This invention relates to the manufacture of foundry mold coatings, and more particularly to an improved refractory coating for graphite molds used in the casting of uranium, uranium alloys and other metals at high temperatures.

The co-pending application of Stephen D. Stoddard, Refractory Coating for Graphite Molds, Serial Number 450,280, filed August 16, 1954, now Patent No. 2,840,480, describes a refractory mold coating for graphite molds used in the casting of uranium and other metals and having maximum usefulness at pouring temperatures below approximately 1500° C. The present invention is an alumino-silicate mold coating, having a high alumina content for added refractoriness which may be used at temperatures in excess of 1500° C. Such pouring temperatures are necessary, for example, in the casting of cobalt, uranium-molybdenum alloys, uranium tungsten alloys and platinum.

The vacuum casting of uranium and uranium alloys is most generally accomplished by the use of graphite molds in which the mold cavity has been coated with a refractory material. Such a coating is necessary in the casting of uranium and other metals, such as nickel and cobalt, having a high affinity for carbon, in order to separate the molten metal from the surface of the graphite due to the wetting power of the metal and its carbon affinity. If no separation is provided and there is contact between the graphite mold and the uranium, or other metal being cast, the metal will be contaminated by carbon pickup and the cavity surface will be irreparably damaged as the casting is removed from the mold. In the state of the art prior to the present invention the refractory material most commonly used as a mold coating has been magnesium oxide applied as a slurry. However, certain difficulties are inherent in the use of magnesium oxide for this purpose. It is relatively difficult to apply, and a rougher surface of the casting than is desirable usually results. In addition, magnesium oxide as a slurry has a short pot life, i.e., approximately one and one-half hours, thus making its immediate use necessary.

The present invention is an alumino-silicate refractory composition capable of withstanding temperatures in excess of 1500° C. which may be used as a mold surface in solid form or as a coating applied to the cavity of a graphite mold, comprising a mixture of aluminum oxide, bentonite, Tennessee ball clay, soluble silicate salt and water in specific proportions as described hereinafter.

It is an object of the present invention to provide an improved refractory high temperature mold coating for graphite molds especially useful in the casting of uranium, nickel, cobalt and other metals having a high affinity for carbon.

It is another object of the present invention to provide an improved high temperature refractory mold coating for graphite molds used in the casting of metals such as nickel, cobalt and their alloys when the complexity of the casting makes the use of graphite molds necessary.

It is a further object of the present invention to provide a high temperature refractory mold material or mold coating for graphite molds which has a long or indefinite pot life.

It is a still further object of the present invention to provide an improved refractory mold coating for graphite molds when the pouring temperature of the metal being cast is in excess of 1500° C.

Other objects and advantages of the present invention will be apparent to those skilled in the art from the following description of a preferred embodiment.

A typical mill charge of the high temperature alumino-silicate refractory coating in its presently preferred embodiment comprises the following mixture by weight: aluminum oxide 98.0 parts, bentonite 0.5 part, Tennessee ball clay 1.5 parts, soluble silicate salt 0.23 part, and water 35 parts based on the dry weight of the mixture.

In the mold coating of co-pending application Serial Number 450,280, by Stephen D. Stoddard, filed August 16, 1954, now Patent No. 2,840,480, the silica and aluminum oxide impurities in the clays of the mixture have a fluxing action. For high temperature uses, these constituents are decreased in order to provide additional refractoriness. The resulting novel mixture is typified by the above proportions, although these may be varied by routine experiments to determine the optimum proportions for any given purpose.

As an example of the preparation of the high temperature refractory coating of the present invention and its use in a typical casting operation, the following procedure is illustrative.

In utilizing the mill charge given hereinbefore, a dry mixture is prepared comprising 1960 grams of 200 mesh calcined aluminum oxide, 10 grams of bentonite, 30 grams of Tennessee ball clay, and 4.56 grams of sodium silicate salt. The mixture is then milled for eleven hours in a porcelain ball mill of 2000 grams capacity using 4200 grams of three-quarter inch and one-half inch diameter balls. The mixture is passed through a 325 mesh screen and shows a grain size of 3.3 microns. The dry mixture is then mixed with 700 cc. of water and applied to the casting surface of the graphite mold which may be, for example, cylindrical in shape.

The mold coating in this illustration is sprayed onto the graphite mold which has been pre-cleaned, by using an air brush having a carbolytip with an air pressure of 40 to 60 pounds per square inch. The mold coating dries upon contact, and is applied to a thickness of 0.010 to 0.015 inch. The mold with coating applied is pre-heated to 1375° C. for a cobalt pour. The cobalt is poured at a temperature of 1650° C. to 1700° C. and freezes almost immediately. The cobalt casting may then be removed, leaving the mold coating intact and ready for reuse. The cobalt casting shows a smooth surface with no carbon pickup.

