are triggered simultaneously but countercyclically achieve their preset values at the same time. This must be heeded particularly when zones 3 and 4 in fired grate A or zones 2 and 3 in fired grate B are to operate simultaneously.

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PATENT CLAIMS

1. Process for incinerating waste products on a fired grate having primary air feed from the lower side of the fired grate, in which process the waste products are first dried and ignited, whereupon the main combustion process is carried out and thereafter the resultant slag is discharged, characterized in that, at the end of the main combustion process, where burnable fractions are still present in addition to slag components which are already forming, the burnup rate or burnup intensity is retarded in selectable sequential time sections and is increased in the intermediate time sections.

2. Process according to Claim 1, characterized in that the retardation and acceleration of the burnup rate or burnup intensity at the end of the main combustion process are achieved by repeated variation of the primary air rate in the respective time sections in the burnup stage critical for slag quality.

3. Process according to Claim 2, characterized in that the primary air rate is varied by decreasing the primary air rate below a standard measure and subsequently increasing the primary air rate to the standard measure.

4. Process according to Claim 2 or 3, characterized in that the time sections having a decreased primary air rate and the time sections having a primary air rate which is standard for this firing range alternate constantly in a selectable ratio to one another.

5. Process according to Claim 4, characterized in that the two time sections are in a ratio of 1:1.

6. Process according to one of Claims 1 to 5, characterized in that the time section having a decreased burnup intensity or

reduced primary air rate is in a preselectable ratio to the number of double grate strokes.

7. Process according to Claim 6, characterized in that the
5 number of double grate strokes per time section can be controlled.

8. Process according to one of Claims 1 to 7, characterized in that a time section of decreased burnup intensity or reduced primary air rate is 3 to 6 minutes.

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9. Process according to one of Claims 2 to 8, characterized in that the reduced primary air rate is 50 to 70% of the standard primary air rate.

15 10. Process according to one of Claims 2 to 9, characterized in that the variation in primary air rate at the end of the main combustion process, based on the total combustion process, is quantitatively neutral.

20 11. Process according to one of Claims 2 to 10, characterized in that the primary air temperature is increased compared with the ambient air temperature.

12. Process according to one of Claims 2 to 11, characterized in
25 that the primary air temperature can be controlled in the range from 110°C to 180°C.

13. Process according to Claim 1, characterized in that the
burnup rate or burnup intensity is changed by varying the O₂
30 content of the primary air.

14. Process according to Claim 13, characterized in that the O₂ content of the primary air is varied with constant mass flow rate of the primary air.

35 15. Process according to Claim 13 or 14, characterized in that the O₂ content is increased compared with that of the ambient air by feeding pure oxygen to the primary air.

16. Process according to Claim 13 or 14, characterized in that the O₂ content is decreased compared with that of the ambient air by feeding nitrogen to the primary air.

- 5 17. Process according to Claim 13 or 14, characterized in that the O₂ content is decreased compared with that of the ambient air by feeding recirculated exhaust gas to the primary air.