PRELIMINARY STUDY ON EFFECT OF SPRAY COATING PARAMETER ON HYDROPHOBIC COATING SURFACE

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PRELIMINARY STUDY ON THE EFFECT OF SPRAY COATINGS PARAMETER ON HYDROPHOBIC COATING SURFACES

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A report submitted
In fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Structure and Materials)

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I declare that this project entitled "Preliminary Study on the Effect of Spray Coatings Parameter on Hydrophobic Coating Surfaces" is the result of my own work except as cited in the references

Signature :.....

Name :.....

Date :.....

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure & Materials).

Signature :.....

Name of Supervisor :.....

Date :.....

DEDICATION

To my beloved mother and father

ABSTRACT

Hydrohobocity means the surface of water is repelled with the surface of the sample or specimen. To determine the hydrophobicity surfaces the contact angle has to be measured which are the angle of contact between surfaces of the solid with the surface of liquid or water. The hydrophobic contact angle will be about 90° to 140° where the water will beads up on the surface of solid. The purpose of the invention of hydrophobic surface is to avoid the problem s including corrosion, higher cost in maintaining the cleanness such as curtain glass of building and solar cell. Besides, by applying the hydrophobic also, the materials can be protected. The effect of thickness of spray coating and the effect of surface roughness of the surface was studied further. Two different layers of spray coating was represent the thickness of spray coating where the specimen was sprayed with one layer spray coating and two layer spray coating. The thickness of coating was only being tested on the aluminum plat. For the roughness of the surface, the sand paper grit represented the roughness where the sand paper used were 2000 grit, 1200 grit, 360grit and 180 grit. The lower the sand paper grit, the higher the roughness of surface of sand paper. So, 180 grit of sand paper is the roughest sand paper. For the roughness, aluminium with coating, uncoated copper and uncoated stainless steel was tested. This is to observe whether the trend of effect of roughness on contact angle followed. For the effect of thickness, it showed that as the thickness of the spray coating increased, the contact angle of hydrophobicity decreased. The surface with two layer spray coating has lower contact angle compared surface one layer spray coating. Then, for the effect of surface roughness on hydrophobicity, the results show that by increasing the roughness of surface, the contact angle of hydrophobicity also increased. The contact angle for 180 sand paper grit has highest contact angle followed by 360grit, 1200 grit and 2000 grit.

ABSTRAK

Hydrohobocity membawa maksud bahawa permukaan air ditolak dengan permukaan sampel atau spesimen. Untuk menentukan permukaan hydrophobicity, sudut sentuh telah diukur dimana ia merupakan sudut hubungan antara permukaan pepejal dengan permukaan cecair atau air. Sudut sentuh hidrofobik adalah diantara 90 ° ke 140 ° di mana air akan membentuk titisan manik pada permukaan pepejal. Tujuan penciptaan permukaan hidrofobik adalah untuk mengelakkan beberapa masalah termasuk pengkaratan, kos yang lebih tinggi dalam mengekalkan kebersihan seperti tirai kaca bangunan dan sel solar. Selain itu, dengan menggunakan hidrofobik juga, sifat bahan-bahan boleh dilindungi. Kesan ketebalan salutan semburan dan kesan kekasaran permukaan permukaan telah dikaji melalui projek ini. Dua lapisan yang berbeza salutan semburan telah mewakili ketebalan salutan semburan di mana spesimen disembur dengan satu lapisan salutan semburan dan dua lapisan salutan semburan. Ketebalan lapisan hanya diuji pada plat aluminium. Untuk kekasaran permukaan, gred kertas pasir mewakili kekasaran di mana kertas pasir yang digunakan adalah 2000 gred, 1200 gred, 360gred dan 180 gred. Semakin rendah gred kertas pasir, semakin tinggi kekasaran permukaan kertas pasir. Jadi, 180 gred kertas pasir merupakan kertas pasir yang paling kasar. Untuk kekasaran, aluminium dengan salutan, tembaga tidak bersalut dan keluli tahan karat tidak bersalut telah diuji. Ini adalah untuk melihat sama ada trend kesan kekasaran pada sudut kenalan diikuti. Untuk kesan ketebalan, ia menunjukkan bahawa apabila ketebalan salutan semburan meningkat, sudut sentuh hydrofobik menurun. Permukaan dengan salutan semburan dua lapisan mempunyai hubungan sudut lebih rendah berbanding permukaan satu lapisan salutan semburan. Kemudian, untuk kesan kekasaran permukaan pada hydrophobicity, keputusan menunjukkan bahawa dengan meningkatkan kekasaran permukaan, sudut kenalan hydrophobicity juga meningkat. Sudut kenalan untuk 180 gred kertas pasir mempunyai sudut sentuh tertinggi diikuti oleh 360gred 1200 gred dan 2000 gred.

