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(71) Applicant: **Kvaerner Power Oy**
33101 Tampere (FI)

(72) Inventors:
- **Mäkelä, Kari**
  36200 Kangasala (FI)
- **Kuukkanen, Kari**
  33250 Tampere (FI)

(74) Representative: **Rönkkö, Taina Mirjam et al**
Tampereen Patenttitoimisto Oy
Hermiankatu 12 B
33720 Tampere (FI)

(54) Erosion shielding for a circulating fluidized bed boiler

(57) A method for shielding the inner surface above the shield refractory (4) of the furnace wall (3) of a circulating fluidized bed boiler from erosion caused by suspension flows, in which method a shield structure is formed on the inner surface of the boiler wall. At least a first zone (1) and a second zone (2) are formed in the shield structure, the erosion-resistance properties of which zones differ from each other. In addition the invention relates to a circulating fluidized bed boiler, which comprises a corresponding shield structure.

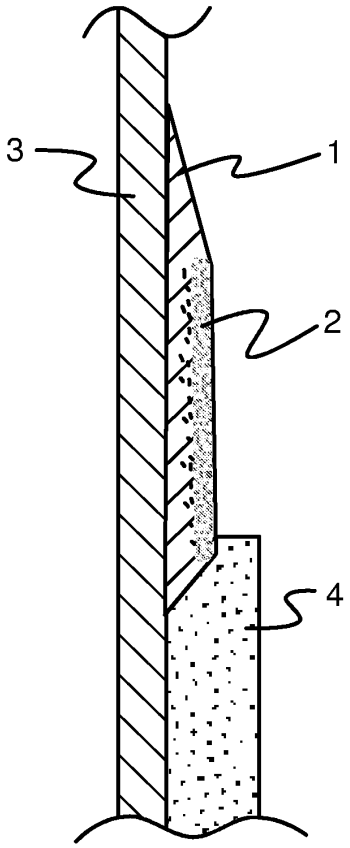

Fig. 1

EP 1 640 660 A2

Description

Field of the invention

[0001] The invention relates to a method for shielding the inner surface above the shield refractory of the furnace wall of a circulating fluidized be boiler from erosion caused by suspension flows according to the preamble of the appended claim 1. In addition, the invention relates to a circulating fluidized bed boiler according to the preamble of the appended claim 8.

Background of the invention

[0002] A complex suspension flow exists in the furnace of a circulating fluidized bed boiler (CFB boiler). The suspension flow of the furnace consists essentially of an upward flow in the central area of the furnace, where the density of the suspension decreases from the value of 1,000 kg/m^3 in the lower part to the density of 3 kg/m^3 in the upper part. Particles separate close to the walls from the upward flow along the way in the central area. The speed of the particles is decreased and finally, close to the wall, it turns into a downward flow. The downward particle flow is typically approximately 50...100 mm thick and the thickness of the particle film formed by the flow is at its greatest in the lower parts of the furnace.

[0003] Because of the erosion effect of the suspension flow in the furnace, the water pipes in the furnace walls are shielded with a shield refractory in the points that are prone to erode. Typically, membrane-built water pipes are shielded with a shield refractory that is approximately 50 to 80 mm thick and at approximately the height of 4 to 6 m from the bottom of the furnace.

[0004] Erosion at the end point of the lower part of the furnace is strong if it is not aimed to be prevented by means of any method. The erosion is believed to be caused at least partly by the downward flowing suspension impinging on the edge of the refractory and together with the upward central flow causes a whirl, which tends to erode the wall of the furnace.

[0005] The erosion at the end point of the refractory has been aimed to be prevented by coating the wall (water pipe) above the refractory at the height of 300 to 600 mm with a erosion-resistant coating (a so-called hard coating), whose upper part is aimed to be made as smooth as possible, without a shoulder. The above-mentioned measurements naturally depend on the size and dimensions of the boiler.

