UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOP HIGH SPEED STEEL FLYING CUTTER

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Process And Technology)
(Faculty of Engineering Technology)

By

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I hereby, declared this report entitled “PSM Title” is the results of my own research except as cited in references.

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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 Engineering Technology (Process) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

This paper show the fabrication process of the flying cutter cutting tool for use at the milling machine. This cutting tool suitable for cutting soft material such as Delrine, Aluminium and Copper. To fabricate this cutting tool, mild steel was selected as the raw material for fabricate tool holder. The cutting medium is made from High Speed Steel singel point lathe cutting tool. Consept of the design is follow the carbide insert face mill, the different is carbide insert face mill have many cutting point but for flying cutter it only have singel point cutting. Before fabricate cutting tool, some research about cutting angle have been study to make this project successful. Flying cutter can be classified as the chipest cutting tool and it often custome made from the machineing operator. From this cutting tool, it can reduce maintenance cost because it can be sharpen only by using table grinding machine. Compare than carbide insert face mill, if the cutting point getting burn or crack, it need to replace with a new one. After the fabrication is done, it has been running at the CNC milling machine and doing facing operation at the sample material which is Delrine, Aluminium and Copper.

ABSTRACT

Kertas kerja ini menunjukkan proses fabrikasi pemotong alat *flying cutter* untuk digunakan pada mesin milling. Alat ini sesuai untuk memotong bahan lembut seperti Delrine, Aluminium dan tembaga. Untuk mereka bentuk alat pemotong ini, keluli lembut telah dipilih sebagai bahan mentah untuk pemegang alat pemotong. Medium memotong diperbuat daripada High Speed Steel alat pemotong mesin larik. Consept reka bentuk adalah mengikut *carbide insert face mill*, yang berbeza adalah *carbide insert face mill* mempunyai banyak titik memotong tetapi untuk *flying cutter* ia hanya mempunyai satu titik pemotong. Sebelum membuat alat pemotong, beberapa kajian tentang sudut pemotongan untuk membuat projek ini berjaya. *Flying cutter* boleh diklasifikasikan sebagai alat pemotongan yang murah dan ia dibuat secara persendirian dan dilakukan dengan pengendali mesin kejuruteraan. Dari alat pemotong ini, ia boleh mengurangkan kos penyelenggaraan kerana ia boleh ditajamkan mengunakan *grinding machine.* Perbezaan dengan *carbide insert face mill*, jika titik pemotongan telah terbakar atau retak, ia perlu digantikan dengan yang baru. Selepas fabrikasi dilakukan, ia akan digunakan pada mesin *milling* CNC untuk melakukan pemotongan pada bahan sampel iaitu Delrine, Aluminium dan tembaga.

DEDICATION

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake.

It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it done one step at a time.

I would like to express my deepest gratitude to my supervisor, En Muhammad Syafik Bin Jumali for his unwearing support, collegiality and mentorship through this project.

To ancestors who paved the path before me upon whose shoulder I stand.

This is also dedicated to many friends who supported me on this journey.

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Beside my advisor, I would thank my co-supervisor, Mr Syahrul Azwan Bin Sundi@Suandi, all technician, Mr Azimin Bin Ibrahim who help me to complete my first final year project. I thank my fellow classmates for the stimulating discussion and for the sleepless night we working together before the deadlines. Last but not least, I would like to thank my family, my parents, my brother and sister for supporting me spiritually throughout writing this thesis and my life in general. Without whose love and encouragement, I would not finished this thesis.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Al	-	Aluminium
ANOVA	-	Analysis of Variance
ASEAN	-	Association of Southeast Asian Nations
AT	-	Annual Turnover
Cl	-	Chlorine
F	-	F Test (ANOVA)
FMM	-	Federation of Malaysian Manufacturers
HU	-	Highly Used
IT	-	Information Technology
LU	-	Least Used
M	-	Million
MITC	-	Melaka International Trade Centre
MNC	-	Multinational Company
MU	-	Moderately Used
NOYP	-	Number of Years in Operations
NOE	-	Number of Employees
NU	-	Not Used
PP	-	Polypropylene
PCL/TPS	-	Polycaprolactone/Thermoplastic Starch Blend
RM	-	Malaysian Ringgit
SD	-	Standard Deviations
SME	-	Small Medium Enterprise
U	-	U Test (Mann Whitney Test)
>	-	More than
σ	-	Stress
ϵ	-	Strain
τ	-	Torque

