

INVESTIGATION OF THIN WALL DUCTILE IRON PARAMETER

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A report submitted in partial fulfillment of  
The requirements for the award of the degree of  
Bachelor of Mechanical Engineering  
With Manufacturing Engineering

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### **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this report and in my opinion this report is sufficient in term of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

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I hereby declare that this thesis entitled "*Investigation of Thin Wall Ductile Iron Parameter*" is the result of my own research except as cited in the references. The thesis has not been accepted for my degree and is not concurrently candidature of any other degree.

Signature

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## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	<b>TITLE</b>	<b>i</b>
	<b>SUPERVISOR'S DECLARATION</b>	<b>ii</b>
	<b>PANEL'S DECLARATION</b>	<b>iii</b>
	<b>STUDENT'S DECLARATION</b>	<b>iv</b>
	<b>DEDICATION</b>	<b>v</b>
	<b>ACKNOWLEDGEMENTS</b>	<b>vi</b>
	<b>ABSTRACT</b>	<b>vii</b>
	<b>ABSTRAK</b>	<b>viii</b>
	<b>TABLE OF CONTENTS</b>	<b>ix,x,xi</b>
	<b>LIST OF TABLES</b>	<b>xii</b>
	<b>LIST OF FIGURES</b>	<b>xiii</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>xiv</b>
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
1.1	Introduction	1
1.2	Importance of research	2
1.3	Problem Statements	2
1.4	Objective of the research	2
1.5	Scope of the research	3
1.6	Research methodology	3
	1.6.1 Literature Review	3
	1.6.2 Flow Chart	5
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	
2.1	Background of Study	6
	2.1.1 Induction Furnaces	6
	2.1.2 Raw material for Melting	7
2.2	Sandwich Treatment Process	9
	2.2.1 Treatment with Magnesium	9
	2.2.2 Sandwich Process	10

2.2.3	Inoculation of Ductile Iron	12
2.3	Moulding and Moulding Material	13
2.3.1	Rigidity of Mould	13
2.3.2	Greensand Moulding	14
2.4	Pouring,Running,and Feeding of Thin Wall Ductile Iron	14
2.4.1	Ladle Size and Capacity	14
2.4.2	Ladle Dimensions	15
2.4.3	Running Systems for Thin Wall Ductile Iron	15

### **CHAPTER 3 RESEARCH METHODOLOGY**

3.1	Introduction	17
3.2	Experiment Apparatus	17
3.2.1	Induction Furnaces	17
3.2.2	Ladle	18
3.2.3	Cavities	19
3.2.4	Greensand Mould	20
3.2.5	Ductile Iron	21
3.2.6	Magnesium Ferrosilicon	21
3.3	Parameters	22
3.3.1	Selecting Parameters	22
3.4	Experiment Methodology	23
3.4.1	Fabrication of Cavities	23
3.4.2	Fabrication of Mould	24
3.4.3	Magnesium Ferrosilicon Allocation	25
3.4.4	Melting the cast iron	26
3.4.5	Pouring and Fettling	26
3.4	Material Analysis	27
3.5.1	Metal Arc Spectrometer	27
3.5.2	Mastuzawa Digital Rockwell Hardness Tester RMT-3	27

**CHAPTER 4      RESULT AND DISCUSSION**

4.1	Result and Analysis	29
4.1.1	Composition of Thin Wall Ductile Iron	29
4.1.2	Magnesium Recovery for Thin Wall Ductile Iron	32
4.1.3	Hardness Test for Thin Wall Ductile Iron	33
4.2	Result and Discussion	36
4.2.1	The Affect of Sulphur Presence	36
4.2.2	Factors Influencing the Magnesium Recovery	38
4.2.3	Factors that Affect the Hardness of Thin Wall Ductile Iron	41

**CHAPTER 5      CONCLUSION**

5.1	Conclusion	44
5.2	Recommendations	46

<b>REFERENCES</b>	47
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**APPENDICES**

