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MULTIPLE FLUX

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This invention relates to ceramics, and more particularly has reference to a flux for whiteware bodies.

Heretofore the flux used in the manufacture of whiteware bodies has usually been solely of a feldspathic nature. In some few instances other compounds have been added in small amounts to such feldspathic materials, as for instance talc, whiting, and magnesium carbonate. These additive compounds have been used principally for the purpose of reducing the moisture expansion, and in some cases as auxiliary fluxes to the feldspathic material.

In all such prior fluxes, there have resided certain objectionable features.

By my invention I have provided a flux which is more economical than the fluxes of the prior art in that the cost per active unit is less than the previously used fluxes, and also an economy in fuel is made possible by virtue of the fact that a lower firing range is permissible. Furthermore, a longer maturing range is possible which tends to obviate warpage of the ware. And the finished body possesses greater mechanical strength and is freer from discoloration than is the case with wares heretofore available.

In general, my invention embraces the concept of a multiple flux composed of a number of materials. More specifically, each of these individual materials is a compound containing an element from the alkaline metals, alkaline earth metals, and/or magnesium families. In the preferred form of my invention one of these compounds is always a feldspathic material.

For reasons of economy, I prefer to use natural minerals rather than pure chemical compounds, although it will be appreciated, of course, that such chemically pure compounds may be used if the exigencies of the situation should so dictate. As instances of the more desirable materials containing elements of the alkaline metal family, I might list: orthoclase, microcline, albite, anorthite, nephelite, nepheline syenite, lepidolite spodumene, cryolite, and amblygonite. Materials containing the alkaline earth metals may be: apatite fluorspar, baryta, barytes (barite), bone ash, whiting, English chalk, witherite dolomite, wollastonite, diopside, colemanite and ulexite. And the more preferable materials containing elements of the magnesium family are: beryl, zinc oxide, willemite, magnesite, French chalk, talc, soapstone and steatite.

The specific ingredients of my multiple flux, and the relative percentage of such ingredients, will be dictated by various considerations in any particular instance—for example, the relative costs of the specific ingredients, the physical properties of the ware to be produced, the uses to which such ware is to be put, etc. For instance, I have used the following ingredients, and amounts, in the manufacture of a semi-vitreous dinnerware body: nepheline syenite, 50%; fluorspar (CaF_2), 15%; barium carbonate ($BaCO_3$), 5%; cryolite (Na_2SiF_6), 5%; talc ($3MgO\ 4SiO_2 2H_2O$), 10%; whiting ($CaCO_3$), 5%; and ulexite (calcium borate), 10%. It will be noted that these materials are water insoluble, basic in character, free from discoloration, and are not easily reducible.

The ingredients of this multiple flux were mixed for two hours in a ball mill, and a test cone was then fired and showed a P. C. E. of 010–011.

Ten pounds dry weight of the body was prepared. The above mentioned multiple flux, at the rate of 5% of the total mass, was used with 35% flint, 30% English China clay, 18% Jernigan ball clay, and 12% Champion and Challenger ball clay. The required weight of ball clay for the body was weighed out after crushing the lumps to a half-inch size, allowance being made for the water content of the ball clays. The materials were blunged with warm water for two and one-half hours in a propeller type blunger at a specific gravity of 1.30, and then passed through a 120-mesh screen and a magnetic separator. It was then dried to the desired consistency in plaster molds and thoroughly wedged by hand.

The body produced in accordance with the above procedure was tested in accordance with the standard testing procedure of the American Ceramics Society, and the following results developed:

Water of plasticity	percent	26
Dry shrinkage	do	5.7
Fired shrinkage (total):		
Cone 01	do	8.5
Cone 5[3]	do	9.7
Cone 7	do	11
Cone 9–10	do	12
Cone 12	do	12.4
Modulus of rupture:		
Cone 01	lbs./sq. in.	3725
Cone 4–5	lbs./sq. in.	4360
Cone 7	lbs./sq. in.	6200
Cone 9–10	lbs./sq. in.	7880
Cone 12	lbs./sq. in.	6825
Absorption:		
Cone 01	per cent	16
Cone 5[3]	do	11.2
Cone 7	do	7.4
Cone 9–10	do	3.7
Cone 12	do	3.5

