

**THE EFFECT OF ADDITION ABRASIVE WATER JET WASTE ON
THE GREEN STRENGTH AND PERMEABILITY OF SAND
MOULD**

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**Faculty of Mechanical and Manufacturing Engineering
Technology**

**THE EFFECT OF ADDITION ABRASIVE WATER JET WASTE ON
THE GREEN STRENGTH AND PERMEABILITY OF SAND MOULD**

Feti Nur Alia Binti Hasmat

**Bachelor of Manufacturing Engineering Technology (Process and Technology) with
Honours.**

2018

DECLARATION

I hereby, declared that this report entitled “The Effect of Addition Abrasive Water Jet Waste on The Green Strength and Permeability of Sand Mould” is the results of my own research except as cited in references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

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Date : 7 December 2018

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow:

Signature :

Supervisor Name : Ts. Zolkarnain Bin Marjom

Date : 7 December 2018

ABSTRAK

Penyediaan pemutus acuan Pasir amat perlu mempertimbangkan sifat-sifat mekanikal penting seperti kekuatan ricih hijau, kekuatan mampatan hijau dan kebolehtelapan. Untuk menentukan kandungan lembapan optimum dan komposisi untuk membuat acuan pasir, hartanah pasir membentuk memainkan peranan yang penting. Komposisi acuan pasir ialah seperti pasir, pengikat, dan bahan tambahan sebelum penyediaan campuran pasir. Malangnya, sisa foundri pada dasarnya terdiri daripada campuran pasir digunakan (kira-kira 71%), sedikit habuk (kira-kira 12%), haba bahan tahan (8%) dan bahan buangan lain (9%). campuran pengacuan (campuran pasir) mewakili bahagian terbesar sisa. Kajian ini adalah tentang kitar semula yang kasar jet air sisa untuk menghasilkan acuan pasir. Acuan pasir diperbuat daripada jet air sisa yang kasar akan bercampur dengan pasir silika sebagai pasir base kemudian akan mengarang dengan komposisi bentonit yang lain seperti, habuk arang batu dan air. Proses serudukan menggunakan Ridsdale-Dietert standard metrik dorongan kuat-kuat untuk membuat spesimen di ketinggian 50 ± 0.3 mm. Setiap sampel telah melalui ujian kebolehtelapan menggunakan Ridsdale-Dietert meter kebolehtelapan dengan ujian kebolehtelapan manakala kekuatan mampatan hijau dan kekuatan ricih hijau telah diuji dengan menggunakan Ridsdale-Dietert pasir universal kekuatan mesin untuk ujian mampatan. Di samping itu, sifat-sifat mekanikal seperti kebolehtelapan, kekuatan ricih hijau dan kekuatan mampatan hijau acuan pasir diperbuat daripada kasar sisa jet air telah dianalisis. Komposisi 60% silika: 40% AWJW didapati mempunyai kekuatan hijau optimum dan kebolehtelapan berkesan.

ABSTRACT

Preparation of sand casting mould should highly considered the important mechanical properties such as green strength, and permeability. In order to determine the optimum moisture content and composition for making green sand mould, these moulding sand properties play a vital role. Moulding sand was a composition of sands, binders, and additives prior to the preparation of the sand mix. Unfortunately, foundry wastes was essentially composed of used sand mixture (about 71%), small amount of dust (approximately 12%), heat resistant materials (8%) and other wastes (9%). Moulding mixtures, represent the largest proportion of wastes. This study was all about the recycling the abrasive water jet waste to produce a sand mould. The sand mould were made of water jet abrasive waste will be mixed with silica sand as a base sand then will be compose with the other composition such bentonite, coal dust and water. Ramming process using Ridsdale-Dietert metric standard rammer to make a specimen in height of 50 ± 0.3 mm. Each sample were undergoes permeability test using Ridsdale-Dietert permeability meter to test its permeability whilst green compression strength and green shear strength were tested by using Ridsdale-Dietert universal sand strength machine for compression test. In addition, mechanical properties such as permeability, green shear strength and green compression strength of the sand mould made of abrasive water jet waste has been analysed. The composition of 60% Silica: 40% AWJW were found to have optimum green strength and effective permeability.

