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Numerical Value Evaluation of Graphite Morphology and Mechanical Property of Flake Graphite Cast Iron

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The variations in graphite morphology have been classified, together with the length of the flakes, by standards that have been utilized for many years. K-FGI(KIRIU Flake Graphite Structure Index)of graphitic structure using an image analyses was proposed to estimate the graphite shape and the size of flake graphite cast iron newly here. The obtained supposition graphite area is divided by 100μm of supposition graphite length. The calculated value was defined as TTR(Thick Thin Ratio). Using K- FGI, the influence of the graphite shape on the thermal conductivity, the tensile strength and the hardness of flake graphite cast iron was investigated. The mechanical property and the thermal property were influenced by the graphite morphology and distribution of flake graphite cast iron.

Keywords: *Cast Iron, Graphite morphology*,

1. Introduction

The mechanical property, the physical properties and the electric properties of the cast iron are governed in part of by the graphite shape, size amount and distribution. Up to now, the graphite shape and the distribution are only applied to the numerical value to the graphitic structure of cast iron by graphite spheroidization ratio about simple spheroidal graphite cast iron and compacted vermicular graphite cast iron relatively. A method for evaluating graphite flake distribution and size in given in ASTM A 247. There are five graphite classifications from type A to type E graphite about the size of the graphite and the distribution by flake graphite cast iron. The large flakes are desirable in applications requiring high thermal conductivity and damping capacity.

Small flakes, because they disrupt the matrix to a lesser extent, are desired when maximum tensile properties. But graphite shape is not estimated numerically.

In this paper, estimation of the graphite shape (the length of the graphite and the thickness) by the numerical value was studied, and the mechanical property and thermal properties of the cast iron based on the flake graphite structure index were suggested.

2. Experimental procedure

2.1 Melting of cast iron

All of the iron samples were produced in a high frequency induction furnace (10kHz, 20kW). The charging materials consisted of high purity pig iron, Fe-75%Si, Fe-72%Mn and Fe-50%S. The target chemical composition is 3.1-3.6%C, 1.8-2.3%Si, 0.5%Mn, 0.02%P and 0.02%S. Each molten iron temperature was raised to 1753K and inoculated at 1723K by Fe-75.5%Si inoculant. After this, the molten iron was poured into CO_2 mold at 1673K.

2.2 Measurement of the number of graphite

A picture of graphitic microstructure of 100 times of magnification is indicated on the monitor with the resolution with 1920 X 1080 dots using CCD camera more than 1,500,000 numbers of pixels. 1000 X 1000 dots of measurement area are set on the indication monitor screen. The number of graphite of more than 5μm of average diameter in the area is measured. The number of measured graphite was defined as KFGI (Kiriu Flake Graphite structure Index).

2.3 Definition of Thick Thin Ratio

A picture of graphitic microstructure of 100 times of magnification is indicated on the monitor with the resolution with 1920 X 1080 dots using CCD camera more than 1,500,000 numbers of pixels. 1000 X 1000 dots of measurement area are set on the indication monitor screen. The length of the graphite and the area are measured about all graphite from 50 to 150μm in the area. The area of the graphite is checked about supposition graphite of 100μm length near the median length of the graphite in the area. The obtained supposition graphite area is divided by 100μm of supposition graphite length. The calculated value was defined as TTR (Thick Thin Ratio).

3. Result

Fig.1 shows a relation between graphitic micro-structure with the various shapes and the number of graphite. It was possible to indicate A type graphite in KFGI of 40-250. The E type graphite is 251-350 KFGI. D type graphite is more than 351KFGI.