[0006] When coating the wall above the refractory with a hard coating, the erosion immediately over the refractory is, however, often so intense that the coatings cannot endure the erosion for long. In addition, during use a small shoulder is formed in the upper part of the coating, for example because of the coating breaking away or the pipe eroding (because the pipe as a softer material erodes faster than the coating). The shoulder causes a point of discontinuity and a whirl in the downward particle flow. Due to the whirl in the particle flow the wall and the pipes in it erode. In other words, known solutions have at least the problem that the pipe and/or coating erodes directly above the refractory, and that the upper end of the coating and the pipe at the corresponding location erode.

Summary of the invention

[0007] Now a solution has been invented, which essentially decreases the erosion of the wall above the refractory.

[0008] To attain this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the independent claim 1. The circulating fluidized bed boiler according to the invention is, in turn, primarily characterized in what will be presented in the characterizing part of the independent claim 8. The other, dependent claims will present some preferred embodiments of the invention.

[0009] A basic idea of the invention is that in order to protect the inner surface of the furnace wall of the steam boiler from the erosion caused by the suspension flows, a shield structure is formed on the inner surface of the boiler wall, which structure comprises at least a first zone and a second zone. The erosion-resistance properties of said zones differ form each other.

[0010] In an embodiment of the invention the first zone is located at least partly above the second zone. The coating of the first zone has such properties that an eroding form is not formed at the end point of the coating. The properties of the material of the second zone prevent the point in question from eroding. According to an embodiment, the first zone is less erosion-resistant than the second zone.

[0011] In a solution according to an embodiment of the invention, a property of the coating, such as its chemical composition, changes gradually or continuously when moving from the first zone to the second zone. Manufacturing the zones is possible with different techniques. The properties of the material can be changed by changing the composition of the material and/or by modifying the material. A possible way to change the properties of the material is by means of so-called laser technology. A smooth connection of the coating to the wall can also be implemented in several ways, such as, for example, by means of coating technology or by machining (for example by grinding).

[0012] In another embodiment of the invention two different coatings are used partly on top of each other. The lower zone is formed of a harder material. For example the wall is coated by means of hard facing or metal spraying in order to form a second zone. After this, welding or coating is performed with a softer material above the second zoned advantageously all the way to the refractory. In an advantageous embodiment the connection of the coating to the pipe is formed as continuous. In an advantageous embodiment the erosion properties of the ma-

terial of the first zone correspond to those of the pipe. Thus, no erosion or formation of a shoulder takes place at that point. In known solutions the formation of a shoulder may be due to either the breaking away of the coating or the fact that the pipe being of a softer material erodes faster than the coating.

[0013] The material of the second zone, i.e. a certain kind of a hard coating, decreases erosion significantly. The firs zone, i.e. the soft coating, is in turn let erode. It can, if necessary, be repaired by adding material, for example, by spraying or welding.

[0014] The structure according to the invention has several advantages. A significant advantage is decrease erosion.

[0015] In some embodiments the invention also enables repairing the coating. In some cases the repairing possibility of the coating is facilitated by the welding possibility.

Description of the drawings

[0016] In the following, the invention will be described in more detail with reference to the appended principle drawings, in which

Fig. 1 shows an embodiment according to the invention, and

Fig. 2 shows another embodiment according to the invention.

[0017] For the sake of clarity, the figures only show the details necessary for understanding the invention. The structures and details that are not necessary for understanding the invention but are obvious for anyone skilled in the art have been omitted from the figures to emphasize the characteristics of the invention. The dimensions of the figures have also been chosen in such a manner that the basic idea of the invention is as apparent as possible in the figures. Thus, the mutual dimensions of the different parts can differ significantly from those in the figures.

Detailed description of the invention

[0018] Fig. 1 shows a part of the lower part of the furnace of a steam boiler, such as a circulating fluidized bed boiler. In the example the furnace wall 3 is a so-called water wall, i.e. the wall is formed by water pipes 3 circulating the furnace, which pipes are typically manufactured of non-alloy or low alloy steel. Typically the lower part of the furnace comprises a shield refractory 4 (often a refractory or the like).