ACKNOWLEDGEMENT

First and foremost, I would like to take this opportunity to express my sincere thanks to my supervisor Professor Dr. Ghazali bin Omar from the Faculty of Mechanical Engineering Universiti Teknikal Malaysia Melaka for all the supported, ideas and essential supervision for me to complete this project report. I also thanked for helping me improving my presentation skills.

I would also like to express my gratitude to Mr. Mahader, the technician from material science laboratory Faculty of Mechanical Engineering for assisted me with the machine in the lab and gave an idea to improved regarding my project.

Then, special thanks to all my parents, siblings and friends for their moral support in completing this project and my degree. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

TABLE OF CONTENT

CHAPTER	CONTENT	PAGE
	SUPERVISOR'S DECLARATION	ii
	APPROVAL	iii
	DEDICATION	vi
	ABSTRACT	v
	ABSTRAK	vi
	ACKNOWLEDGEMENT	vii
	TABLE OF CONTENT	viii
	LIST OF FIGURES	xi
	LIST OF TABLES	xii
	LIST OF GRAPH	xiv
	LIST OF ABBREVIATIONS	xv
CHAPTER 1	**INTRODUCTION**	1
	1.1 Background	1
	1.2 Problem Statement	3
	1.3 Objectives	4
	1.4 Scope of Project	4
	1.5 General Methodology	5
CHAPTER 2	**LITERATURE REVIEW**	8
	2.1 Overview	8
	2.2 Hydrophobicity Properties	8
	2.2.1 Hydrophobic and Superhydrophobic	8
	2.2.2 Lotus Effect	14
	2.2.3 Wettability and Contact Angle	17
	2.3 Factor Effecting Hydrophobicity	19

2.3.1 Surface Roughness 19
2.3.2 Thickness of Coating 23
2.4 Structural Characterization Utilizing 24
2.4.1 Portable microscope 24
2.4.2 Light microscope 25
2.4.3 Profilometer 28

CHAPTER 3 METHODOLOGY 29
3.1 Overview 29
3.2 Material Description 29
3.2.1 Aerosol 30
3.2.2 Lacquer 30
3.2.3 Sandpaper 31
3.3 Sample Preparation 32
3.3.1 Dimensioning 32
3.3.2 Fabrication 32
3.3.2.1 Cutting Plat Process 32
3.3.2.2 Spray Process 33
3.3.2.3 Grinding Process 34
3.4 Testing 36
3.4.1 Contact Angle 36
3.4.2 Surface Morphology/Profile 37
3.4.3 Roughness 37

CHAPTER 4 RESULTS AND DISCUSSION 39
4.1 Results 39
4.1.1 First Method 40
4.1.1.1 One Layer Spray Coating 40
4.1.1.2 Two Layer Spray Coating 42
4.1.1.3 Comparison between One Layer Coatings with Two Layer Coating 43

4.1.2 Second method 46
4.1.2.1 One Layer Spray Coating 46
4.1.2.2 Two Layers Spray Coating 47
4.1.2.3 Stainless Steel 49
4.1.2.4 Copper 51
4.1.2.5 Comparison between All Materials 52
4.2 Discussion 54
4.2.1 Effect of Surface Roughness 54
4.2.2 Effect of Coating Thickness 57

