

- 1600° C. for two hours in an argon gas environment. After, one cube was, sectioned to verify the existence of phosphates in the Cr₂O₃ refractory. EDX (Energy dispersive x-ray) analysis confirmed that phosphate compounds were formed in the chromium refractory.
- b) After the P₂O₅ heat treatment, the hole in the second cube was filled with an industrial coal slag and the cube was heated to 1600° C. and held for one hour in an argon gas atmosphere. After cool-down, the cube was sectioned for optical and SEM analysis. SEM analysis confirmed that slag penetration into the chromium refractory was limited to within 1 mm of the refractory-slag interface.
- c) A chromium-based refractory matrix with a small amount (<5 weight percent) of a phosphate-based material was treated as follows. A cup or hole was drilled into the phosphate-modified, high-chromium refractory brick and filled with a coal ash slag with the composition (weight percent) 51% SiO₂, 21% Al₂O₃, 20% Fe₂O₃, 6% CaO and 2% MgO. The slag-filled cup was then placed in a furnace and heated to 1600° C. for 24 hours in an argon environment. Following the exposure test, the refractory was cross-sectioned and examined for evidence of slag penetration and attack. As can be seen in FIG. 2, the level of slag penetration in the phosphate-modified refractory is limited to within 1 mm of the refractory-slag interface.
- d) A cup-shaped refractory was pressed from a mixture of Cr₂O₃ aggregate (164.8 gm) (-4+10 mesh), Cr₂O₃ small aggregates (84 gm) (-10+28 mesh), Cr₂O₃ (39.2 gm) and Al₂O₃ (6.34 gm) powders and phosphoric acid (12.8 cc). The packing density of this cup was about 85%. The cup was then fired up to a temperature of 1600° C. for one hour in air. To perform the cup test, the cup was filled with industrial coal slag. The filled cup with the coal slag was fired up to 1600° C. for one hour in argon gas. Results from the cup test show that the combination of aluminum and chromium phosphates in the matrix reduced the slag penetration to within less than 1 mm from the refractory-slag interface.
- e) A cup-shaped refractory was pressed from a mixture of Cr₂O₃ aggregate (164.8 gm), Cr₂O₃ small aggregates (84 gm), Cr₂O₃ (60.57 gm) powder and phosphoric acid (12.8 cc). The packing density of this cup was about 85%. The cup was then fired up to a temperature of 1600° C. for one hour in air. To perform the cup test, the cup was filled with industrial coal slag. The filled cup with the coal slag was fired up to 1600° C. for one hour in argon gas. Results from the cup test show that chromium phosphates in the matrix reduced the slag penetration to within less than 1 mm from the refractory-slag interface, as shown in FIG. 3.

Thus, in accordance with the invention, there has been provided a high chromium refractory that resists the penetration of coal slag into the cured refractory during use. There has also been provided a high chromium refractory that slows the penetration of coal slag into the cured and fired refractory.

With this description of the invention in detail, those skilled in the art will appreciate that modification may be made to the invention without departing from the spirit thereof. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments that have been illustrated and described. Rather, it is intended that the

scope of the invention be determined by the scope of the appended claims.

We claim:

1. A refractory material for the reduction of coal slag penetration comprising an aggregate and a matrix comprising a mixture of chromium oxide, an inorganic oxide and a phosphate, wherein the matrix contains at least about sixty weight percent of chromium oxide.
2. A refractory material of claim 1 wherein the matrix further comprises aluminum oxide.
3. A refractory material of claim 1 wherein the matrix further comprises ZrO₂.
4. The refractory material of claim 1 wherein the refractory contains at least seventy weight percent chromium oxide.
5. The refractory material of claim 1 wherein the phosphate is an inorganic phosphate.
6. The refractory material of claim 1 wherein the phosphate is formed by the reaction of chromium oxide and the inorganic oxides with a phosphorus source, wherein the phosphorous source is selected from the group of phosphoric acid and P₂O₅.
7. The refractory material of claim 1 wherein the matrix contains from about one weight percent to about ten weight percent phosphates.
8. The refractory material of claim 1 wherein the chromium oxide is sintered.
9. The refractory material of claim 1 wherein the matrix contains less than about 0.1 weight percent of a halogen.
10. The refractory material of claim 1 wherein the phosphate contains less than 0.1 weight percent of a halogen.
11. A process for manufacturing a refractory material for reduction of coal slag penetration comprising
 - providing an aggregate;
 - blending the aggregate with a matrix comprising a mixture of chromium oxide, inorganic oxides and a phosphate, to form a green refractory, wherein the matrix contains at least sixty weight percent of chromium oxide;
 - forming the green refractory into a shape; and
 - curing and firing the shape of green refractory to form an aggregate and a binder of chromium oxide and alumina phosphate.
12. The process for manufacturing refractory material of claim 11 wherein the phosphate is inorganic.
13. The process for manufacturing refractory material of claim 11 wherein the phosphate is formed by the reaction of chromium oxide and the inorganic oxide with a phosphorus source, wherein the phosphorous source is selected from the group of phosphoric acid and P₂O₅.
14. The process for manufacturing refractory material of claim 11 wherein the matrix contains from about one weight percent to about ten weight percent phosphate.
15. The process for manufacturing refractory material of claim 11 wherein the chromium oxide is sintered.
16. The process for manufacturing refractory material of claim 11 wherein the matrix contain less than about 0.1 weight percent of a halogen.
17. The process for manufacturing refractory material of claim 11 wherein the phosphate contains less than 0.1 weight percent of a halogen.