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DESIGN AND FABRICATE A DROPLET FORMATION NOZZLE FOR DISPERSION SYSTEM

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ABSTRACT

The title is building a Droplet Formation Nozzle. The student needs to design and fabricate a Droplet Formation Nozzle for dispersion system. It is to overcome oil pollution problems that happened at sea area. The project started with the flow chart to achieve the objective of this project. Then, the sketching of the design will be selected based on the selection and comparison concept table. Next, it will be design in the Solid Work software. The fabrication process can proceed after the design is finish. In order to finish the project, there are various fabrication processes is needed. All the skill had been taught during previous lab session in UMP. The nozzle had been tested using 3 bar pressure of water and the image of spray from the nozzle was captured and the result based on the picture. This project was referenced from an AFEDO nozzle with some design change to analyze the differences result. This project is done to help in recovering the oil pollution using dispersion system.

ABSTRAK

Projek ini bertajuk pembinaan nozzle untuk pembentukan titisan. Pelajar perlu untuk mereka bentuk dan memasang satu nozzle untuk pembentukan titisan bagi sistem penyebaran. Ia adalah untuk mengatasi masalah pencemaran minyak yang berlaku di kawasan laut. Projek ini dimulakan dengan carta aliran untuk mencapai objektif projek ini. Kemudian, lakaran reka bentuk akan dipilih berdasarkan pemilihan dan perbandingan. Seterusnya, lakaran akan direka bentuk menggunakan perisian Solid Work. Proses fabrikasi diteruskan setelah proses reka bentuk selesai. Dalam usaha untuk menyelesaikan projek, terdapat pelbagai proses fabrikasi diperlukan. Semua kemahiran yang telah diajar semasa sesi makmal sebelumnya di UMP. Nozzle tersebut diuji menggunakan tekanan air 3 bar dan keputusan adalah berdasarkan imej yang telah diambil. Projek ini dirujuk berdasarkan nozzle AFEDO denagn beberapa perubahan reka bentuk untuk menganalisis keputusan yang berbeza. Projek ini dilakukan untuk membantu dalam memulihkan pencemaran minyak menggunakan sistem penyebaran.

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P	Pressure
P	Density
v	Velocity
g	Gravity
h	Height
Q	Flow rate

CHAPTER 1

INTRODUCTION

1.1 Background

Oil waste on seawater. It is a phenomenon that happen on earth that make the seawater cover with foil or in other words is water pollution. Oil spills comes from ships and super-tankers, and from off-shore oil drilling operations cause pollution to the water although it not on purpose. Oil forms a thin layer on top of water and cannot dissolve in water. Its can make an animals and plants that living in the water cannot breathe, the oil coats the feathers of water birds, and the fur of animals that swim in the water, causing them to become sick and if there is a great amount of oil on their bodies, to die. The ingestion of oil causes dehydration and impairs the digestive process. Even the insects that live on the surface of the water are badly affected.

This water pollution also will make an effect to the economy of a country. It can be damaging the economy by the costing the price to treat and prevent the oil recover. Based on The Daily Beast, there are 11 Extreme Oil Spill Solutions, which are peat moss, oil corral, sand berms, using garbage, nuclear bomb, surfactants, using hair, woodchips, fire, spraying hay and hot tap.

Nowadays, many experiment and investigation had been conducted to prevent the problem from become maximize. One of the solutions is to use a dispersant liquid to atomize the oil by helping the liquid to become a droplet formation. Nozzle dispersion system had been experimented since many years until now to make a better nozzle for better ways in clean up the oil spills.

1.2 Problem Statement

Oil waste cause the water cover by oil and of the living things especially marine life hard to survive due to the environment disaster. It also make the life cycle of all living thing not in correct order and can cause many life in dangerous. In order to reduce oil waste of sea water, oil can be brake or atomized into particles. This process of atomization can be done through nozzle curtain spray using dispersed method.

1.3 Project Objective

To design and fabricate droplets formation nozzle for dispersion system.

1.4 Project Scope

- To design a nozzle droplet formation dispersed system using solid work.
- To fabricate nozzle using Aluminium rod.
- To fabricate nozzle that will be tested using water.
- Nozzle inlet to outlet dimensions is set to 5 degrees.
- Experiment parameters discussed are the cone angle spray and distance covered by the fluid.
- Pressures are test at 3 bar.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

Nozzle are widely use in the area of chemical industry, metallurgy and aviation field. It also had been used in the garden for spray a water to all over the garden make the plants get the water for it photosynthesis system. There are many type of nozzle suitable along it useful and also the maximum pressure it can take to make a droplet depends on the nozzle diameter and the length as well as chamfer angle. The nozzle also must be referring to the fluid that will be flow through it, because it will affect the nozzle long term life.