CHAPTER 5 CONCLUSION AND RECOMMENDATION 58
5.1 Conclusion 58
5.2 Recommendation 59

REFERENCES 60

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Computer Graphic of the „Lotus Effect“	2
1.2	Flowchart of general methodology	7
2.1	Hydrophobic surface	9
2.2	Hydrophobes molecules with water	10
2.3	Superhydrophobic surface	12
2.4 (a)	Lotus leaf	15
2.4 (b)	SEM image of hierarchical surface structures of lotus leaf	15
2.4 (c)	Wax tubules on upper leaf side	15
2.5	Hydrophobic and hydrophilic	18
2.6	Illustration of contact angles formed by sessile liquid drops on a smooth homogeneous solid surface	19
2.7(a)	A droplet resting a smooth surface	21
2.7 (b)	A droplet resting on a small rough surface in normally the Wenzel wetting state	21
2.7 (c)	A droplet resting on a large rough surface in normally the Cassie/Baxter wetting state.	21
2.8	The graph of SWCNT film thickness against contact angle	23
2.9	Panrico“s USB3.0 digital microscope	25
2.10	Example of light microscope	26
2.11	Portable Surface Roughness Tester - TR200	28
3.1	Light blue spray paint	30
3.2	Crystal clear lacquer	31
3.3	Sand paper	32

3.4	Example of sample with dimension (20mm × 20mm × 2mm)	33
3.5	The process of grinding/polishing	35
3.6	Set up apparatus for contact angle measurement	37
3.7	Example of roughness measurement	38

LIST OF TABLES

TABLE	TITLE	PAGE
4.1	Image of contact angle and surface of one layer spray coating	40
4.2	Contact angle and roughness for one layer spray coating	41
4.3	Image of contact angle and surface of two layers spray coating	42
4.4	Contact angle and roughness for two layers spray coating	43
4.5	Comparison of contact angle between one layer coating and two layers coating	43
4.6	Comparison of roughness between one layer coating and two layers coating	44
4.7	Image of contact angle and surface of one layer spray coating	46
4.8	Contact angle for one layer spray coating	47
4.9	Images for contact angle and surface of two layers spray coating	47
4.10	Contact angle for two layers spray coating	48
4.11	Images of contact angle and surface of stainless steel	49
4.12	Contact angle for stainless steel	50
4.13	Images of contact angle and surface of copper	51
4.14	Contact angle for copper	51
4.15	Comparison of contact angle for all materials	51

LIST OF GRAPHS

GRAPH	TITLE	PAGE
4.1	Comparison of contact angle between one layer coating and two layers coating	44
4.2	Comparison of roughness between one layer coating and two layers coating	45
4.3	Comparison of contact angle for all materials	53

LIST OF ABBREVIATION

SEM	Scanning electron microscope
PC	Personal computer

CHAPTER 1

INTRODUCTION

1.1 Background

Hydrophobic is a word from Greek where the words hydro- which means water and -phobia which means fearing of heating. So, the general means of hydrophobic is naturally repelled or fails to mix with water. In another words, it also means that the surface of water will repelled from the surface of the materials coatings and causing the droplets to form. Water will forms a film on the surface without a hydrophobic surface which leading to the high losses. Hydrophobic can be determined if the droplets forms a sphere that barely touch the surface and it will have contact angle more than 90 degrees. Superhydrophobic surfaces exhibit superior water repellent properties. It has the same nature as the lotus leaf. When two hydrophilic bodies are brought into contact, any liquid present at the interface forms menisci, which increases adhesion/friction and the magnitude, is dependent upon the contact angle. Though the definitions of these terms are less precise, surfaces where tight droplets form a contact angle of more than 160 degrees are considered super hydrophobic. It exemplifies the behavior of the super hydrophobic from nature comprises micro-Nano roughness on its surface structure. One of the examples of super hydrophobic is lotus leaf as the contact angle is greater than 150 degree. The effect of hydrophobicity on lotus leaves will be showed in Figure 1.1. Water drops that fall onto them bead up and roll off leaving the leaves dry. Lotus leaves also

have the ability to stay clean because when the droplets roll, they will pick the dirt together which is called as self-cleaning (David, 2013).