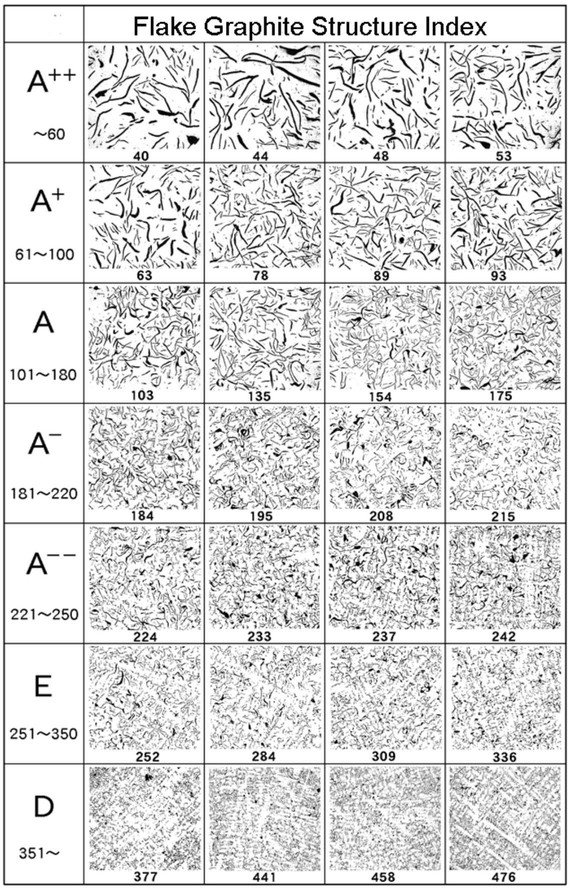

Fig.1 Relation between graphitic microstructure and KFGI.

Fig.2 shows Thick Thin Ratio(TTR) of samples. The number of graphite by each graphitic microstructure was 90KFGI, but respective Thick Thin Ratio (TTR) was different. When the thickness and thinness of the graphite are converted into rectangular latitude of 100μm of length, the size of the flake graphite is the index to show the tendency of the thickness of the graphite in spite of the size of the graphite and the relative length of the graphite. It is possible to make it the means to compare graphitic microstructure.

Fig.3 shows a relation between thermal conductivity and KFGI.

Fig.4 shows a relation between thermal conductivity and Thick Thin Ratio. As Thick thin ratio is increased, thermal conductivity is increased.

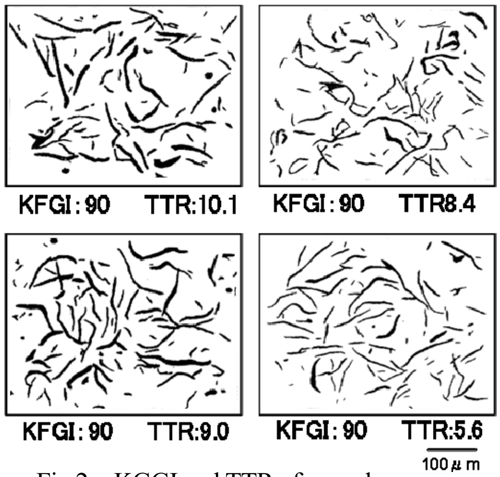

Fig.2 KGGI and TTR of sample

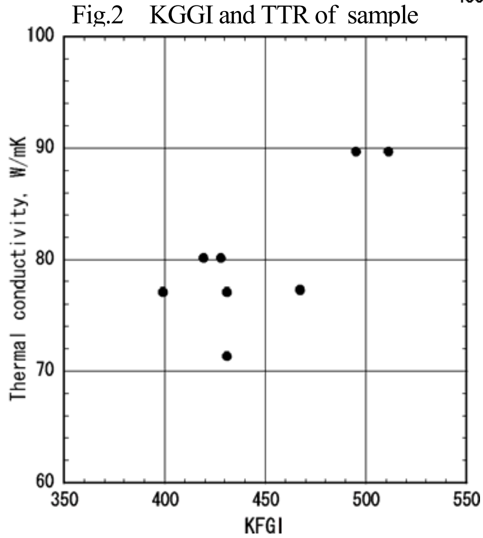

Fig.3 Relation between thermal conductivity and KFGI

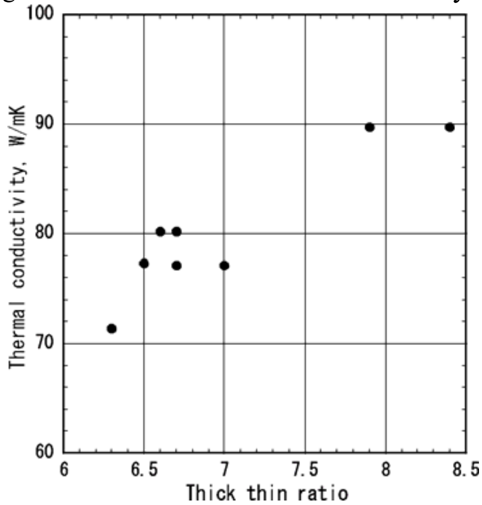

Fig.4 Relation between thermal conductivity and TTR

4. Conclusion

1) It was possible to show graphite shape at KFGI and Thick Thin Ratio.
2) A type graphite was indicated by 40-250KFGI.
3) As thick thin ratio is increased, thermal conductivity is increased.