The performance of a combustion apparatus is improved by providing a burner tile wherein which includes a coating of a high-emissivity (high-E) material. Preferably, the high-E material has an emissivity of greater than about 0.80, usually between about 0.85 to about 0.98. In some embodiments, the high-E material has an emissivity of about 0.92. The coating thickness on of the high-E material on the burner tile can be about 0.0005 to about 0.025 inch, preferably between about 0.001 to about 0.002 inch. In especially preferred embodiments, the high-E material is ceramic. A burner tile comprising a coating layer of the high-emissivity material may therefore be incorporated into a combustion apparatus so as to improve its combustion performance.
REFRACTORY BURNER TILES HAVING IMPROVED EMISSIVITY AND
COMBUSTION APPARATUS EMPLOYING THE SAME

FIELD OF THE INVENTION

The present invention relates generally to combustion apparatus such as process heaters, furnaces, boilers, and other fired heating systems. In especially preferred forms, the present invention relates to combustion apparatus which include refractory burner tiles provided with improved emissivity characteristics.

BACKGROUND AND SUMMARY OF THE INVENTION

Many industrial applications require large scale generation of heat from burners for process heaters, furnaces, boilers or other fired heating systems. In essence, the burners function to combust burner fuel and air so as to generate the required heat. The efficiency of the burner is very important to operators due to fuel costs and the need to reduce nitrogen oxides (NOx) in the combustion gases. In this regard, burners designed for combusting fuel with air in a manner resulting in less NOx emissions are commonly referred to as “low NOx” burners and are well known in the art as evidenced by U.S. Pat. Nos. 6,905,328, 6,499,990 and 6,394,792, the entire content of each being expressly incorporated hereinto by reference.

According to the present invention, the present invention, combustion apparatus are improved by providing a high emissivity (high-E) coating onto faces of refractory burner tiles. In such a manner, the combustion apparatus which employ the high-E coated burner tiles of the present invention may achieve longer service life, improved flame stability, easier combustion and a more stable flame pattern under a wide range of operating conditions.

According to some embodiments, the performance of a combustion apparatus is improved by providing burner tiles wherein which include a coating of a high emissivity (high-E) material. Preferably, the high-E material has an emissivity of greater than about 0.80, usually between about 0.85 to about 0.98. In some embodiments, the high-E material has an emissivity of about 0.92.

The coating thickness of the high-E material on the burner tile can be between about 0.0005 to about 0.025 inch, preferably between about 0.001 to about 0.002 inch. In especially preferred embodiments, the high-E material is ceramic. Burner tiles comprising a coating layer of the high-emissivity material may therefore be incorporated into a combustion apparatus so as to improve its performance.

These and other aspects and advantages will become more apparent after careful consideration is given to the following detailed description of the preferred exemplary embodiments thereof.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Reference will hereinafter be made to the accompanying drawings FIGURE which is a partial cross-sectional elevational schematic view of a combustion apparatus employing the high-E coated burner tiles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

According to the present invention, a high-emissivity (high-E) ceramic coating is applied to surfaces of burner tiles associated with a combustion apparatus so as to provide enhanced combustion. More specifically enhanced combustion of the burner fuel is provided according to the present invention by the higher heat energy (flux) from the high-E ceramic coated surfaces of the burner tiles.

As used herein, the emissivity (E) of a material is meant to refer to a unitless number measured on a scale between zero (total energy reflection) and 1.0 (a perfect “black body” capable of total energy absorption and re-radiation). According to the present invention, a relatively high emissivity (high-E) is meant to refer to coating materials having an emissivity of greater than about 0.80, and usually between about 0.85 to about 0.98, and most preferably between about 0.85 to about 0.95.

The accompanying drawing FIGURE depicts in schematic fashion a furnace 10 having a burner apparatus 12 operatively attached to the furnace’s refractory wall 14. Any suitable burner apparatus may be employed, such as the burner described in U.S. Pat. No. 5,961,312 (the entire content of which is expressly incorporated hereinto by reference.) The refractory wall 14 includes a burner tunnel 16 which is defined by burner tiles 18. In this regard, the burner tiles 18 depicted in the accompanying FIGURE define a generally cylindrical burner tunnel 16, but other geometric shapes may be employed as desired. For example, a square or rectangular burner tunnel 16 may be defined by the refractory tiles 18. The individual burner tiles 18 are constructed of a body of refractory material, e.g., ceramics, conventionally employed for high temperature environments.

Important to the present invention, the burner tiles 18 have a coating 20 on the surfaces thereof which is formed from a high-E ceramic material. Virtually any commercially available high-E ceramic coating material may be employed satisfactorily in the practice of the present invention. For example, one presently preferred high-E ceramic coating includes CERAK R360/R370 ceramic coating commercially available form Cetek, Ltd. of Brook Park, Ohio, having an emissivity of about 0.92.

The thickness of the coating 20 on the surfaces of the burner tiles 20 is not critical but will vary in dependence upon the desired resulting thermal flux and/or the particular material forming the coating. Thus, coating thicknesses of from about 0.0005 to about 0.025, usually between about 0.001 inch to about 0.002 inch may be appropriate. Coating densities will typically be greater than about 65%, more
specifically 80% or greater, including up to 100%. By “coating density” is meant the amount (wt. %) of the high-E ceramic coating material that is present in the coating 20.

[0014] The high-E coating material may be applied to the burner tiles 18 in any conventional manner. The high-E coating material forming the coating 20 may thus be applied to the surfaces of the burner tiles 18 via any pressurized spray system while the burner tiles are being manufactured or while off-line (i.e., is not at its operational temperatures) during refurbishment.

[0015] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A method of improving performance of a combustion apparatus comprising providing a burner tile in the combustion apparatus which includes a coating of a high-emissivity (high-E) material.
2. Method as in claim 1, wherein the high-E material has an emissivity of greater than about 0.80.
3. Method as in claim 1, wherein the high-E material has an emissivity of between about 0.85 to about 0.98.
4. Method as in claim 1, wherein the high-E material has an emissivity of about 0.92.
5. Method as in claim 1, wherein the coating has a thickness of between about 0.0005 to about 0.025 inch.
6. Method as in claim 1, wherein the coating has a thickness of between about 0.001 to about 0.002 inch.
7. Method as in claim 1, wherein the high-E material is ceramic.
8. A burner tile for a combustion apparatus comprising a coating layer of a high-emissivity material.
9. Burner tile as in claim 8, wherein the high-E material has an emissivity of greater than about 0.80.
10. Burner tile as in claim 9, wherein the high-E material has an emissivity of between about 0.85 to about 0.98.
11. Burner tile as in claim 9, wherein the high-E material has an emissivity of about 0.92.
12. Burner tile as in claim 9, wherein the coating has a thickness of between about 0.0005 to about 0.025 inch.
13. Burner tile as in claim 9, wherein the coating has a thickness of between about 0.001 to about 0.002 inch.

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