18. A Fundamental Study on Nodular Graphite Cast Iron. (III)

The Influence of the Chemical Compositions on the Graphitization Time of Pearlite in the As-cast Structures of Nodular Graphite Cast Iron

Shirō Morita and *Keiji Shimokawa*

(Sawamura Laboratory)

The influence of the chemical compositions on the annealing time required for the complete graphitization of pearlite cementite in the as-cast structures of nodular graphite cast iron was studied by means of the dilatometric method.

The method of the preparation of nodular graphite cast iron was the same as described in the 1st. Report.

The central part of the cast bar, 20 mm dia.×130 mm long, was longitudinally cut into four pieces and the dilatometric specimen, 5.5 mm dia.×70 mm long, was machined from each piece.

The test specimen was heated from the room temperature to about 890°C at the rate of 5°C/min. and was held at this temperature for a short time (there was little or no free cementite in the as-cast structures of those specimens), and then cooled down in the furnace at the rate of 3°C/min. When the abnormal expansion of the specimen ended at the Ar_1, the test specimen was constantly held at the temperature just below this ending temperature and the time required for the complete graphitization of pearlite cementite just after the abnormal expansion was measured by the dilatometer.

The following results were obtained:

(1) In the case of 0.030–0.046% Cr, the annealing time (the time required for the complete decomposition of pearlite cementite after the end of the abnormal expansion at Ar_1) considerably decreased with the increase of (T. C+Si)% up to 5.2%, but gradually decreased with the further increase, and considerably decreased with the increase of (G. C+Si)% up to 4.8% or with it of (C. C+Si)% up to 2.3%. But on the contrary, in the case of 0.17–0.25% Cr, the annealing time increased with the increase of (C. C+Si)%, and decreased with the increase of (T. C+Si)% or (G. C+Si)%.

(2) The increase of the silicon content reduced the annealing time and in the case of 2.3–2.4% Si there was no remarkable difference in annealing times obtained, irrespective of carbon content.

(3) The annealing time decreased with the increase of (G. C)% and increased with the increase of (C. C)%.

(4) The annealing time remarkably increased with the increase of the chromium content and the effect of chromium was stronger in the lower silicon content.

When the silicon content was higher than about 2.8%, there was little influence of chromium up to about 0.1%.

(5) There was no influence of magnesium on the annealing time up to about 0.2% Mg, but with the further magnesium content the graphitization of pearlite cementite of nodular graphite cast iron seemed to be slightly hindered.

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19. Particles Size Determination by the Electron Microscope and the Light Scattering Measurement

Keinosuke Kobayashi and *Hiroshi Inagaki*

(Horio Laboratory)

The intensity of the light scattered by the particles in solution depends on the angle at which it was observed, when the particle dimension is more than one twentieth of the wave length of incident beam. There is a dissymmetry in the angular distribution of the intensity, and the dissymmetry correlates intimately with size and shape of the solute particles. The relations of this effect to the dimension of the molecules have been evaluated by P. Debye for spherical, rod-like and random coiled particles in extreme dilution. (J. phys. colloid Chem., **51**, 18, 1947).

The experimental procedure consists of measuring the ratio of relative intensities $I(\theta_1)/I(\theta_2)$ of the light scattered at two different angles θ_1 and θ_2. If we adopt the dissymmetry coefficient [q] defined by B. Zimm as $[q]=I(\theta_1)/I(\theta_2)-1$ and $\theta_2=180°-\theta_1$, then from the Debye's calculations it is possible to evaluate L which shows the dimension of the particles in various shapes.

In order to verify the above theoretical relations and to test the accuracy of our arrangement (K. Kobayashi and H. Inagaki, J. Chem. Soc. Jap an (in press) and H. Inagaki, Shimazu Rev. 8, 16, 1951), the particle size of the suspension of polystrene obtained with the emulsion polymerization, was determined on one hand by the [q]-measurement, on the other hand by an electron-microscope. The diameter of particles was found to be 1200Å, by [q]-measurements, using the experimental values, [q] $50°\sim130°=0.56$, [q] $55°\sim125°=0.50$ and [q] $60°\sim120°=0.93$ with $\lambda'=5461$ Å/n, where n is the refractive index of the solution. This agrees closely with the value obtained from electron-micrographs on the same sample, which was 1230Å in average. On the determination of particle size by electron-micrographs, only the images of particles appearing in the central area of photographic plates were subjected to the measurement, to avoid the error based on the distortional aberration of the microscope.
