EFFECT OF HEAT TREATMENT ON MODIFYING THE MICROSTRUCTURE AND THE MECHANICAL PROPERTIES OF THREE GRADES OF DUCTILE CAST IRON

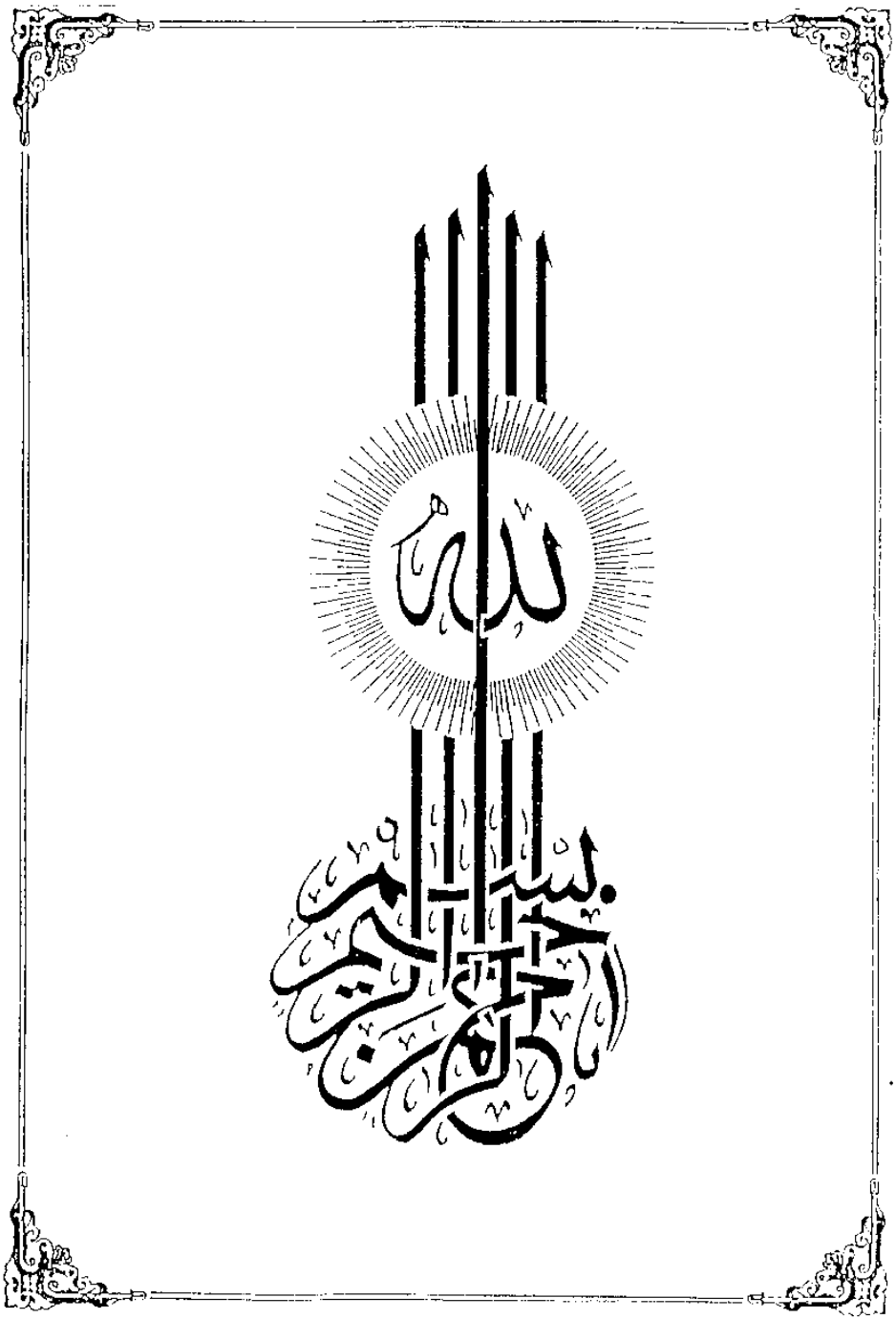
by

Eng. Mohallab M. El-Dawood

A thesis submitted to the
Faculty of Engineering at Cairo University
in partial fulfillment of the
requirements for the degree of
MASTER OF SCIENCE
in
MECHANICAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT

September 1999



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Approved by the

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1999

بسم الله الرحمن الرحيم

وقل ربي زدني علما

صدق الله العظيم

ABSTRACT

Ductile cast iron combines the principal advantages of gray cast iron (low melting point, good fluidity, castability, machinability, high vibration damping capacity and good wear resistance) with the engineering advantages of steel (high strength, toughness, ductility, hot workability and hardenability).

An experimental investigation was conducted on three grades of ductile cast iron: GGG 40, GGG 50 and GGG 60 (DIN 1693). Their "as cast " structure was: "spheroidal graphite, embedded in ferritic-pearlitic matrix".

The BHN of these three grades of ductile cast iron were: 150, 196 and 255, and their ultimate tensile strength were: 465, 545 and 662 N/mm^2 (as cast condition) respectively.

The critical temperature (Ac_3) was determined for each one of these three grades of ductile cast iron. They were quench hardened and tempered at different levels of temperature, using local made molten lead bath (or oil) crucible furnaces, with proper temperature control. By so doing, the matrix was changed to "tempered martensite" and a wide range of mechanical properties could be obtained at the different levels of tempering temperature.

It was found possible to increase the ultimate tensile strength of these three grades of ductile cast iron to: 1195, 1260 and 1280 N/mm^2 respectively. This maximum gain in tensile strength was accomplished when the tempering temperature was in the order of 400 °C to 450 °C. The described heat treatment is thus capable to increase the ultimate tensile strength of the three grades of ductile cast iron, *GGG 40*, *GGG 50*, and *GGG 60* by a factor of; 257%, 231%, and 193% respectively. These percentages are based on the ultimate tensile strength of each grade of ductile cast iron in the as cast condition.

Both optical and scanning electron microscopy (SEM) were used to study the changes in microstructure before and after heat treatment.

DEDICATIONS

To my dear Mother and Father

To my faithful Wife

To my lovely Children

To my dear Brothers and Sisters

ACKNOWLEDGEMENTS

The present work has been suggested by ***Prof. Samir Moustafa Riad****, to whom I am deeply thankful for his supervision, technical giudance, suggestions, invaluable advices and encouragement through the course of this work. I am deeply intented to him for his enthusiastic and effective scientific support*

I would like to express my deep sincere gratitude to ***Dr. Mahmoud Abd El-Rahman Adly****, for his sincere supervision, comments and generous guidance. I would like to thank him for his help through the practical work.*

I would like to thank ***Prof. AbdelHamid Hussein and Dr. E.M. El-Banna,*** *Department of Metallurgical Engineering, Faculty of Engineering, Cairo University, for their sincere help and suggestions through out this study.*

I am grateful to ***Dr. Ragaie M. R.****, Dept. of Mechanical Design and Production, Faculty of Engineering, Cairo University, for his fruitful discussions through the course of this study.*

Special thanks are due to ***Dr. Mohamad R. Taha****, Department of Mechanical Power Engineering, Faculty of Engineering, Cairo University, for his sincere help.*

I wish to thank all members of the Department of Mechanical Design and Production, Faculty of Engineering, Cairo University, for their help in conducting the experimental work.

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CHAPTER 3