temperatures and rapidly cooled down in air to room temperature. As examples, the changes in density with time are shown in Table 1-a, b and c.

Table 1. Change in Density (g./cm³.) at Room Temperature with Time of Heat Treatment.

(a) 540°C

Time (min.)	Density Increase	Density Decrease
0	2.4887 (1)	2.4975 (2)
2.5	2.4918	2.4958
5	2.4924	2.4949
10	2.4927	2.4936
20	2.4928	2.4928

(b) 530°C

Time (min.)	Density Increase	Density Decrease
0	2.4887 (1)	2.4975 (2)
2.5	2.4916	2.4966
5	2.4926	2.4964
10	2.4935	2.4957
20	2.4938	2.4951
40	2.4939	2.4948
80	2.4941	2.4944
120	2.4942	2.4942

(c) 460°C

Time (hr.)	Density Increase	Density Decrease
0	2.4887 (1)	2.5003 (3)
2.5	2.4961	2.5003
5	2.4971	2.5004
10	2.4983	2.5005
20	2.4992	2.5006
40	2.5000	2.5013
80	2.5010	2.5017
280	2.5023	2.5020

(1): Density of rod-as-drawn, 4mm. in diameter. (2) and (3): Density of samples treated at 480°C for 4hrs. and 10 days respectively.

From the above figures, it is shown that the change in density, D, with time, t, can not be represented by the relaxation equation of Maxwell type: $d(D_T-D)/dt=k_1\cdot(D_T-D)$, where D_T is equilibrium density at temperature T°C, nor of Adams-Williamson type: $d(D_T-D)/dt=k_2\cdot(D_T-D)^2$, as the rate of change in density is extremely rapid while the difference, (D_T-D), is large and the rate decreases rapidly as D approaches to D_T. To interpret these figures, it seems imporant to take account of the change in viscosity of glass with time at constant temperatures in the annealing range.

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11. Factors Affecting Diffusion Velocity of Oxygen through Heat-Resistant Enamel Coatings

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At high temperatures, oxygen in air diffuses through an enamel layer and reacts with the base metal. Therefore, the property to prevent the diffusion of oxygen is most essential for the heat-resistant enamel. In order to acquire fundamental knowledge about factors which affect the diffusion velocity of oxygen, the authors measured succesively the volume of oxygen, which diffuses through an enamel layer during heating at 800°C. The method used for the measurement is the same as reported by one of the authors (Jap. Ceram. Assoc. 1949, **57**, 96). With a few exception, the frits now generally applied as the heat-resistant coatings were used for the present experiments. Their compositions, mill additions and fusibilities are shown in Table 1. The fusibility is represented by the ratio of the area of the enamel flowed down at the button-test. The application weight of enamel on low carbon steel plates was in all cases 4 gr. per sq. dm.

The diffusion velocities of oxygen for the various enamels determined from the experiments are shown at the end of Table 1.

Table 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	55.0	66.0	69.0	71.0	73.0	75.0	63.0	56.4	49.7	51.1
Al_2O_3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	7.2	7.4	7.6
Na_2O	15.0	15.0	14.0	13.0	11.0	9.0	13.0	10.5	10.6	10.9
K_2O	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.6	4.5	4.7
CaO	5.0	5.0	3.0	2.0	2.0	2.0	5.0	3.0	–	–
B_2O_3	15.0	4.0	4.0	4.0	4.0	4.0	–	9.9	9.3	9.6
CaF_2	–	–	–	–	–	–	–	4.2	3.9	4.1
TiO	–	–	–	–	–	–	–	–	–	12.3
ZrO_2	–	–	–	–	–	–	9.0	–	–	–
BeO	–	–	–	–	–	–	–	–	12.0	–
CoO	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	–
NiO	–	–	–	–	–	–	–	0.5	0.5	–
MnO_2	–	–	–	–	–	–	–	1.7	1.6	–
Total	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.5	100.0	100.3
	Frit 100, Clay 5.5, $MgSO_4$ 0.2									
Fusibility	1.00	0.65	0.59	0.45	0.37	0.27	0.44	0.70	0.37	0.24
Diffusion Velocity of Oxygen ($cc/min.cm^2$)	8.50	6.46	5.74	5.12	2.80	2.23	4.94	4.57	1.86	1.45 $\times 10^{-3}$

From these results the authors have reached to the following conclusions:

(1) The diffusion velocity of oxygen is mainly controlled by the fusibility of enamel. Their relasionship is in linearly inversproportional.

(2) The composition of the enamelf does not affect the diffusion velocity of oxygen, if the fusibility of enamels are the same.