International Journal of Cast Metals Research

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ycmr20

Effect of microstructure on the hardness of ASTM A48 class 20 flaked graphite cast iron

Manojkumar V. Sheladiya, Shailee G. Acharya & Ghanshyam D. Acharya

To cite this article: Manojkumar V. Sheladiya, Shailee G. Acharya & Ghanshyam D. Acharya (2022): Effect of microstructure on the hardness of ASTM A48 class 20 flaked graphite cast iron, International Journal of Cast Metals Research, DOI: 10.1080/13640461.2022.2093586

To link to this article: https://doi.org/10.1080/13640461.2022.2093586

Published online: 05 Jul 2022.

INTERNATIONAL JOURNAL OF CAST METALS RESEARCH
https://doi.org/10.1080/13640461.2022.2093586

Taylor & Francis
Taylor & Francis Group

RESEARCH ARTICLE

Effect of microstructure on the hardness of ASTM A48 class 20 flaked graphite cast iron

Manojkumar V. Sheladiya[a,b], Shailee G. Acharya[c] and Ghanshyam D. Acharya[d]

[a]Research Scholar, Gujarat Technological University (GTU), Ahmedabad, Gujarat, India; [b]Faculty of Engineering & Tech, Atmiya University, Rajkot, Gujarat, India; [c]Mechanical Engineering, Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat, INDIA; [d]Mechanical Engineering, Atmiya University, Rajkot, Gujarat, India

ABSTRACT
In foundries, it becomes necessary to minimise the machining allowance for economic reasons. It will save resources and costs by reducing the energy and expenses incurred on re-melting, machining and tooling. A deeper understanding of the complicated microstructures developed within about 3.5 mm of the mould-metal interface is necessary. The current research work uses a unique experimental design that involves performing surface and subsurface microscopy and spectroscopy at 0.5 mm intervals from the as-cast surface to a depth of up to 3.5 mm for three samples. The objective is on evaluating microstructure for determining graphite flake size, distribution, grouping, pearlite and ferrite percentage, and different elements. All three samples were subjected to a hardness test, which is a measure of machinability. The relationship between hardness as a single response to percentage presence of elements, graphite distribution and pearlite has been established using statistical analysis.

ARTICLE HISTORY
Received 1 December 2020
Accepted 20 June 2022

KEYWORDS
Mould-metal interface; Sub-surface; flake graphite size; hardness; machinability

Introduction

Casting Technology is 6000 years young process, and the contribution of the grey cast iron is 45% in major cast metals [1]. No-bake sand binders system is swiftly developing technology and is universally acceptable in the current era considering the benefits of dimensional stability, surface accuracy, low hardening time and usage of reclaimed sand for economic justification [2,3].

In the no-bake family, furan no-bake casting process employs resins and acid catalyst to form a furan binder system. However, this process configures castings with augmented strength and quality surface finish. But it is facing the limitation of cast skin thickness development of a minimum of 3.5 mm and must be removed by machining.

The casting process is called the process of uncertainty. With the latest development in the field of solidification simulation software, metallurgy, and machining, the uncertainty reduced to a great extent. Still, the field is open for research in casting metallurgy. Grey Irons (G.I.) is characterised by the presence of a large portion of its carbon in the form of graphite flakes.

Figure 1 indicates the graph of annual casting production from the 50th Census of the world casting production and almost 45% contributor is of grey cast iron alone. So, research on the grey cast iron is impactful.

To ensure the quality of a grey iron casting product, it is necessary to understand and correctly use the methodologies of characterisation and evaluation of mechanical properties that are used in the industry, but also applying technical and scientific knowledge to explain the results observed [4].

Most castings retain most of the as-cast surface. This surface layer (the casting skin) includes both surface and subsurface features. Because of the casting skin, the mechanical properties of the part are typically significantly lower than those found on standard ASTM machined specimens [5].

Castings are produced by a manufacturing method which gives the components properties that are dependent on design, metallurgy, and casting method. The wall thickness influences the resulting coarseness and type of microstructure and the material will have properties dependent on local metallurgical and thermal history. If the microstructure is determined or predicted at a given point, it is possible to calculate the local material properties and its deformation behaviour [6].

Most of the relationships between mechanical properties and experimental measurements are limited to the small data set conducted by a single research project. In the study made by the University of Alabama at Birmingham, 2000 cast iron sample data were collected from the literature. Statistical analysis was done to compare predicted mechanical properties and experimental measurements [7].

CONTACT Manojkumar V. Sheladiya mvsheladiya@gmail.com Research Scholar, Gujarat Technological University (GTU), Gujarat, India Faculty of Engg. & Tech., Atmiya University, Rajkot, Gujarat, India