[0019] According to a basic idea of the invention, a shield structure 1,2 is formed on the inner surface of the furnace wall 3 in order to shield the inner surface above the refractory 4 from the erosion caused by suspension flows. The shield structure in question comprises at least a first zone 1 and a second zone 2, whose erosion-resistance properties differ from each other. The coating 1 of the first zone has such properties that a form eroding the wall 3 is not formed at the end point of the coating. The properties of the material of the second zone 2, in turn, prevent the shield structure from eroding excessively. The second zone 2 is a certain type of a hard coating. Advantageously the first zone is less erosion-resistant than the second zone. The first zone 1 is allowed to erode during use. By suitably selecting the material of the first zone 1, it is possible to repair the first zone, if necessary, for example by spraying or welding.

[0020] As can be seen in Fig. 1, in an embodiment of the invention according to the example the first zone 1 is located at least partly above the second zone 2 in the direction of the furnace wall 3. In a solution according to an example, a property of the coating, such as, for example, its chemical composition, changes gradually or continuously when moving from the first zone 1 to the second zone 2. Making the zones 1,2 is possible with different techniques. A possible way to change the properties of the material is by means of so-called laser technology. The properties of the material can be changed by changing the composition of the material and/or by modifying the material. A smooth connection of the coating (especially the first zone) to the wall 3 can also be implemented in several ways, such as, for example, by means of coating technology or by machining (for example by grinding).

[0021] Fig. 2, in turn, shows another embodiment of the invention, where two different coatings are used partly on top of each other. The second, i.e. lower zone 2 is formed of a more erosion-resistant material than the first, i.e. upper zone 1. For example, the wall 3 can be coated by hard facing or metal spraying in order to form the second zone 2. After this, the first zone 1 is formed by welding or coating in some other manner, advantageously all the up to the shield refractory 4 from above the second zone 2. In an advantageous embodiment the erosion properties of the material of the first zone 1 correspond substantially to the properties of the furnace wall 3, i.e. the water pipe in the example. Thus, there is no harmful amount of erosion in the connecting point of the first zone 1 and the wall 3, and therefore no formation of a shoulder takes palace either. In an advantageous embodiment the connection of the first zone 1 to the pipe 3 is formed into such that it does not cause substantial erosion. For example, the connection can be implemented in such a manner that the angle between the surfaces of the pipe 3 and the first zone 1 in the direction of the particle flow is formed as small as possible or the connection is implemented as substantially continuous. By means of the solutions presented above, the problems of prior art can be decrease or substantially removed, such as, for example, that the formation of a shoulder is caused by either the coating breaking away or by that the pipe being a softer material erodes faster than the coating.

[0022] By combining, in various ways, the modes and

structures disclosed in connection with the different embodiments of the invention presented above, it is possible to produce various embodiments of the invention in accordance with the spirit of the invention. Therefore, the above-presented examples must not be interpreted as restrictive to the invention, but the embodiments of the invention may be freely varied within the scope of the inventive features presented in the claims hereinbelow.

Claims

1. A method for shielding the inner surface above the shield refractory (4) of the furnace wall (3) of a circulating fluidized bed boiler from erosion caused by suspension flows, in which method a shield structure is formed on the inner surface of the boiler wall,
characterized in that
at least a first zone (1) and a second zone (2) are formed in the shield structure, the erosion-resistance properties of which zones differ from each other.

2. The method according to claim 1, **characterized in that** the shield structure is formed on the surface of the water pipe (3) of the water wall of the boiler.

3. The method according to claim 1 or 2, **characterized in that** the first zone (1) is located at least partly above the second zone (2) in the directi on of the furnace wall (3).

4. The method according to any of the preceding claims, **characterized in that** the first zone (1) is less erosion-resistant than the second zone (2) in operating conditions.

5. The method according to any of the preceding claims, **characterized in that** the first zone (1) and the second zone (2) are formed of different materials.

6. The method according to any of the preceding claims 1 to 4, **characterized in that** the first zone (1) is formed of a first material and the second zone (2) is formed by blending the first material.

7. The method according to any of the preceding claims 1 to 4, **characterized in that** the second zone (2) is formed of a first material and the first zone (1) is formed by blending the first material.