The improved results obtained by the use of a multiple flux in accordance with my invention are apparent from the above. Of paramount

significance is the fact that with only 5% of my multiple flux (as compared to the usual 12% of a feldspathic flux) I attained greater vitrification, as shown by the absorption properties. It will be noted that when the body was fired to cone 9–10, it had an absorption value of 3.7%, whereas most semi-vitreous bodies have an adsorption value of 8% when fired to this cone. Thus 5% of the multiple flux produced more action than 12% of feldspar to secure the absorption value of a typical semi-vitreous body, it was necessary to fire the above described body to only cone 7. Furthermore, inasmuch as feldspar deforms as a cone at cone 8, whereas the multiple flux mentioned above deforms as a cone at cone 010, an appreciably lower temperature is possible when using a multiple flux. And finally, it will be noted that the ware formed from a multiple flux, when used as above described, posseses a greater mechanical strength than ware that is merely fluxed with feldspar.

Of course, the economy, resulting both from the decreased fuel consumption, and also the savings effected by the smaller amount of flux required (notwithstanding the fact that some of the ingredients may be more expensive per unit), is apparent. Another advantage residing in the use of multiple fluxes arises from the fact that such fluxes might be readily mixed by a producer of raw materials, and then shipped, in a ready-mixed condition, to the plants where the whiteware products are being manufactured.

As suggested above, various combinations of the ingredients may be used, and the above specific example is merely illustrative of the principle. Furthermore, while I have referred particularly to semi-vitreous dinnerware, it will be appreciated that multiple fluxes may be used in all ceramic bodies where a flux is necessary.

In general, my invention is to be defined solely by the scope of the appended claims.

I claim:

1. A ceramic flux comprising feldspathic material and at least three other compounds, each of said other compounds containing an element from the alkali family, the alkaline earth family, or the magnesium family, and said compounds being basic in character, water insoluble, free from discoloration, and not easily reducible.

2. A ceramic flux comprising at least four compounds, each compound containing an element from the alkali family, the alkaline earth family, or the magnesium family, said flux having a P. C. E. of not more than 010–011.

3. A ceramic flux comprising a feldspathic material, and at least three other compounds, each of said last mentioned compounds containing an element from the alkali family, the alkaline earth family, or the magnesium family.

4. A ceramic flux comprising a feldspathic material, and a plurality of other compounds, said other compounds containing elements from the alkali family, alkaline earth family, and magnesium family, said flux having a P. C. E. of not more than 010–011.

5. A ceramic flux comprising a feldspathic material and at least three other materials selected from the group consisting of orthoclase, microcline, albite, anorthite, nephelite, nepheline syenite, lepidolite, spodumene, cryolite, amblygonite, apatite, fluorspar, baryta, barytes (barite), bone ash, whiting, English chalk, witherite, dolomite, wallastonite, diopside, colemanite, ulexite, beryl, zinc oxide, willemite, magnesite, French chalk, talc, soapstone and steatite.

6. A ceramic flux comprising substantially the following: nepheline syenite, 50%; fluorspar (CaF_2), 15%; barium carbonate ($BaCO_3$), 5%; cryolite (Na_2SiF_6), 5%; talc (3Mgo $4Sio_2 2H_2O$), 10%; whiting ($CaCO_3$), 5%; and ulexite (calcium borate), 10%.

7. A ceramic flux comprising at least three compounds in addition to a feldspathic material, one compound containing at least one element from the alkali family, another compound containing at least one element from the alkaline earth family and another compound containing at least one element from the magnesium family.

8. A ceramic flux comprising at least one compound of the alkali family, at least one compound of the alkaline earth family, and at least one compound of the magnesium family, said alkali-family material predominating substantially in the flux and consisting at least in part of a nepheline-containing substance.

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