A	Gantt chart for first semester	49
B	Gantt chart for second semester	50

**LIST OF TABLES**

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
3.1	Thin wall thickness	23
4.1	Composition of cast iron	29
4.2	Composition of 5mm thin wall ductile iron	30
4.3	Composition of 7mm thin wall ductile iron	30
4.4	Magnesium recovery of 5mm thin wall ductile iron	32
4.5	Magnesium recovery of 7mm thin wall ductile iron	32
4.6	Rockwell hardness test result of 5mm thin wall ductile iron	33
4.7	Rockwell hardness test result of 7mm thin wall ductile iron	34
4.8	Brinell hardness number (BHN) for thin wall ductile iron	34
4.9	Sulphur properties	36
4.10	Magnesium properties	37
4.11	Carbon properties	37



## LIST OF FIGURES

<b>Figure No.</b>	<b>Title</b>	<b>Page</b>
1.1	The flow chart for final year project	5
2.1	A graphite flakes in a matrix	8
2.2	The influence of matrix structure	8
2.3	The height to diameter ratio	11
2.4	The affect of inoculation to the presence of nodule numbers	12
2.5	Holding time affect the presence of nodule numbers	13
2.6	Gating ratio is (sprue exit):(total runner area):(total ingate area)	16
3.1	Types of sandwich pocket	18
3.2	Height to diameter ratio	19
3.3	Thin wall cavities	20
3.4	Green sand mould	20
3.5	Parameters that affect thin wall ductile iron	22
3.6	5mm thin wall cavity	24
3.7	7mm thin wall cavity	24
3.8	Thin wall cavities	25
3.9	Steps for performing hardness test	28
4.1	The graph of magnesium composition	31
4.2	The graph of magnesium added against hardness	35

**LIST OF ABBREVIATIONS**

Al	Aluminum
Ba	Barium
BCIRA	British Cast Iron Research Association
BHN	Brinell Hardness Number
BID	Brinell Indentation Diameter
C	Carbon
Ca	Calcium
EDX	Energy Dispersive X-ray
Fe	Ferum
FeTi	Ferrotitanium
Si	Silicon
LCD	Liquid Crystal Display
Mg	Magnesium
MgFeSi	Magnesium Ferrosilicon
MgS	Magnesium Sulphide
S	Sulphur
SEM	Scanning Electron Microscope
Sr	Strontium
Ti	Titanium
TiFeSi	Titanium Ferrosilicon
Zr	Zirconium

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## **ABSTRACT**

This thesis deals with thin wall ductile iron parameter. There are two main objectives of this research, firstly, to investigate the processing parameter of thin wall ductile iron by using Sandwich method and to investigate the process design parameter for thin wall ductile iron. The cast iron has graphite in a matrix called pearlitic. The graphite shape is flake which is has lower strength. The study of graphite changes from flake form to nodular form by adding magnesium ferrosilicon as inoculation agent is under consideration. The ductile iron form is enhanced in strength and other mechanical properties. However, the thickness of thin wall is related to the composition of the magnesium adding. Green sand casting is one of the method for converting cast iron to ductile iron. The thesis describes the method of green sand casting by using Sandwich technique to get the thin wall ductile iron sample. From the sample, the hardness test and composition of element is checked to determine the effect and mechanical properties of different thickness of thin wall ductile iron.

## ABSTRAK

Tesis ini membentangkan tentang parameter dinding nipis besi mulur. Terdapat dua tujuan utama dalam kajian ini, pertama, untuk menyiasat aturan parameter dinding nipis besi mulur menggunakan kaedah Terapit dan untuk menyiasat aturan corak parameter untuk dinding nipis besi mulur. Besi tuang mempunyai grafit di dalam matrik yang di panggil pearlitik. Bentuk grafit adalah emping yang mempunyai kekuatan rendah. Kajian tentang perubahan grafit dari bentuk emping ke bentuk bintil dengan menambahkan magnesium ferrosilikon sebagai ejen inokulasi adalah dalam perkiraan. Bentuk besi mulur diperkayakan kekuatan dan sifat-sifat mekanikal lain. Walaubagaimanapun, ketebalan dinding nipis berkait dengan komposisi magnesium yang ditambah. Teracuan pasir hijau adalah salah satu kaedah untuk menukarkan besi tuang ke besi mulur. Tesis ini turut membincangkan kaedah teracuan pasir hijau dengan menggunakan kaedah Terapit untuk mendapatkan sampel dinding nipis besi mulur. Dari sampel, ujian kekerasan dan pemeriksaan komposisi bahan untuk menentukan kesan dan sifat-sifat mekanikal dijalankan ke atas besi mulur yang mempunyai ketebalan yang berbeza.