2.2 Nozzle use in many applications

2.2.1 Rocket Engine Acceleration

A rocket engine uses a nozzle to accelerate hot exhaust to produce thrust as described by Newton's third law of motion had been experimented by NASA. The amount of thrust produced by engine depends on the mass flow rate through the engine, the exit velocity of the flow, and the pressure at the exit of the engine.

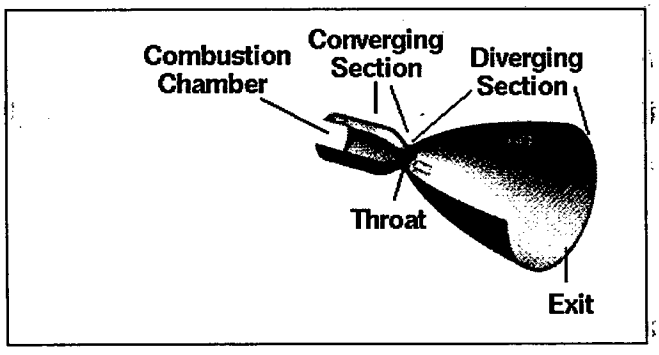

Figure 2.1 Nozzle Design

A nozzle is a relatively simple device, just a specially shaped tube through which hot gases flow. Rockets typically use a fixed convergent section followed by a fixed divergent section for the design of the nozzle. In the nozzle, the hot exhaust leaves the combustion chamber and converges down to the minimum area, or throat, of the nozzle.

2.2.2 Sand Blasting Nozzle

Sand blasting nozzle are a crucial element for surface-treatment sand blasting systems, designed for forming the pressurized abrasive jet. It's made from tungsten-free cemented carbide, or sintered silicon carbide. The application of sand blasting nozzle are in marine engineering for pre-painting surface treatment, in engineering for cleaning of castings and welded parts and in oil and gas for pipeline treatment prior to application of protective painting layer.

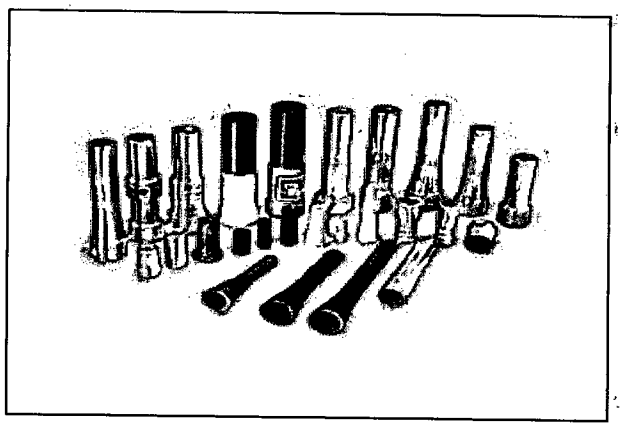

Figure 2.2 Sand Blasting Nozzle

2.3 Sea Water Oil Recovery

In the sea water oil recovery, nozzle had been used to produces a droplet formation liquid in dispersion system. The system will involve a dispersant liquid and water to be spray over the oil layer for making the oil formation become separate and recover it from the sea water. In Malaysia, one of the experiments for this dispersion system had been conducted by using the Afedo Nozzles.

There are several nozzle designs that have connection in making the water droplet, such as a design use of water spray curtain to disperse Liquefied Natural Gas, (LNG) vapor cloud (Morsded A. Rana), CFD modeling of water spray interaction with dense gas plumes (Robert N. Meroney) and lastly AFEDO 30 and AFEDO 50 that have been specially developed by Ayles Fernie to meet a requirement for dispersant application system.

2.4 Droplet Formation Nozzle for Sea Water

At end of 90's century, there was a complaint that was evaluated by Ross of using vessel to apply dispersants is outdated and inappropriate for most oil spills situation. The aircraft was more prefer because it can apply enough dispersant in one pass to threat oil spills problem. In 1999, Belore and Ross made a recent study to analyze factors and identify application condition. The analyze give a result that the new nozzle was chose for long distance dispersant spray than used a wire mesh bag. Single nozzle systems designed for dispersant application in un- diluted form are a newer concept currently under development. As envisioned, this system could provide larger swath widths than spray arm systems (S. Ross, 2000).