8. A circulating fluidized bed boiler, which comprises at least

- a furnace,
- a shield refractory (4) arranged in the wall (3) of the lower part of the furnace to shield the inner surface from the erosion caused by suspension flows, and
- a shield structure, which is located at least partly above the shield refractory (4) on the inner surface of the wall (3) to shield the inner surface above the shield refractory (4) from the erosion caused by suspension flows,

characterized in that
the shield structure comprises at least a first zone (1) and a second zone (2), whose erosion-resistance properties differ from each other.

9. The circulating fluidized bed boiler according to claim 8, **characterized in that** the shield structure is formed on the surface of the water pipe (3) of the water wall of the boiler.

10. The circulating fluidized bed boiler according to claim 8 or 9, **characterized in that** the first zone (1) is located at least partly above the second zone (2) in the direction of the furnace wall (3).

11. The circulating fluidized bed boiler according to any of the preceding claims 8 to 10, **characterized in that** the first zone (1) is less erosion-resistant than the second zone (2) in operating conditions.

12. The circulating fluidized bed boiler according to any of the preceding claims 8 to 11, **characterized in that** the first zone (1) and the second zone (2) are formed of different materials.

13. The circulating fluidized bed boiler according to any of the preceding claims 8 to 11, **characterized in that** the first zone (1) is formed of a first material and the second zone (2) is formed by blending the first material.

14. The circulating fluidized bed boiler according to any of the preceding claims 8 to 11, **characterized in that** the second zone (2) is formed of a first material and the first zone (1) is formed by blending the first material.

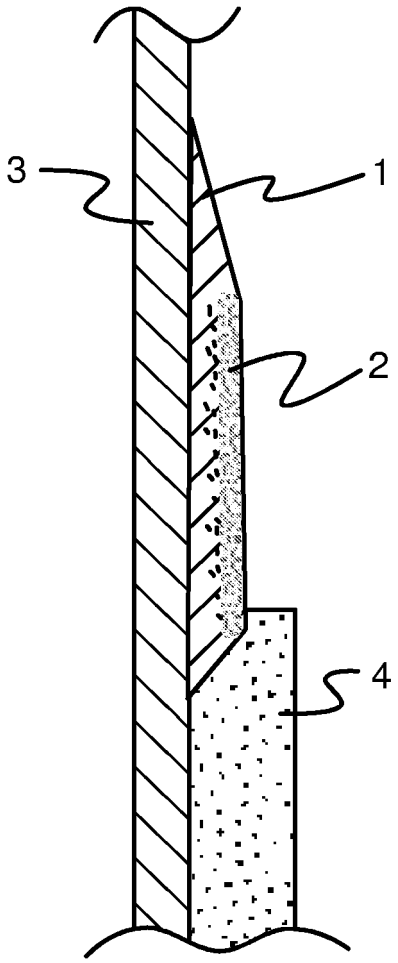

Fig. 1

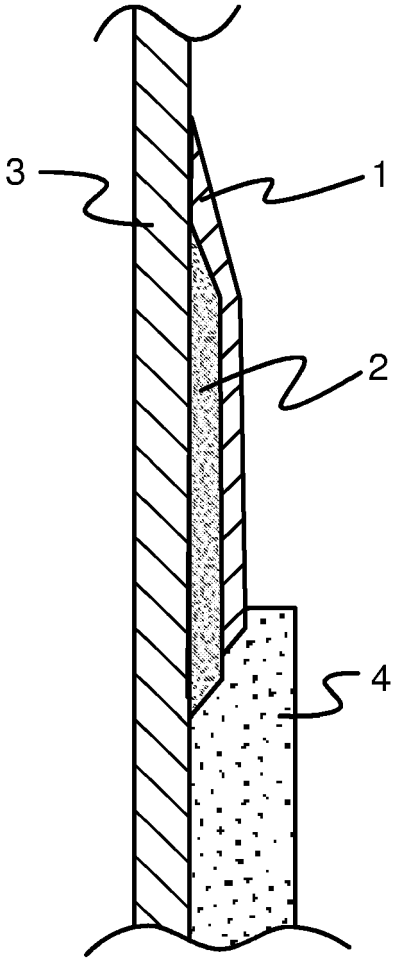

Fig. 2