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HEATING ELEMENT FOR A REGENERATIVE HEAT EXCHANGER AND METHOD
FOR PRODUCING A HEATING ELEMENT

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The present invention relates to a heating element for a regenerative heat exchanger, which element is realized as a profiled steel plate.

10 Heating elements of this type are generally known. A plurality of heating elements form the storage mass of the regenerative heat exchanger. The storage mass which is needed for the heat transfer is under unique operational demands when utilized in corrosive and/or dust laden gas streams. For
15 example, this applies to the storage mass on the cold side of air preheaters, where the temperature of the storage mass is at least intermittently below the dew point of sulfuric acid, and corrosive deposits form in connection with airborne dust. Similar problems arise in gas preheaters for reheating
20 scrubbed gases from flue gas cleaners, where not only acids and dust but also sorption or neutralization agents and products from the flue gas cleaning plant deposit on the heating surfaces. The storage mass must therefore be sufficiently resistant to corrosion, and the deposits should
25 be optimally easy to wash off by blasting or flushing. Storage masses comprising enameled steel plate profiles or plastic storage materials are known for such applications (DE 32 07 213 C2).

30 The disadvantage of enameled steel plates is that, while enamel has a good resistance to acids such as sulfuric acid and hydrochloric acid, it is not resistant to hydrofluoric acid, which occurs in flue gases, and does not withstand a basic attack for a sufficient length of time, for instance an



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attack due to the precipitation of neutralization agents (additives or sorption agents) for forming acidic gases, and that deposits adhere more or less permanently owing to the relatively good wettability of enamel. Storage material made of inexpensive plastic has held up only to a limited extent. As a result of the complex load (temperature exchange load, chemical attack), the material embrittles too rapidly and becomes damaged. Owing to the relatively low mechanical stability, it is also impossible to clean plastic storage masses with the conventional blasting or flushing pressures. Another disadvantage is the small heat storage capacity and heat conductivity of plastics, which is thermically disadvantageous and must be compensated by larger storage masses when plastics are utilized as the storage material.

In order to circumvent the embrittling and aging problems, special storage materials composed of fluorocarbon resins such as PTFE have been proposed, such as those described in DE 195 12 351 C1. Fluorocarbon resins are almost chemically inert and have the additional advantage of being particularly stain-resistant. But the material is substantially more expensive compared to enameled steel plates and cannot be economically produced in any arbitrary shape and dimension. For these reasons, the utilization of storage masses which consist solely of fluorocarbon plastics is limited to applications as the cold-side layer with a thickness of approx. 300 mm, which necessitates additional tanks with the storage mass and therefore additional outlay for construction. Besides this, fluorocarbon plastics also have the disadvantage of having a small heat storage capacity and heat conductivity, and they are not economically feasible to produce in the profile form which is expedient for heat transfer.

The object is to lay out a heating element of the above described type which is resistant to hydrofluoric acid, has stain-resistant properties, and nevertheless exhibits a good heat storage capacity, that is to say, good heat conductivity.

This object is inventively achieved by the features set forth in claim 1.

10 A corrosion guard is created by the enameling. The permeability of the fluorocarbon plastic (PTFE) is thus not so important, and a thin PTFE coating suffices. Said coating guarantees the anti-adhesive properties, and it influences the heat storage capacity and heat conductivity only marginally
15 owing to the small layer thickness.

A layer thickness between 10 and 50 μm is preferably selected, because up to this layer thickness the PTFE can be applied in one procedure.

20 To increase the corrosion protection, the enamel layer is implemented in an acid-resistant form.

A method for producing a heating element as claimed in claim 1
25 is characterized by the following steps:

- a. Steel coils are profiled with the aid of roll forming, and heating elements are cut therefrom in accordance with the required dimensions;
- 30 b. the heating element is enameled; and
- c. the fluorocarbon plastic is applied.

Surprisingly, it turns out that a thin layer of fluorocarbon plastic, for instance 10 to 50 μm thick, adheres sufficiently

well to the enamel without any particular pretreating of the enamel surface.