2.5 Spray Curtain

The spray curtain is a factor that can affect the efficiency of the dispersed. It will be calculate based on the shape, angle, and distance the fluid can go according the nozzle shape. An experimented had been taken by S.L Ross Environmental Research Ltd. that it was also found that by increasing the discharge tube length the spray drop sizes could be increased. This can be used as advantage during windy spray condition to reduce dispersant loss and improve the ability to place the dispersant on the target oil.

CHAPTER 3

METHODOLOGY

3.1 Methodology

The methodology had been discuses right after the motivation and the objectives of the project were identified. The methodology functioned as a guideline for complete the project and for the reference the flow of the project.

3.2 Flow Chart

The flow chart that in Figure 3.1 is to achieve the objective of this project. It is shown to guide the student in order to complete the project in proper flow. From the start, it shown that a study and gathering any kind of information that related to the project had already been conducted. This project start with literature view and research anything related to the title as a reference. Then, the design of nozzle will be looked and the decision will be making after the characteristic was qualify. The design also needed to refer to the objective in this project so it can be concluded weather it was follow the qualification needed in industries or not. When the result was produced, the project will be tested to see it performance. Lastly, the project will be documented and present to the presenter. During the work progress, writing had been done until the presentation was complete.

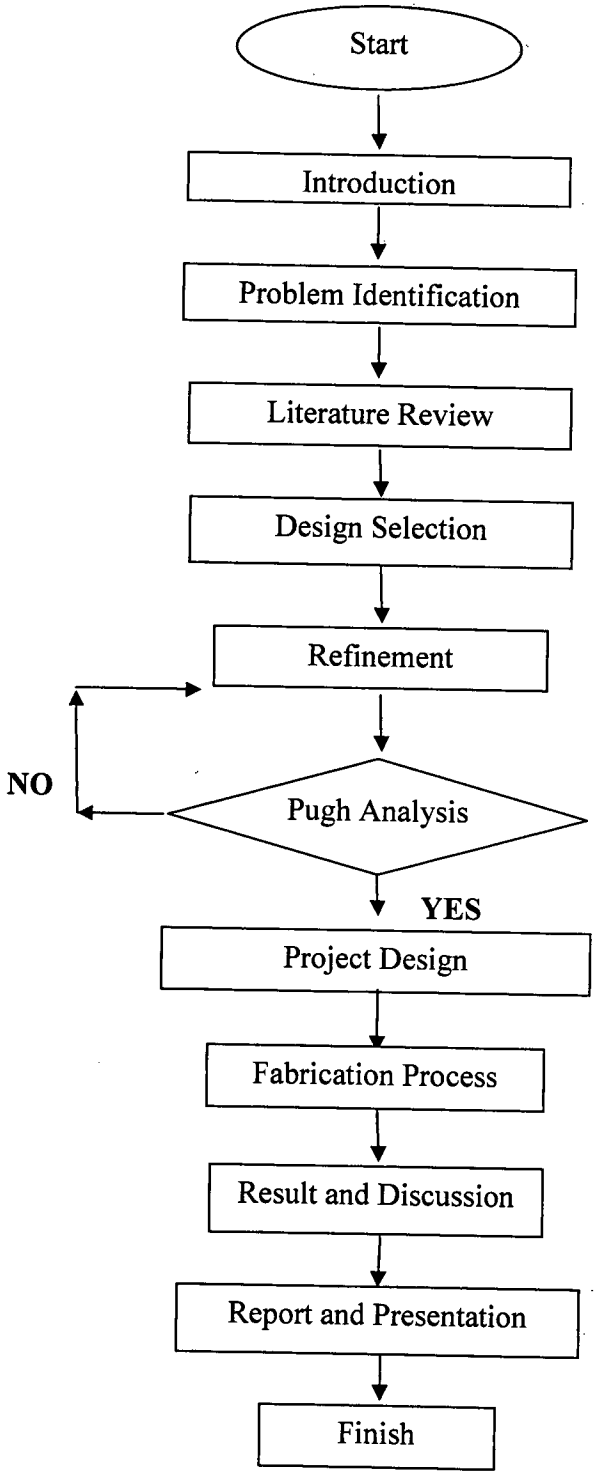

Figure 3.1: Flow Chart

3.3 Sketching

There were 3 sketching that have already prepared in order to get the best qualification. The sketching also comes with its' own characteristic and concept as followed:

3.3.1 Concept 1

Figure 3.2 below show a design that refers to the shower concept. The head of this design have many holes to make the liquid flow through it and making a lot of droplet formation.

