CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Nowadays waterjet cutting is one of a method that is widely used in most of industrial applications because its ability to cut material either hard or soft by using water stream. The cutting process can be done by applying a pure water to cut soft materials such as foam or by adding abrasive to the stream to cut hard materials such as metals effectively. The operating principle of this process is by forcing a large volume of water through a small hole in the cutting head. The small hole or either known as orifice is place at the upper part of nozzle to reduce the cross sectional area to achieve a high velocity of water by maintaining a constant volume travelling through the cutting head. The high velocity of water will accelerate when going out the nozzle to cut the materials.

Typically in a larger manufacture industry the stream of water produced under the pressure of 276 MPa up to 414 MPa (Hashish, Steelers, & Bothelli, 1997). During the cutting process the material is placed on the bed and the CNC controller is programmed. Once the process start the nozzle will move around the bed to cut the material. A typical waterjet machine consist of controller, cutting head, pump, system and machine table. The movement of cutting head is controlled by a computer. When the computer has been properly programmed, the cutting head will move around the bed of a machine as per instructed. The
cutting head will move all over the area of machine’s bed to get the desired cut. The cutting head of a waterjet machine allow the water to enter at the inlet and will be left through a small orifice located at the bottom part of cutting head. In the case of abrasive cutting, the high velocity exits the small orifice to create a suction effect to pull in abrasive particles in the nozzle. