EFFECT OF Li_2O ON THE WHITENESS OF ENAMELS FOR ALUMINUM

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The whiteness of opaque titanium-dioxide silicate enamels for aluminum depends not only on the content of TiO_2 but also on the content of Li_2O which is an opacifying activator.

The activation effect of Li_2O has quite a complex character.

Above all Li_2O is an excellent flux and seriously reduces the viscosity of the glass in the enamel during firing of it on to aluminum, creating thereby optimum conditions for intensive transition of part of the TiO_2 into the opacifying phase.

Furthermore, the strong polarizing effect of the cations Li^+ with relatively low polarization of the Ti^{+4} also is important.

The effect of Li_2O on the opacification of leadless silicate enamels for aluminum with titanium dioxide is seen from the following experiment. If in enamel of composition (in weight part): 28.96 SiO_2, 17.0 TiO_2, 6.96 B_2O_3, 2.0 Al_2O_3, 6.0 SnO_2, 4.5 Li_2O, 13.08 K_2O, 18,12 Na_2O, developed at a firing temperature of 580°, whiteness about 78%, all the Li_2O is replaced in equivalent quantities by Na_2O or K_2O, then in the same conditions of firing for aluminum enamel the coating becomes clear, although the quantity of opacifier (TiO_2 and SnO_2) remain as previously. The firing of this nonlithium enamel at higher temperatures of 600°, 620°, and 630° does not give rise to opacification.

The above position was confirmed also in experiments with other enamels (Fig. 1 and 2). In Fig. 1 enamel No. 959 is nonlithium. Its composition in weight parts is: 36 SiO_2, 10 TiO_2, 6 SnO_2, 8 B_2O_3, 2 P_2O_5, 23 Na_2O, 12 K_2O. In enamel No. 951 there are four parts by weight of Li_2O. The composition is as follows: 38 SiO_2, 8 TiO_2, 6 SnO_2, 8 B_2O_3, 2 P_2O_5, 19 Na_2O, 12 K_2O, 4 Li_2O. The composition of enamel No. 955 (see Fig. 2) is 28 SiO_2, 18 TiO_2, 6 SnO_2, 8 B_2O_3, 2 P_2O_5, 23 Na_2O, 12 K_2O.

An increase in the nonlithium enamel of the content of TiO_2 at the expense of SiO_2 to the maximum possible quantities has very little influence on the coefficient of diffuse reflection and permits us to obtain on the aluminum only gray enamel coatings.

The introduction into the enamel (instead of Li_2O) of other oxides, such as MgO, CaO, BaO, SiO, P_2O_5 did not give the expected positive results.

Without Li_2O it is impossible to obtain opacified (TiO_2) leadless silicate enamels for aluminum with high percentage of whiteness.

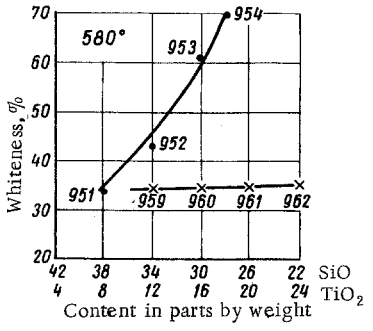

Fig. 1

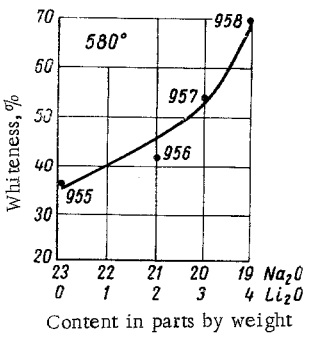

Fig. 2

Translated from Steklo i Keramika, No. 10, pp. 23-24, October, 1966.

Since a high percentage of whiteness of leadless boron-titanium silicate enamelsproved to be possible only in the presence of both TiO_2 and Li_2O, then naturally the question arises as to the optimum ratio of these oxides.

Investigation showed that the high percentage of whiteness (70-80%) with excellent development of other properties in leadless silicate enamels for aluminum can be obtained with a ratio of 1 Li_2O: (1.5-2) TiO_2 and a total content of TiO_2 of 18-21% by weight.