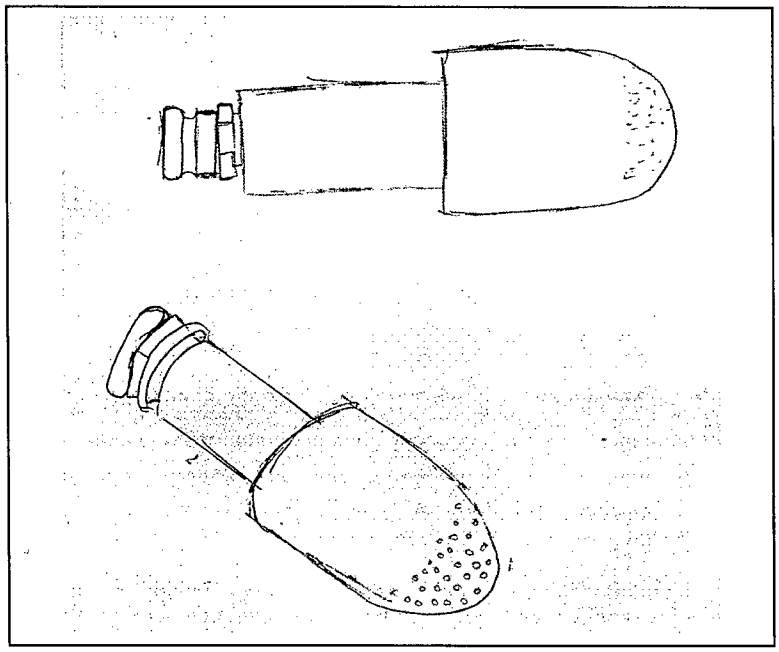

Figure 3.2: Sketch 1

3.3.2 Concept 2

Figure 3.3 below show a design was make to get a long distance droplet formation. The head have two holes that make the high pressure of liquid through it and then strike to the arcs making a droplet formation.

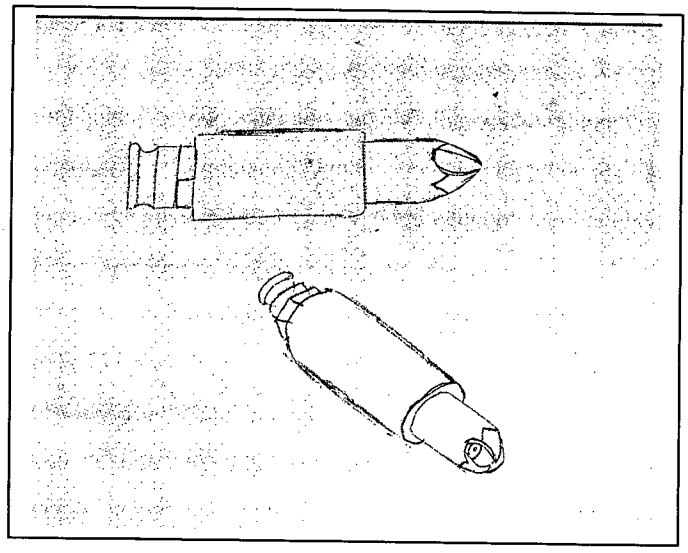

Figure 3.3: Sketch 2

3.3.3 Concept 3

Figure 3.4 is a design that taking place to get 360^0 spray along the nozzle. The head have two rod that will go around make a 360^0 of spray curtain after the high fluid pressure strike to the mechanism.