DEDICATION

I dedicate this thesis to my supportive family, who never stop giving off themselves in countless ways. For their endless love, support and encouragement that keep me moving forward. I also dedicate this thesis to all my dearest relatives, lecturers, and friends as without whom none of my success would be possible.

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LIST OF ABBREVIATIONS

1. **AFS = American Foundry Society**
2. **AWJW = Abrasive water jet waste**

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This chapter will discuss briefly about the analysis of sand mould using abrasive water jet waste. The content of this chapter includes the background of the study, problem statement, objectives, significance, limitation, scope and structure of the study.

1.1 BACKGROUND OF STUDY

Casting is among of the earliest metals moulding technique that ever exist in the world. It is one of the least expensive methods utilized for mass production of any part plus it is adequately used to make a complex shaped parts which is difficult to create by other production process (Choudhari, Narkhede, & Mahajan, 2014). In other journal stated that casting is one of the important and versatile processes of manufacturing. The major purpose is to form solid or hollow objects, parts or desired shapes and sizes. Incorrect sand condition may occurred in the production scraps (Patel et al., 2015). Other than that, sand casting additionally referred to a role as sand moulded casting, is a metal casting process portrayed by utilizing sand as a mould material (Rao, 2016).

Moulding sand control may only be testing of all the raw materials such as sands, binders, and additives prior to the preparation of the sand mix. Sands found in different

locations can have wide variations in the surface, physical, and chemical characteristics due to ecological, environmental, geological factors and climatic (Patel et al., 2015). In addition, for every sands, they have their own foundry properties. The suitability of a sand for casting a given metal is unable to detect until the standard necessary laboratory tests are properly carried out on it (Patel et al., 2015). Referring to the journals, the properties such as green shear strength, green compression strength and permeability are influencing the quality of castings in green sand mould. The relations of these properties is complex with the input parameters such as sand, shape, grain size, binder, and clay (Patel et al., 2015).

1.2 PROBLEM STATEMENT

Industrial activity is connected to waste production. Hence, a large amount of these wastes is characterized as hazardous materials. The basic yet important questions, “How can we use these wastes or how can we disposed this wastes?” are the major problem for today’s society. The main reason is protection of human health, establishment of environmental friendly technology, but the economical aspect plays the important roles as well (Špirutová, Beňo, Bednářová, Kříž, & Kandrnál, 2012).

Based on the journal of “Influence green sand system by core sand additions” briefly stated that foundry industry generates about 0.6 tons of waste per 1 ton of castings, even though the raw metal material for casting production is recycled. Foundry wastes are essentially composed of used sand mixture (about 71%), small amount of dust (approximately 12%), heat resistant materials (8%) and other wastes (9%). Moulding

mixtures (sand mixtures) represent the largest proportion of wastes. The most attention is paid to recycle sands (Špirutová et al., 2012).

This study will examines the water jet abrasive waste from a water jet cutting operation, to assess the conceivable reuse of abrasive water jet waste sand (AWJW). The sand cutting agent used to shape an assortment of materials including metal. Referring to the journal, there are about 70,000 pounds of waste sand is created every year by the cutting operation (Mathews & Wilson, 1998).

This study is all about the recycling the abrasive water jet waste to produce a sand mould. The sand mould are made of abrasive water jet waste will be mixed with silica sand as a base sand then will be compose with the other composition such clay, coal dust and water will be undergoes several testing in the laboratory to test its permeability, strength, and also its compression when load is applied. Perhaps the most popular of these is the simplest: permeability test and compression strength test. In order to achieved a good experimental results and the same time managed to recycle the water jet abrasive waste for a good usage in the future.

1.3 OBJECTIVES OF STUDY

The objectives of this study is to analyse and also develop a sand mould from abrasive water jet waste for sand casting process. The specific research tasks to fulfil the objectives of this thesis are summarized as follows:

1. To recycle sand waste from abrasive water jet machine which is at present disposed of to landfill and restoring it for re-use by the foundry industry.
2. To analyse the mechanical properties such as permeability and green strength for the sand mould compose of silica and abrasive water jet waste.
3. To determine the best composition based on permeability, green compression strength, and green shear strength between silica sand: abrasive water jet waste (%).

