High Density Isotropic Carbon Blocks KMFC Made from Coal Tar Pitch*1

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1 Introduction

Carbon block, with its many excellent features, is widely used in various fields. However, it also has several drawbacks. For instance, since it is produced, in general, by mixing and kneading of a binder and filler coke, the production process is complicated, thereby making it difficult to attain high density and high strength. Further it is frequently a disadvantage, when viewing carbon block as a special carbon material, that it is anisotropic.

After extended research into measures for dealing with these problems, the authors have sucessfully developed a carbon powder, **Kawasaki Mesophase Fine Carbon** (Brand name: **KMFC**), produced from coal tar pitch as an original. It is possible, with KMFC, to manufacture, without using a binder, isotropic carbon blocks having higher density and higher strength than conventional products on the market. This paper describes the characteristics of KMFC powder and the physical properties of KMFC blocks.

2 Manufacturing Method for KMFC

KMFC is manufactured by the solvent-extraction and separation of mesophase spheres, which are generated when coal tar pitch is given heat treatment, and a portion of the pitch component, followed by refining treatments. The manufacturing process is shown in **Fig. 1**.

The manufacturing process consists of heat treatment of coal tar pitch, which is the original raw material, followed by the four steps of solvent extraction, filtration, calcination, and classification. Through this process, it has become possible to manufacture KMFC, from which high-density isotropic carbon blocks can be obtained, in an commercially stabilized manner.

3 Properties and Features of KMFC

Properties and features of KMFC are enumerated below.

(1) Fine Carbon Powder

A scanning electron micrograph of KMFC is shown

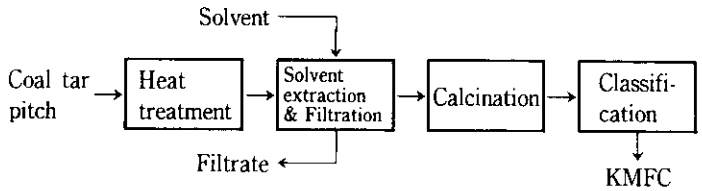

Fig. 1 Manufacturing process for KMFC

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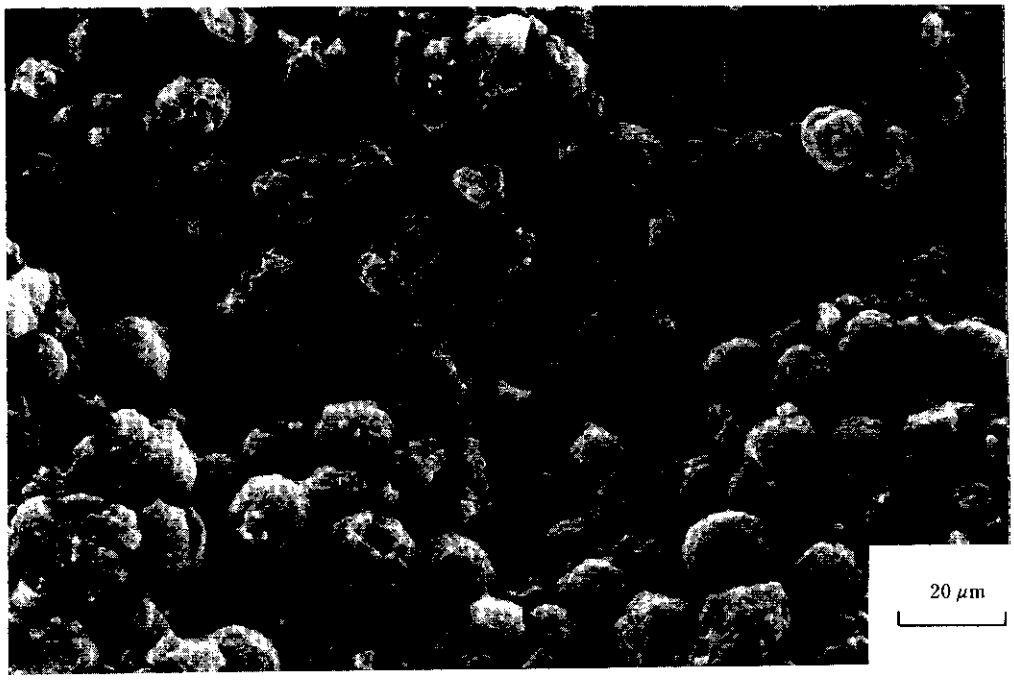

Photo 1 Scanning electron micrograph of KMFC

in **Photo 1**. KMFC is a powder and is of spherical shape with an average particle diameter of about 10 to 15 μm.