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

Cast iron typically contain Fe-3.2C-2.5Si wt%, which is all cast iron contain more than 2% carbon. In addition to carbon, cast iron also contains silicon, usually from 1 to 3%; thus, it's actually iron-carbon-silicon alloys. Hence, it's containing graphite flakes in a matrix. This microstructure is called pearlitic. Carbon in cast irons is known to cause the formation of graphite flakes.

Treatment with magnesium is the way for changing form from flake to nodular. Magnesium will act as nodularising elements which is also a powerful desulphurizing element and so reacts with all of sulphur present in the cast iron before it becomes effective in changing graphite form from flake to nodular. One of the techniques of adding magnesium to molten metal is Sandwich process. The main objective of this technique is to produce a high magnesium recovery.

Inoculation is the addition of material to liquid iron (molten metal) in order to increase the nucleation of the iron or to increase the number of points which is the iron begins to solidify. It also will decrease the tendency to form chill or mottle. Normally, the most commonly used for ductile iron is foundry grade ferrosilicon, so that, in this case, the stabilizing inoculant is ferrosilicon. Actually, the inoculation process is important in order for maintaining good nodule shape and produce high nodule numbers.

Thin wall is the most application used especially in automotive part. Thin wall ductile iron is an alternative for producing automotive parts such as intake manifold. The definition of thin wall is it the thickness is must below 10mm and its length must 12 times its thickness. However, the minimum thickness of thin wall is 2mm.

## **1.2 IMPORTANCE OF RESEARCH**

This research is significant because of several causes:

- i. Analysis of the effect of different thickness of thin wall ductile iron.
- ii. Analysis of mechanical properties of the different thickness of thin wall ductile iron.

## **1.3 PROBLEM STATEMENTS**

The cast iron has graphite in a matrix called pearlitic. The graphite shape is flake which is has lower strength. The study of graphite changes from flake form to nodular form by adding magnesium ferrosilicon as inoculation agent is under consideration. The ductile iron form is enhanced in strength and other mechanical properties. However the thickness of thin wall is related to the composition of the magnesium adding.

## **1.4 OBJECTIVE OF THE RESEARCH**

There are two main objectives of this research:

- i. To investigate the processing parameter of thin wall ductile iron by using Sandwich method.
- iii. To investigate the process design parameter for thin wall ductile iron

## **1.5 SCOPE OF THE RESEARCH**

The mould use in the ductile iron metal casting is green sand mould. For producing thin wall ductile iron, the thickness of cavity from 3mm and 7mm. For inoculation, the treatment use is nodularisation of magnesium ferrosilicon (MgFeSi).

## **1.6 RESEARCH METHODOLOGY**

### **1.6.1 Literature Review**

Induction furnace functional for melting cast iron ingot which is has high melting temperature around 1350°C. This invention relates to induction furnaces for use in metal casting [1]. So that, the induction furnace can resist high temperature. Sandwich process was used ladle which is has the height to diameter ratio around 1.5 to 2:1.

There are many types of retaining pocket for use with sandwich treatment which is normal recess, deep pocket and weir recess. However, the normal recess type was used since the type of pocket is not under consideration parameter. For completing the height to diameter ratio and making normal recess type pocket, lining material which is CO<sub>2</sub>/silicate sand is used. This lining material maybe employed with equally advantageous effects [2] and easily for making the needed height to diameter ratio and normal recess pocket. However, it is not permanent and has short life.

Cast irons ingot is used as a material under investigation. Cast irons same family as ferrous alloys. Usually steel contain less than 1 percent carbon, but cast iron is different. Normally, cast irons contain 2 to percent and 1 to 3 percent silicon [3]. So that, magnesium ferrosilicon (MgFeSi) is needed where as magnesium act as nodularising agent and ferrosilicon act as inoculating agent.



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