1.4 SIGNIFICANCE OF STUDY

The findings of this study will contribute to the significance of the study for the future use. Those are the list of significance of this study:

1. To prevent wastage of sand resources so that it can be reused commonly as green sand by reconditioning it with clay, water, and other materials.
2. The changes in recycling approach encourages the utilization of recycled sand as a potential construction material.
3. More efficient use of resources, less pollutions, and improved economic competitiveness.
4. Maximise the use of the existing apparatus and machine in the laboratory to reduce cost of the whole project.

1.5 LIMITATIONS OF STUDY

Although this study is carefully prepared, the limitations and shortcomings are still under aware. Those are the list of limitations that will be faced will conducting the study:

1. Specimen size:

The number of the units of specimen that will be used in this study is dictated by the type of research problem stated. All specimen will be rammed until the satisfy size of 50 ± 0.3 mm are achieved.

2. Lack of dried water jet abrasive waste:

A lack of the AWJW sand will limit the scope of the study. However, the best method will be used to maximise the usage of the AWJW available.

3. Measure used to collect the data:

The best way should be discovered in order to gather all the data inhibits the ability to conduct a thorough analysis of the data after the interpretation of the findings are completed.

4. Access to literature:

Studies will only start after identifying the gaps in the literature and tried to address to the previous researcher. However, the identification that there is a gap to the existing literature depends on the researcher's level of access. Research gap will be a big misconception owing to the fact that the person do not have access to huge range of scientific literature.

1.6 SCOPES OF STUDY

This study will only cover on:

1. Development of the sand mould for casting process by using all machines that available at the laboratory.
2. To build a sand mould made of silica sand and abrasive water jet waste as a base sand.
3. To compare the permeability, green shear strength and green compression strength between different compositions of green sand mould made of silica sand and abrasive water jet waste.
4. The size of the abrasive particle of 70-80 mesh are used.
5. The size of silica sand 60-70 mesh only will be used to compare its mechanical properties with silica of 70-80 mesh.

1.7 STRUCTURE OF STUDY

Chapter 1 states the problem and background of the study. This chapter also discussed the objective and scope of the project. Apart from that, the significance and limitations of the study also stated in Chapter 1. Hence, the reader can get an initial idea about what the project is all about.

Chapter 2 explains in detail about literature review of the study. It consists of the basic principle of sand casting in the production of sand mould and its uses along with the advantages. It also consists if the general problem that this study tries to overcome. It explains about the main important tasks which need to be considered in embodiment analysis stage. The methods of completing the embodiment analysis phase are also discussed here.

Chapter 3 explains the methodology of this study. There are four stages in this study:

Stage 1: The Planning Stage

Stage 2: Sample preparation

Stage 3: Experimental Testing

Stage 4: Report Preparation and Presentation

Chapter 4 is analysis and discussion chapter. The results from the survey in phase 1 and experiments in phase 2 are analysed here. In experiment result, there are divided by two stages. The first one is focused on the preparation of the sand mould using water jet abrasive waste and the second one is focused on testing of the permeability, green shear strength and green compression strength of the sand mould. All the result and data will be recorded in this chapter.

Chapter 5 is conclusion chapter. It conclude the findings from this study. Generally, this chapter will conclude the project and will suggest the future work for this AWJW.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter is mainly explains about all findings obtained from many literature reviews, which may come from internet, journals, article, and books about the topic related to this study. Related information of previous studies is extracted as references and discussion based on their findings of the overview about sand mould, permeability, green sand strength, and its process.

2.1 SAND MOULD

Based on journal of Influence of Cement-Silica Ratio on the Molding Properties of Portland Cement Bonded Sand Stated that, “Moulding sand is one of the materials used particularly in metal foundries for making moulds and cores. Despite its name, moulding sand is not sand alone but a composite material made from several other materials to give some amount of heat resistance, porosity, strength and binding qualities necessary to create moulds and cores” (Ajibola, Oloruntoba, & Adewuyi, 2015). Another journals had stated that moulding processes where a sand aggregate is utilized to influence the mould create by a long shot the biggest quantity of castings. No matter what kind of metal is used to be pour