CHAPTER 1

INTRODUCTION

1.0 Introduction

A general overview of the project entitled with "Green Manufacturing: Effect of Vortex Tube on Machinability in Dry Turning" is provided throughout this chapter. Vortex Tube for spot cooling during manufacturing process had been started to be implement widely among industry. The purpose of this project is to study on the effectiveness of Vortex Tube on improving the performance of machined product and cutting tool with the consideration of environmental issue and utilization of resources such as carbon footprint.

This chapter started with the brief description on the background of the study, followed by the problem statement. The objectives aimed to be achieved in this project and the scope of the project being extended is discussed and documented in this chapter. The main vision of this project is to have a detailed investigation on the effect of Vortex tube on the machinability of material in terms of power consumption, surface roughness and tool wear in dry machining.

1.1 Project Background

Heat was generated during manufacturing process at the cutting point of three sources which are primary shear zone where the major part of energy converted to heat, secondary deformation zone at the chip-tool interface where further heat generated due to rubbing between tool-chip interface and third is the worn out flank which generated by

rubbing between tool and finished surface. The possible detrimental effects of high temperature on cutting tool are: rapid tool wear, plastic deformation of cutting edge, thermal flanking and fracturing of cutting edge, dimensional inaccuracy of workpiece and surface damage by oxidation or rapid corrosion (ME IIT Kharagpur, 2009).

During turning operation, high temperature was generated in the region of tool cutting edge which defined as summation of plastic deformation of involved in chip formation, friction between tool and workpiece and friction between tool and chip. Cutting tool become softens at high temperature, thus thermal dependency tool wear is easily formed and the surface finish of product is affected. The amount of heat loss in cutting edge region is depending on the thermal conductivity of tool and cooling strategy being applied (Sreejith and Ngoi, 2009).

In order to reduce heat generated for the purpose of quality improvement and cost effectiveness, new cooling approaches had been introduced such as near dry machining, cryogenic cooling and compressed air cooling. Thus, as for the environment protection and fulfillment for legislative ISO 14000 Environment Management System in balance with the industrial benefit, the used of chilled air to replace traditional lubricant which to eliminate adverse effect to environment and as improvement for traditional dry machining for better surface quality and prolonged tool life. The used of Vortex Tube for spot cooling had been preferred by industry for its cost effective, user friendly and flexibility of installation compare to other non-lubricant cooling method.

Align with the concept of green manufacturing that encourage the principle of energy resource utilization and environment sustainability improvement, the main measurement being used for the evaluation on effectiveness of different machining condition applied is the energy efficiency. Theoretically, the power efficiency of a machining process is a ratio of absolute minimum energy required (usually refer to the carbon-footprint) for a task to the total amount of removed material. As for experimental measurement, efficiency of machining is also defined as specific energy which refers as the ratio processing power and material removal rate (Dietmair and Verl, 2009).

1.2 Problem Statement

The main core issue being studied in this project is the performance of selected cooling strategy which is the cooling air by Vortex Tube applied in the dry turning compared with the purely dry turning without any cooling strategy in the context of material's machinability, especially power consumption.

From the background study, the study on effects of cooling strategy had mainly measured by tool wear and surface roughness which cause the insufficient data for comparison of the performance on power consumption and energy utilization. There is a need for a clear defined power consumption measurement method to be established and become standardized judgment for the evaluation of the cooling strategy effects in the context of energy utilization.

This paper present the complete experimental set up for two different cooling strategies used which traditional dry machining and chilled air dry are machining through Vortex Tube with the main measured output in the context of specific energy consumption obtained through formula. The experiment is run under various cutting parameters such as spindle speed, freed rate and depth of cut. The data being collected and analyzed through comparison between both output data from two different cooling strategies with the descriptive statistical tool. This study aims to perform an energy efficiency comparison between the two different cooling strategy implemented during turning process under varying cutting parameters. Other than that, the surface roughness and tool wear also being measured in order to obtain the overall performance comparison and evaluation of material's machinability for the different cooling strategy chosen in this research.