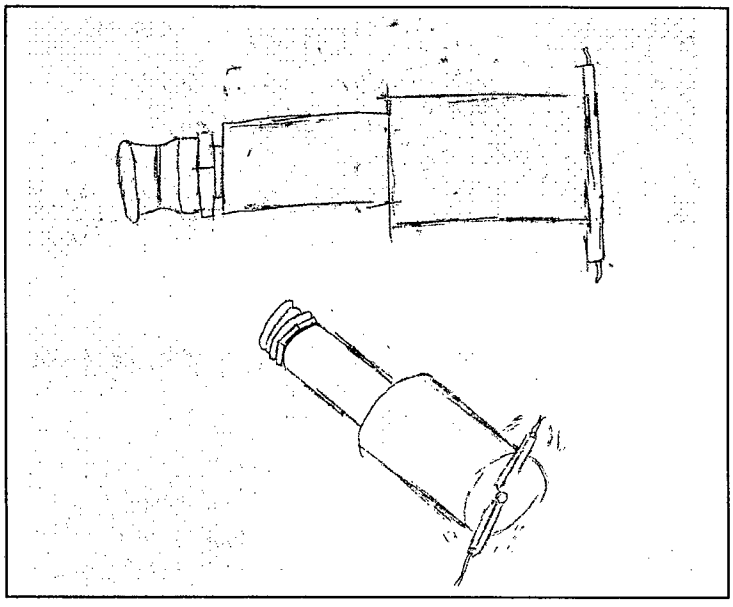

Figure 3.4: Sketch 3

3.4 Concept Selection and Comparison

Concept selection and comparison were made to select the best concept that suitable according to the place use. The concept were compare using the forth concept as a referred. Table 3.1 discussed about the concept generation using concept screening to analysis the 9 concepts that are comfort, durability, easy to handle, production cost, portable, user limit, easy to fabricate, simplify of design and strength.

Matrix Concept	Concept 1	Concept 2	Concept 3	Concept 4 (reference)
Comfort	0	0	-	0
Durability	+	+	+	0
Easy to handle	0	+	0	0
Production cost	0	+	-	0
Portable	_	+	0	0
User limit	_	0	0	0
Easy to fabricate	0	0	-	0
Simplify of design	+	-	-	0
Strength	+	0	-	0
Total (+)	3	4	1	0
Total (-)	2	0	3	0
Total Score	1	4	-2	0
Rank	2	1	3	0

Table 3.1 Concept Screening

3.5 CAD

This is a 3rd angle projection for the design that had been finalized after the selection and after making and improvement.

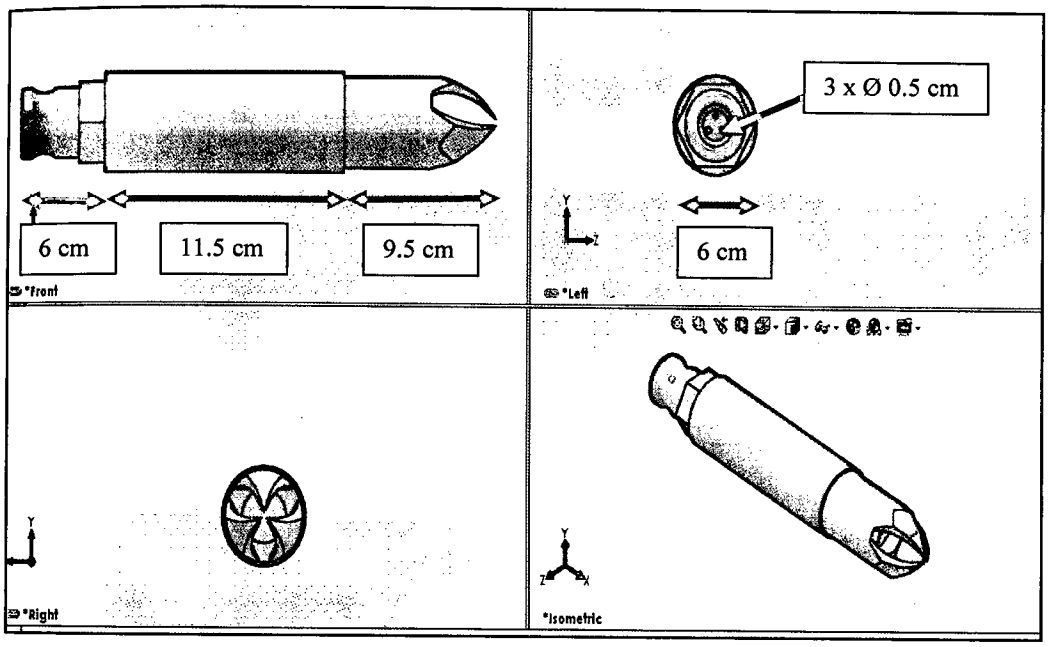

Figure 3.5: 3rd Angle Projections.