CHAPTER 1
INTRODUCTION

1.1 Background

Fly cutters is rotary tools that use one or single-point tools for plane surfacing. The fly cutter is a single-point cutting tool similar to a lathe tool mounted in a special holder. There are many types of fly cutters. Examples include a single point cutter, rotary cutting tool, and a rotary carving tool. A single point cutter is designed for cutting densely populated corals. Its needle-like points help to reach in harder to reach areas and precision ground edges gives a precise and cleaner cut every time. A rotary cutting tool cut all types and layers quickly and easily without distorting pattern cutting lines. A rotary carving tool is used to carve on hard materials such as wood, to carve through the grain, or even engrave a piece of blown glass. Fly cutters may also be a single or double fly cutter bit. A single fly cutter bit type is derived from a machinist's designs and is used in material up to mild steel. A fly cutter bit type is available for more stability and faster cutting, but are more difficult to setup.

1.2 Problem Statement

The problem statement is about an inappropriate cutting tool to cut soft material. Classify the type of cutting tool with the type of material to be cut. From this, it can reduce cost from buying the new cutting tool.

1.3 Objective

In this study, some targets have been select to focus on investigations. Therefore the main objectives of the current project are:

a) To produce/fabricate flying cutter tool
b) Able to test cut on soft material e.g. Delrine, Aluminium and Copper

1.4 Scope

This project scope focused that can be cut soft listed material that is Teflon, Delrin, Aluminium and Copper. While doing cutting test, coolant is be required to prevent heated at the cutting tool. Cutting operation is done by using CNC milling machine. The body of the flying cutter is made from mild steel and the tool bit is made from the High Speed Steel lathe cutting tool.

1.5 Organization of the thesis

This report has been divided into five chapters. The five chapters are an introduction, literature review, methodology, result, discussion, conclusion, and recommendation. Chapter 1 is the introduction of the project including the background, problem statement, objectives, and scope of work. Chapter 2 is written about the literature review based on the theories and experiments from previous journals. Chapter 3 the methodology introduces about the materials, equipment's, fabrication, procedures and experimental work. For chapter 4 presents the results of currents study based on tables and graphs. Besides that, all the result of the project will be discussed in detail in this chapter. Lastly, in the chapter 5 explanations about the conclusion and recommendation for future work are presented.

CHAPTER 2
LITERATURE REVIEW

The flying cutter usually uses to face soft and large material. Reference and information were gained from journal, catalog and website. This literature review focused on the material properties of the raw material and type of machine that use to fabricate flying cutter.

2.1 Carbide insert face mill

The function of carbide insert face mill is quite similar with flying cutter. The different is flying cutter use high-speed steel single point cutter to cut the material. For the carbide insert face mill a body rotatable about an axis and including a circumferential end edge (Adamson et. al, (1982). Face mill with adjustable cutting inserts). Normally to get better surface during cutting process using carbide insert face mill is around 710-1,400 rpm with 224-450 mm/min depth of cut (Rawangwong et al. 2014). Nowadays, many types of face mill has being developed along with the progress and variation milling machine. According to from (cnccookbook.com, 2011) the type of face mill includes the degree of cutting which is 45 and 90 degree. The another type is the number of the insert, the more number of carbide inserts the more capability to get higher depth of cut.

2.2 High speed steel single point cutting tool

High speed steel single point cutting tool usually use at the lathe machine. The capability of this cutting tool is wear resistance and heat resistance with sufficient strength and plasticity. Therefore, the problem of wear resistance of tool for conditions of cutting always saves the urgency, despite a plenty of new instrumental materials and methods of increasing their wear resistance. By using this tool it can give profitability, reliability and productivity (output) of cutting process, on the whole depend on the service characteristics of the cutting tool as the report given by (Kononov et.al, 2000).