(2) Excellent Self-binding Capacity
Proximate and ultimate analysis values of KMFC are shown in **Table 1**. Since KMFC has a high self-binding capacity, high density, high strength carbon blocks can be manufactured without use of a binder.

(3) Isotropy
KMFC itself has a structure similar to graphite and is anisotropic, but since it consists of spherical particles, these show a random arrangement on forming, and are isotropic in the formed body.

Table 1 Proximate and ultimate analysis values

(%)

Proximate analyses				Ultimate analyses				
BI*	QI**	VM***	Ash	C	H	N	S	O
97.0	95.0	8.0	0.2	93.1	3.1	1.5	0.3	2.0
∫	∫	∫	∫	∫	∫	∫	∫	∫
98.0	85.0	12.0	0.1	93.5	2.9	1.0	0.2	2.4

*BI : Benzene insoluble
**QI : Quinoline insoluble
***VM: Volatile matter

4 Manufacturing Method for KMFC Blocks

The manufacturing method for KMFC carbon blocks, in comparison with that of conventional carbon blocks (current method), is shown in **Fig. 2**. The KMFC method is simpler than the conventional method, because the steps of kneading with a binder or impregnation are not required in order to obtain high density.

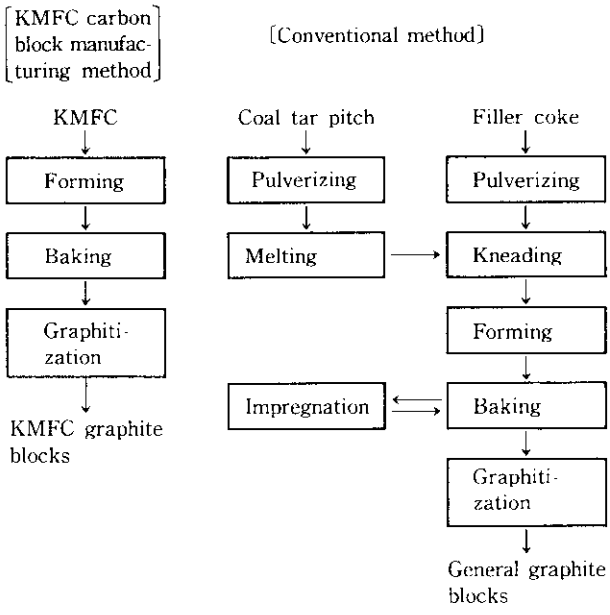

Fig. 2 Comparison between manufacturing method for KMFC carbon blocks and current method

5 Chacteristics of KMFC Carbon Blocks

Physical property values of KMFC carbon blocks, which have been given graphitization treatment at about 2 500°C, are shown in **Table 2**. Results indicate that KMFC carbon blocks have two to three times the mechanical strength value and twice the fracture toughness value of general isotropic graphite currently available commercially. The anisotropic ratio in the measurement of the thermal expansion coefficient reaches 1.01, indicating nearly perfect isotropy.

Table 2 Physical properties of KMFC graphite blocks

	KMFC graphite blocks	General isotropic block(Comparative material)
Bulk density (g/cm³)	1.90	1.74
Shore hardness	85	45
Bending strength (kg/cm²)	1 000	280
Electrical resistivity (μΩ·cm)	1 400	1050
Compressive strength (kg/cm²)	1 850	605
Young's modulus (kg/mm²)	1 300	—
Fracture toughness (MN/m$^{3/2}$)	2.22	1.04
Thermal expansion coeff.(10^{-6}/°C)	6.0	3.4
Thermal expansion coeff. anisotropic ratio	1.01	1.14

6 Applications of KMFC Carbon Blocks

Major applications of KMFC carbon blocks are as follows:

(1) Electro-discharge Machining
Electrodes for electro-discharge machining
(2) Metallurgical Use
Jigs, hot press molds, continuous casting nozzles, crucibles, etc.
(3) Machine Use
Bearings, mechanical seals, piston rings, etc.
(4) Electrical Use
Motor brushes, trolley shoes, etc.
(5) Nuclear Applications

References

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