NEW HEAT TREATMENT TECHNIQUE (TEMPERING-AUSTEMPERED IN SINGLE TREATMENT) FOR MATRIX TRANSFORMATION AND MECHANICAL PROPERTIES OF DUCTILE IRON

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2. Letter of Offer (Research Grant)

UNIVERSITI TEKNOLOGI MARA

PEMENANG Anugerah Kualiti Perdana Menteri 2008

Surat Kami : 600-RMI/ST/FRGS 5/3/Fst (124/2010)
Tarikh : 22 Mac 2010

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Y. Bhg. Prof/Prof. Madya/Dr./Tuan/Puan

KELULUSAN SKIM GERAN PENYELIDIKAN FRGS FASA 01/2010

Tajuk Projek	:	New Heat Treatment Technique (Tempering - Austempered in Single Treatment) for Matrix Transformation and Mechanical Properties of Ductile Iron
Kod Projek	:	600-RMI/ST/FRGS 5/3/Fst (124/2010)
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Ketua Projek	:	Bulan Abdullah

Dengan hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan pihak Kementerian Pengajian Tinggi melalui surat JPT.S(BPKI) 2000/011/010 Jilid. 2 (19) telah meluluskan cadangan penyelidikan Prof/Prof. Madya/Dr./Tuan/Puan untuk di biayai di bawah Skim Geran Penyelidikan Fundamental (FRGS) Fasa 1/2010.

Bagi pihak Universiti kami mengucapkan tahniah kepada Prof/Prof. Madya/Dr./Tuan/Puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

Untuk tujuan mengemaskini, pihak Prof/Prof. Madya/Dr./Tuan/Puan adalah di minta untuk menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

MUSTAFAR KAMAL HAMZAH
Ketua INFOREC
Merangkap Ketua Penyelidikan (Sains & Teknologi)

/RS.

5. Report

5.1 Proposed Executive Summary

A new heat treatment process which synthesized using the concepts from Austempered Ductile Cast Iron (ADI), Tempering and Quenching technology. The metallurgy of materials matrix transformation on each sequential cycle with different parameter such as time and temperature will be determine through the mechanical properties of ductile iron. Samples for the testing specimen will produce using the CO2 casting. The compositions of samples will be determined by using the spectrometer machine. The heat treatment process consists of Quenching, Austempering and new developed heat treatment process with different parameter such as time and temperature. The new developed heat treatment process will be synthesized using the concepts from Austempered Ductile Cast Iron (ADI) and Quenching technology. The microstructure of specimens will be observed on each sequential cycle of heat treatment process. The chemical information of matrix surface will gain through the energy Dispersive X-Ray spectroscopy (EDX). The hardness, impact (ASTM E23), tensile (TS 138 EN10002-1) and density test were carried out before and after heat treatment process. The fracture surface of the tensile and impact samples will examine under Scanning Electron Microscope (SEM). A treatment process is expected possessed the better mechanical properties compared to conventional heat treatment can be used for the specific application that suite the properties requirement such as in automotive part, heavy machinery and pipe industries. The scientific understanding of materials matrix transformation on each sequential cycle of new heat treatment technique will be contribute to a new knowledge for Metallurgical area.

5.3 Introduction

A branch of the cast iron family, ductile iron has recently become a subject of renewed interest because of its high-quality structural and mechanical properties and its competitive cost compared with other materials, such as grey cast iron and steel. The typical microstructure constituents of ductile iron normally comprised of ferrite, pearlite and spheroidal graphite. There are several types of ductile iron exist, and its name is designed according to the matrix presented, such as ferritic, pearlitic and ferritic-pearlitic. The microstructure constituents presented in the matrix directly influence the mechanical properties of ductile iron [1]. Hence, alloy elements usually have been added to promote the formation of certain microstructure constituents with desired properties, because it has a good effect on the microstructure of ductile iron.

However, such variation process is complex because it involves precise selection of several elements and compositions during casting. Moreover, the volume fraction of the presented matrix and the composition of alloy elements have a random and unstable relationship, which thus becomes difficult to predict. This could be seen in Hsu et al. [2] research which they added several combinations of alloying elements to manipulate the volume fraction of ferrite and pearlite. For the metallurgical, environmental and economic reasons thus, alloy elements have to be selected with proper and should be used as minimum as possible in order avoiding material wastage [3].

Aside from the addition of alloying elements, the heat treatment process is likewise effective in improving the mechanical properties of ductile iron. Heat treatment uses a metallurgical process that involves heating and cooling of ductile iron in its solid condition to alter the matrix structure without the use of alloying elements. Austempering is one of the trendiest heat treatment processes nowadays because it promotes the excellent strength and toughness to the ductile iron, by changing pearlitic-ferritic matrix into ausferritic. However, the practice is complex because it involves the usage of aqueous solutions as quenchant (salt bath solution). Proper selection of aqueous solutions is necessary because the volumetric heat capacity of quenchant has to be in accordance to the tempering temperature that would be applied to sample. The usage of aqueous also is uneconomic because it is consumable material and costly.