2.3 Mild Steel

For this project, mild steel is used to fabricate tool holder. Mild steel is a very popular metal and one of the cheapest types of steel available. It's found in almost every metal product. This type of steel contains less than two percent carbon, which makes it magnetize well. Since it's relatively inexpensive, mild steel is useful for most projects requiring huge amounts of steel. Mild steel does not have great structural strength, making it unsuitable for building girders or structural beams. Since it has a weak resistance to corrosion, mild steel must be painted or sealed to keep it from rusting. Putting a coat of grease or oil on mild steel also helps to protect it from corrosion. Because it is a soft material, mild steel is easy to weld and machining, whereas high-carbon steels, such as stainless steel, require the use of specialized welding techniques. Also, electricity can flow through mild steel easily without impacting its structural integrity. Mild steel is a variant of hard steels, which makes it much less brittle and enhances its flexibility.

2.4 Aluminium

Aluminium has a density around one third that of steel or copper making it one of the lightest commercially available metals. The resultant high strength to weight ratio makes it an important structural material allowing increased payloads or fuel savings for transport industries in particular. Information from (www.aluminiumdesign.net, 2012) states that pure Aluminium doesn't have a high tensile strength. However, the addition of alloying elements like manganese, silicon, copper and magnesium can increase the strength properties of Aluminium and produce an alloy with properties tailored to particular applications. For the corrosion resistance of Aluminium, when exposed to air, a layer of Aluminium oxide forms almost instantaneously on the surface of Aluminium.

This layer has excellent resistance to corrosion. It is fairly resistant to most acids but less resistant to alkalis. The thermal conductivity of Aluminium is about three times greater than that of steel. This makes Aluminium an important material for both cooling and heating applications such as heat-exchangers. Combined with it being non-toxic this property means Aluminium is used extensively in cooking utensils and kitchenware. Along with copper Information from (www.aluminiumdesign.net, 2012) said, Aluminium has an electrical conductivity high enough for use as an electrical conductor. Although the conductivity of the commonly used conducting alloy (1350) is only around 62% of annealed copper, it is only one third the weights and can therefore conduct twice as much electricity when compared with copper of the same weight. From UV to infra-red, Aluminium is an excellent reflector of radiant energy. Visible light reflectivity of around 80% means it is widely used in light fixtures. The same properties of reflectivity make Aluminium ideal as an insulating material to protect against the sun's rays in summer while insulating against heat loss in winter.

2.5 Delrin

Delrin is a crystalline plastic which offers an excellent balance of properties that bridge the gap between metals and plastics. Delrin possesses high tensile strength, creep resistance and toughness. It also exhibits low moisture absorption. It is chemically resistant to hydrocarbons, solvents and neutral chemicals. These properties along with its fatigue endurance make Delrin ideal for many applications such as for chemical application, it uses full for the garden chemical sprayer, carburetor venture, pumps and beverage valves. (www.complast.com) said it has high wear resistance for many types of bushing, bearing and cams. It also suitable to fabricate gear such as spur, cluster, helical and bevel. For the electrical purpose, it can use to made automotive switches and connectors, coil forms, telephone terminal strips and relay component. Delrin grade is 100, 500, 900 and 1700. The grades show the different melt viscosity of the Delrin. The Delrin product are also available as special grade with additives that allow for enhanced UV stability, faster cycling, lower friction and wear, and toughness.

Standard Delrin Resin Products				
Melt Flow Rates	Processing Method	Process Characteristics	Product Characteristics	Applications
100,[a,b] 100P	Extruded, Injection Molded	High viscosity resin used in easy-to-fill molds. Surface lubricated. Delrin 100P has superior processing characteristics.	Maximum toughness without modification.	Highly stressed parts; mill shapes, sheet, rod tubing.
500,[a,b] 500P	Extruded, Injection Molded	General purpose, surface lubricated resin. Delrin 500P has superior processing characteristics.	Good balance of properties.	General mechanical parts—gears, fasteners, cams. Mill shapes for production machining.
900,[a,b] 900P	Injection Molded	Low viscosity, high flow, surface lubricated resin. Delrin 900P has superior processing characteristics.	Similar to Delrin 500 with slightly lower tensile elongation and impact resistance.	Multicavity molds and thin sections that are difficult to fill.
1700, 1700P	Injection Molded	Ultra-low viscosity suitable for special purpose molding. Delrin 1700P has superior processing characteristics.	Balance of properties lower than general purpose Delrin.	Parts with complex shapes, thin walls, long flow paths or multicavity tools.

Figure 2.5 Compositions of Delrin Acetal Resins (www.complast.com)