Although in the typical mill charge specified above, Tennessee ball clay was used, other white-or-light-creeburning clays which represent the maximum degree of subdivision and the highest degree of plasticity of the fired clay materials may be employed. Ball clays such as those found in Dorsetshire, England, southwestern Kentucky and Tennessee are satisfactory. It is preferable that the ball clay used be of the air floated type from the standpoint of particle size, purity and uniformity. In the presently preferred embodiment, approximately 1.5 parts by weight of ball clay are used in the mixture. However, the proportion of ball clay may vary from 0.5 part to 3.5 parts with little or no detrimental effects.

The aluminum oxide of the mixture is preferably the artificially formed fused Al₂O₃ used in industrial porcelain which is acid leached free of iron. However, other forms of α-alumina, β-alumina or γ-alumina are acceptable.
The alumina should be calcined and pass a 200 mesh screen. Further, it is desirable that the aluminum oxide be granular to permit the requisite porosity. The proportion of aluminum oxide in the mixture may vary from 95 to 99 parts. Bentonite is used to increase the plastic working strength of the mixture. In the presently preferred embodiment 0.23 part by weight of sodium silicate salt is used, however, this may vary from 0.1 part to 0.5 part. Other soluble silicate salts such as potassium silicate may also be used, and the optimum content of the salt in the mixture may be determined by routine experiment by a person skilled in the art.

The water content is held to close tolerances for any specified viscosity, but may be varied appreciably according to the method by which the coating is to be applied. Thus, where the coating is to be slush applied, the water content may vary from 25 parts to 40 parts based on the dry weight of the mixture in order to facilitate coating of blind corners and relatively inaccessible areas.

The alumino-silicate refractory coating of the present invention has proved superior both in process and product to those refractory coatings heretofore known to the art, especially where pouring temperatures are in excess of approximately 1500° C. It may be sprayed in thinner applications than magnesium oxide, and results in a product of cast uranium or other metal having a smoother surface than was heretofore possible by the use of magnesium oxide. It is easier to apply and shows less tendency to clog and foul the spray gun when spray application is used. Its pot life is indefinite as compared to the short pot life of a magnesium oxide coating, and it shows better adherence characteristics at high temperatures than those previously known coatings. The stronger adherence to graphite of the present alumino-silicate coating makes possible repeated use of graphite molds coated therewith, while magnesium oxide coatings heretofore known to the art are most generally not re-useable after one casting, due to flaking and chipping of the coating from the graphite surface. The mold coating described herein is superior to the mold coating described in co-pending application of Stephen D. Stoddard, referred to above, when the pouring temperature of the metal being cast exceeds approximately 1500° C. Thus, it is especially useful in the casting of metals such as cobalt, uranium molybdenum alloys, uranium tungsten alloys and platinum.

It will be apparent to those skilled in the art that this invention is not necessarily limited to the particular embodiments described herein, but that various modifications may be made without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. An alumino-silicate high temperature refractory mold coating, consisting essentially of an aqueous slurry of the following mixture of ingredients by dry weight: 95 parts to 99 parts fused aluminum oxide, 0.5 part to 2.0 parts bentonite, 0.5 part to 3.5 parts ball clay, and 0.1 part to 0.5 parts soluble silicate salts, all of said ingredients having an average particle size of about 3.3 microns and a maximum of 44 microns.

2. An alumino-silicate high temperature refractory mold coating, consisting essentially of an aqueous slurry of a mixture consisting essentially by dry weight of about 98 parts fused aluminum oxide, about 0.5 part bentonite, about 1.5 parts ball clay, and about 0.23 part soluble silicate salt, all of said ingredients having an average particle size of about 3.3 microns and a maximum of 44 microns.

3. An alumino-silicate high temperature refractory mold coating, consisting essentially of a mixture by weight of about 98 parts fused aluminum oxide; about 0.5 part bentonite; about 1.5 parts ball clay; about 0.23 parts powdered sodium silicate; and about 35 parts water based on the dry weight of the mixture, all of said dry ingredients having an average particle size of about 3.3 microns and a maximum of 44 microns.

References Cited in the file of this patent

UNITED STATES PATENTS

1,318,838 Braun ------------------ Oct. 14, 1919 1,442,413 Olsson ---------------- Jan. 16, 1923

2,144,532 Hall --------------- Jan. 17, 1939 2,311,228 Heaney -------- Feb. 16, 1943


FOREIGN PATENTS

674,477 Great Britain ---------- June 25, 1952

OTHER REFERENCES