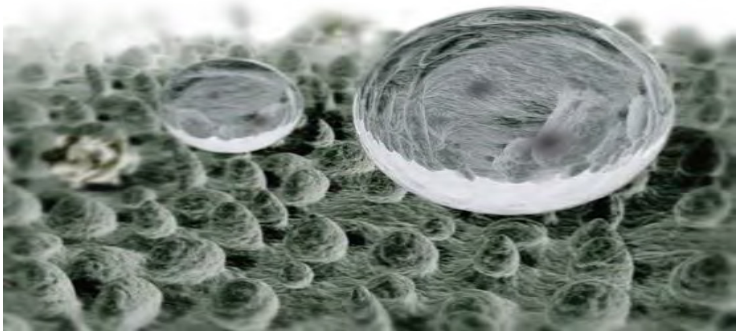

Figure 1.1: Computer Graphic of the ‗Lotus Effect'(David, 2013)

Hydrophobicity can be applied as waterproof devices, anti-corrosion, anti- icing, self-cleaning and some kind of similar function that are non-wetting related application. As water is the main reason of corrosion mechanism, it is important to reduce the presence of water contact with the surface. Hydrophobic and superhydrophobic coating can be used in every area. There are a few types of application that using hydrophobic such as solar panels, displays, windows, paints and fabric which coated by hydrophobic coating (Ramakrishna et al. , 2015).

So, for this project, two factors that affecting the hydrophobicity that will be studied which are effect of the thickness of coating on the hydrophobicity and the effect of surface roughness on the hydrophobicity. The detailed of the both two factors will be studied further throughout the experiment. By studied the two factors, improvement on the surface coating can be made.

For fundamental and aspects, one of the important properties of solid surface is wettability. The most factors that affect the wettability are surface energy and surface roughness. The hydrophobicity will be enhancing if only the surface energy is lower. So, for higher hydrophobicity, it is important to provide proper surface roughness. Contact angle of water also is one of the criteria for the evaluation of the hydrophobicity of the surface. The higher contact angle shows that the surface is more hydrophobic. Wettability is affected by surface microstructure, roughness and surface free energy. It shows that the higher of the surface roughness can affect the hydrophobicity (Bharathidasan et al., 2014).

In this project, the surface of the hydrophobic can be observed by light microscope. Light microscope is easy to handle. It contains two basic concepts which are magnification and resolution power or numerical aperture. The magnification power is provided by ocular lens which usually the power is 10x and 15x. There also four objective lenses on a microscope consisting of 4x, 10x, 40x and 100x (Fabio, 2009). Then, the roughness of the surface can be calculated by using profilometer or portable surface roughness tester.

1.2 Problem Statement

Hydrophobic has the application of water proofing, self-cleaning, anti-corrosion, and anti-icing. It can help to protects things like fabrics, electronics devices and glass window from water. There are a few problem faced that need to be solved by the application of hydrophobic coating. For example, air friction produced high amount of fuel consumption and pollution when it is applied to the hull of the ship and flight vehicle. Other than that, the high cost in maintaining the clean of the curtain glass of building, solar cell, surface of the satellite

antenna and front windscreen of the vehicle. So, by applying the hydrophobic coating, the problem faced can be reduced Other than that, some materials also easy to corrode when are being exposed to the water that it is hard to maintaining the shape or strength of the materials. This problem can be reduced by makes the devices as the hydrophobic where it can be water proofing devices.

1.3 Objectives

The objectives of the project are as follows:

1. To investigate the effect of coating thickness on contact angle.
2. To observe the surface morphology on different surface roughness of the polymer coating surface.

1.4 Scope of project

The scopes of this project are:

Four different grit of sand paper used in this project was 2000 grit, 1200 grit, 360 grit and 180 grit to differentiate the surface roughness. The grit of sand paper will represented the surface roughness. Only two different thickness of polymer coating used which are one and two layer. Others thickness of polymer coating will not be included in this study. For the first method, the material used is aluminum with polymer coating while for second method the materials used are aluminum with polymer coating, copper and stainless steel.

