cm; the radius of curvature: about 7 m).

The lens behind the covering is that of a Tessar Zeiss camera. (f=40 cm. 1: 4.5) And following modes of covering were used.

1. The edge vertical in front of the light source and the edge vertical in front of the camera lens.

2. The slit horizontal in front of the light source, (3.5 cm in horizontal length, 0.35 cm in vertical length) and the bar-stop.

3. The circular slit (r=0.35 cm) in front of the light source and the circular stop in front of the lens.

Thus we obtained various figures of Schlieren which vary as the mode of covering.

51. Bubbles in Glass. (II)

Deformation of Bubbles in Sheet Glasses.

Masao Mine and *Masatami Takeda*.

The characteristics of the shape of bubbles in the drawn sheet glass were studied to obtain knowledge on their deformation processes in shaping the glass. The relations among the length A, the width B and the thickness C of the typical bubble were found to be expressed as follows:

$$(A/D_0)=(B/D_0)^{N_A}, \qquad (C/D_0)=(B/D_0)^{N_C}$$

The constants N_A and N_C are determined by the type of deformation of glass and the observed value of N_A=1.8, N_C=0.4 for any drawn sheet glass. On the other hand, the constant length D_0, obtained by extrapolating the linear relations of $\log A : \log B$ and $\log C : \log B$ is determined by the degree of the deformation of glass and the observed value of D_0 for sheet glass of 2 mm thick made by the Colburn process is about 4.3×10^{-4} cm.

Three sections of the typical bubbles observed by microphotograph are found all to be made of curves of parabolic type, but all of these sectional curves lie between ellipse and quadratic parabola with axes of the same length. These results were verified by measuring the volume of fragments of relatively large bubbles by filling mercury therein. The diameter of the sphere having the same volume as the real bubble in sheet glass is estimated to be about 7 % less than that of the sphere having the same volume as the ellipsoide, with three axes, A, B and C.

52. Enamel Defects due to Hydrogen in Steel.

Megumi Tashiro and *Tsuneo Okamura*.

It is well known that hydrogen is absorbed by steel by the pickling operation.

However, it has not been quantitatively determined whether the hydrogen once absorbed during pickling could be perfectly driven off by the usual treatments, such as immersing in hot neutralizing solution, in hot water and drying below 100°C.

By the hot vacuum extraction method for the analysis of hydrogen in steel, the authors determined the quantities of hydrogen which remained in steel after the end of all the usual cleaning operations (pickling in 10 % H_2SO_4 soln. at 70°C for 5 min, neutralizing in Na_2CO_3 soln. at 70°C for 5 min, and drying at at 80°C for 3 min).

The initial quantities of hydrogen in steel which inherited from the steel manufacturing process were also determined with the sample which was only polished by the sand papers.

The test pieces used were the steel plates for enameling containing 0.05–0.10 % carbon, which are commonly used in Japanese enameling works.

The results of analysis are as follows, (1) When the steel plates are free from cavitites and blowholes, the quantity of hydrogen is about 2–4 c.c. per 100 g steel before as well as after the cleaning treatments, (2) When the steel plates have many cavities and blowholes found by microscope, the quantity of hydrogen increases nearly 3 times by the cleaning operations.

Therefore, the hydrogen once dissolved in steel during pickling operation can be completely driven off by the succeeding treatments, when the steel sheets contain no cavities which can be detected by microscope.

---

53. Studies on the Manufacture of Roofing Tiles "Kusube Gawara". (IV)

Ikutaro Sawai and *Kiyoshi Terada.*

The authors have published a series of papers (J. Ceram. Assoc. (Jap.) 57 (635) 19; (636) 43, 1949) on the studies of Japanese "Daruma" kiln which is generally used for the manufacture of roofing tiles.

It was revealed that the water vapour, which is an efficient diluent of hydrocarbon vapours in smoking period, acts to eliminate the beautiful graphitic color when it comes in contact with the hot stock surface in the cooling period.

The authors made some investigations to find the source of water vapour, which flows into the completely enclosed kiln. By field work and model experiments it was ascertained that the water vapour came from the flues of the kiln, as in the usual construction the flue is not covered by refractories.

When the firing is repeated more than 7~8 times the temperature at the depth