For the purpose of improving the adhesion, the enamel layer
5 can be roughened.

The fluorocarbon plastic coating can basically be realized in one or more layers.

10 With the heating element profiles enameled and coated with fluorocarbon plastic, a storage mass which is corrosion-proof and stain-resistant and which does not have any thermic or structural disadvantages or any limitations with respect to operation can be produced in a particularly economical
15 fashion, it being possible to utilize steel plate profiles which have been proven and optimized with respect to heat exchange, pressure loss and mechanical stability, whereby the thin fluorocarbon plastic layer influences the heat transfer performance only marginally (practically not at all). Another
20 advantage of the inventive method is that the fluorocarbon plastic coating can be accomplished with the aid of the customary devices for enameling heating plates, and therefore no additional equipment is required for production.

25 The stain-resistant character of the inventive heating element profile reduces or even completely prevents the buildup of dirt layers which increase the pressure loss on the profiles. This brings operational advantages by making it possible to extend the intervals for the storage mass cleaning processes
30 which are required when the maximum allowable pressure loss is reached, so that smaller amounts of waste water are generated. If deposits nevertheless form, they adhere less strongly to fluorocarbon plastic and can therefore be washed off with

lower blast or flush pressure and therefore with smaller amounts of blasting medium and rinsing water.

For reasons of greater economic efficiency in a boiler plant,
5 in air preheaters an optimally low flue gas exit temperature (temperature of the flue gas after passing through the heat exchanger), and thus an optimally low cold-end temperature of the heat exchanger, is desirable. This has been limited in the case of dust laden flue gases by the excessive rapidity of
10 deposit formation and the poor washability. With the inventive stain-repellent heating plate profiles, deposit formation given an extreme temperature drop far below the dewpoint is hindered or at least more manageable, which ultimately allows a more effective lowering of the flue gas
15 temperature. A lower flue gas temperature means a higher boiler effectiveness and therefore a lower level of CO₂ emissions, and the equipment that is connected to the air preheater on the downstream side (electrofilters, flue gas cleaning systems) can be built smaller.

20 In regenerative heat exchangers for systems for selectively reducing nitrogen oxides (SCR-De NO_x), as well, the ammonium sulfate deposits which form on the hot layer, i.e. the middle layer, can be more easily cleaned off with the aid of the
25 inventive coating combination.

An exemplifying embodiment of an inventive heating element and a method for producing the heating element will now be described.

30 A heating element consists of a steel plate which is prepared for the enameling by being degreased or pickled subsequent to being profiled. Following the completion of the enameling with an acid-resistant enamel, without any pretreating of the

enameled surface, the fluorocarbon plastic (e.g. PTFE) is applied with a layer thickness of 10 to 50 μm , for instance by spraying, and then dried and tempered. For purposes of improving the adhesive force, the enamel surface can be roughened prior to the application of the fluorocarbon plastic coating, for instance by mild sandblasting or pickling with hydrofluoric acid or a base.

The coating can be applied in one or more layers. According to a preferred embodiment, a particularly strongly adhesive fluorocarbon resin primer is applied without pretreatment, and over that a fluorocarbon resin coverlayer.

Patent Claims

1. Heating element for a regenerative heat exchanger, which is constructed as a profiled steel plate, characterized in
5 that the steel plate is enameled, and the enameled surface is provided with a fluorocarbon plastic coating.
2. Heating element as claimed in claim 1, characterized in that the fluorocarbon plastic coating is from 10 to 50
10 micrometers thick.
3. Heating element as claimed in claim 1, characterized in that the enameled surface is acid-resistant.
- 15 4. Method for producing a heating element for regenerative heat exchangers as claimed in claim 1, characterized in that steel coils are profiled by roll forming, and the heating element is cut therefrom according to the required size; that the steel plate is enameled; and that the fluorocarbon plastic
20 coating is applied.
5. Method as claimed in claim 4, characterized in that the enameled surface of the steel plate is roughened.
- 25 6. Method as claimed in claim 4, characterized in that the fluorocarbon plastic coating is applied in one or more layers.