1.4 General Methodology

The actions that need to be carried out to achieve the objectives in this project are listed below.

1. Identify the problem statement.

   The problem related of the needed of the hydrophobic coating will be studied.

2. Write literature review.

   The journals and articles regarding the effect of thickness and surface roughness to hydrophobicity will be reviewed. The information regarding the machine that will be used also will be reviewed.

3. Find the material and fabricate.

   Find the aluminum, copper and stainless steel that will be used in the experiment and fabricates by following the specific parameter.

4. Prepare the sample.

   After fabricate, the sample will be prepared by spraying the coating on the surface of the sample. Four different grit of sand paper will be used to study the effects of the surface roughness.

5. Testing.

   Different spots on the sample will be dropped with water before being tested. Then, the roughness will be observed by using light microscope.

6. Data and results.

   The result of the contact angle will be tabulated by following the thickness of the spray coating and the different roughness of the coating surface. The figure from the light microscope also will be included.

7. Report writing.

   A report on this study will be written at the end of the project.

The methodology of this study is summarized in the flow chart as shown in Figure 1.2.

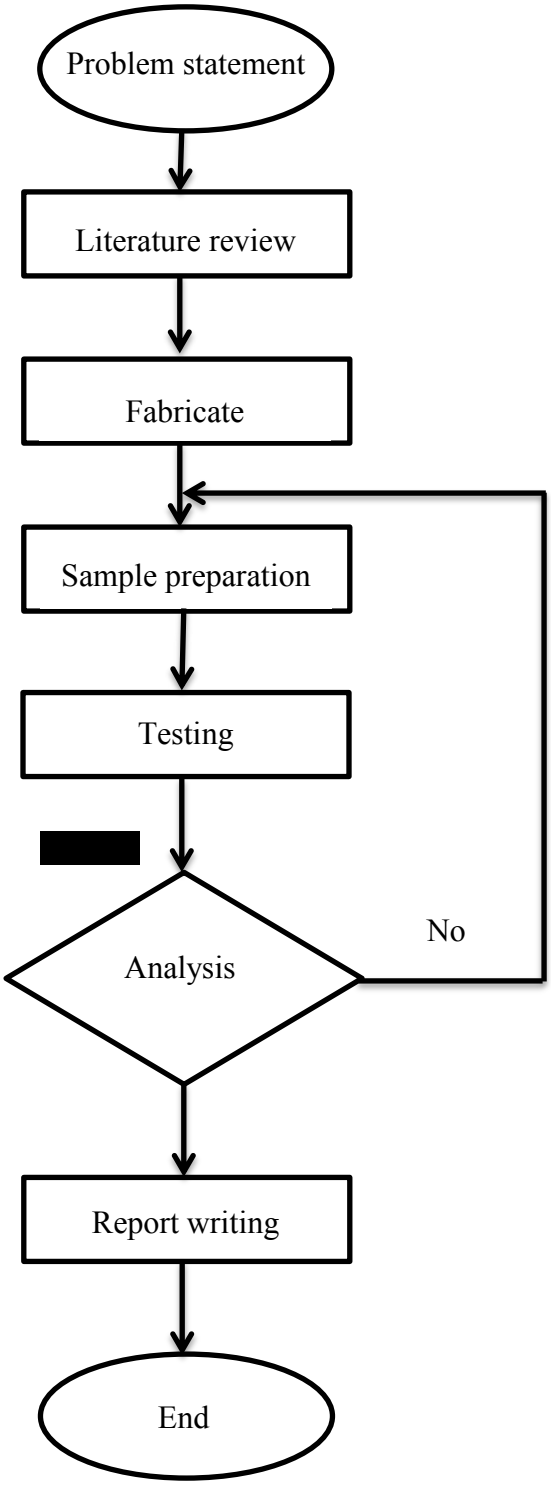

Figure 1.2: Flowchart of general methodology