REDDUCTION OF SLAG FORMATION IN COAL-FIRED FURNACES, BOILERS AND THE LIKE

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This invention, in general, relates to chemical compositions which are useful in the reduction of slag formation and fireside deposits in coal-fired furnaces, boilers and the like, and to methods for burning solid carbonaceous fuels such as coal in the presence of these compounds.

In furnaces, boilers, and the like wherein the fuel employed is a solid carbonaceous fuel such as coal, it is desirable to reduce as much as possible the slag formation resulting from the burning of the coal, particularly on walls, boiler tubes and other fireside heat transfer surfaces in units such as boilers, wherein the heat derived from the burning of coal is transferred through metal surfaces to heat a fluid, the amount of deposits on the surfaces is a serious factor because these deposits materially decrease the effectiveness of heat transfer to the fluid being heated. Furthermore, some deposits are corrosive to the metal heat transfer surfaces, particularly at the high boiler temperatures, and the reduction or elimination of these deposits is beneficial in the prevention of corrosion of the metals.

Briefly, the instant invention relates to slag inhibiting compositions comprising a mixture of major proportion of magnesium oxide and a minor proportion of a phosphate salt, both ingredients in the form of small particles. This mixture is added to the solid carbonaceous fuel in an amount usually within the range of about 0.1 to 1.0 pounds of the particulate mixture per ton of coal. A convenient and economical method of addition of these particles is achieved by the spraying thereof onto the surface of the burning coal—either continuously or intermittently.

It is an object of the present invention to provide chemical compositions useful in the reduction of slag formation and fireside deposits resulting from the burning of solid carbonaceous fuel such as coal.

Another object of the invention is to provide new chemical compositions composed of a particulate mixture of magnesium oxide and a phosphate salt as the active, essential ingredients with respect to the reduction of slag formation and fireside deposits resulting from burning of solid carbonaceous fuel such as coal.

Another object of the invention is to provide improvements in the burning of coal and the like.

A still further object of the invention is to provide methods for burning coal wherein the chemical compositions of this invention are added to the coal while the latter is burning.

A still further object of the invention is to provide improvements in the firing of furnaces, boilers and the like with solid carbonaceous fuel such as coal.

In accordance with the invention, magnesium oxide and a phosphate salt are mixed in proportions wherein the magnesium oxide constitutes approximately 50-80% by weight of the mixture and the phosphate salt constitutes about 20-50% by weight of the mixture. The two components are in the form of solid particles having an average particle size falling within the range of approximately 0.001 inch to 0.05 inch. Extremely fine powders are not recommended for the purposes of this invention because they tend to be entombed in the furnace ash and carried out of the fireside area before they can perform their beneficial functions.

The magnesium oxide particles which are used for pur-
Example III

Seventy-five percent of magnesium oxide particles having an average particle size of about 0.006 inch and 25% of tricalcium phosphate particles having an average particle size of about 0.003 inch are thoroughly mixed together. The mixed particles are packaged and ready for distribution as a slag-inhibiting composition for use in coal-fired furnaces, boilers and the like.

To determine the slag-inhibiting properties of the composition of this invention, a test was conducted with the composition of Example I in a coal-fired boiler. The test composition was added by spraying the same onto the burning coal via the overfire air. The boiler was a Wickes-Type B boiler having a steam capacity of 75,000 pounds per hour at 435 p.s.i. at 590°F. Superheat. The boiler had a pressurized stoker. On an average day, the boiler burns 75 tons of coal.

The test was conducted over a six-week period, and the magnesium oxide-phosphate rock composition was added intermittently by each hour shift. For the first two weeks, the feed of the magnesium oxide-phosphate rock mixture was one-third pound of the mixture per ton of coal fired. For the second two weeks, the dosage was reduced to one-third pound per ton of coal fired. During the fifth week, the feed was started at a rate of 1/6 pound per ton of coal fired, but was reduced gradually so that during the sixth and last week of the trial the treatment was down to about 1/10 of one pound per ton of coal fired.

Prior to the test, trouble had been encountered with slag and with a consequent increase in stack gas temperature. This increase in the stack gas temperature was usually noticed about two weeks after the firing of the boilers had been cleaned. Near the end of the fourth week of the trial with the magnesium oxide-phosphate rock treatment, no rise in stack gas temperature had been noted since the start of the trial.

While the trial was being conducted, a shipment of bad coal was received. This coal was so poor that considerable trouble was experienced in even burning the fuel. Finally, the boiler operators had to resort to blending the bad coal on a 50-50 basis with some better coal. Due to this bad coal, there was some slag built up immediately above the grates, evidenced when the boiler was torn down for cleaning. This slag was very friable and could be pulled away from the boiler tubes by hand and had a spongy, honeycomb appearance. The result of the boiler was in excellent condition. The overhead screen tubes and superheater showed no sign of slag build-up. The tubes were about 75% bare metal, with the remaining 25% covered by a very light coating no more than 1/6" thick. In previous operations even with good coal, but without the addition of the magnesium oxide-phosphate rock mixture, the overhead usually becomes plugged with slag—requiring boiler shutdown to manually clean off the slag. Further, it was reported after the trial that this was the first time in operation of the boiler that no manual cleaning of the superheater section was required. Also, during the six-week trial the stack gas temperature remained steady at 550°F. Under normal conditions, without the treatment in accordance with the invention, the stack gas temperature will start to rise after about two weeks and will eventually get up to 620-630°F. Also, it was noted during the trial that the superheat temperature ran approximately 10°F higher than normal.

Thus, it will be seen that the treatments provided by the instant invention provide economics in the operation of furnaces, boilers and thelike. By materially reducing slag deposits on boiler walls, boiler tubes and other heat transfer surfaces, boilers may be operated at considerably longer periods of time before shutdown is necessary to clean the boilers. Further, by reducing slag deposits, the boilers can be operated at more efficient heat transfer efficiency than is possible without the addition of the treating compounds of this invention.

The invention is hereby claimed as follows:

1. A composition useful in slag prevention in coal-fired furnaces comprising a mixture of small, dense particles of an average particle size in the range of 0.001 to 0.05 inch of 50-85% by weight of magnesium oxide particles obtained by the calcination of a member of the group consisting of magnesium ore and amorphous magnesium hydroxide and 20-50% by weight of alkaline earth phosphate salt particles.

2. A composition useful in slag prevention in coal-fired furnaces comprising a mixture of small, dense particles of 50-80% by weight of magnesium oxide particles obtained by the calcination of a member of the group consisting of magnesium ore and amorphous magnesium hydroxide and 20-50% by weight of calcined phosphate rock particles.

3. A composition useful in slag prevention in coal-fired furnaces comprising a mixture of small, dense particles of 50-80% by weight of magnesium oxide particles and 20-50% by weight of calcined phosphate rock particles, analyzing at least 70% by weight as tricalcium phosphate and at least 30% by weight as P2O5.

4. A process for firing furnaces which comprises burning coal and adding to the burning coal a composition comprising a mixture of small particles of an average particle size in the range of 0.001 to 0.05 inch of 50-80% by weight of magnesium oxide particles and 20-50% by weight of alkaline earth phosphate salt particles in an amount in the range of 0.1 to 1 pound of said composition per ton of said coal.

5. A process for firing furnaces which comprises burning a solid carbonaceous fuel and adding to the burning fuel a composition comprising a mixture of small particles of 50-80% by weight of magnesium oxide particles and 20-50% by weight of calcined phosphate rock particles.

6. A process for firing furnaces which comprises burning a solid carbonaceous fuel and adding to the burning fuel a composition comprising a mixture of small particles having 50-80% by weight of magnesium oxide particles and 20-50% by weight of calcined phosphate rock particles, analyzing at least 70% by weight as tricalcium phosphate and at least 30% by weight as P2O5.

7. A process for firing furnaces which comprises burning a solid carbonaceous fuel in the presence of a particulate mixture of an average particle size in the range of 0.001 to 0.05 inch of 50-80% by weight of magnesium oxide and 20-50% by weight of an alkaline earth phosphate salt.

8. A process for firing furnaces which comprises burning a solid carbonaceous fuel in the presence of a particulate mixture of an average particle size in the range of 0.001 to 0.05 inch of 50-80% by weight of magnesium oxide and 20-50% by weight of an alkaline earth phosphate salt, present as said fuel in an amount in the range of 0.1 to 1 pound of said mixture per ton of said solid carbonaceous fuel.

9. The process of claim 8 wherein said solid carbonaceous fuel is coal.

References Cited in the file of this patent

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CERTIFICATE OF CORRECTION

Patent No. 3,004,836

October 17, 196

Harris Thompson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 57, for "95.5%" read -- 99.5% --.

Signed and sealed this 17th day of April 1962.

(SEAL)

Attest:

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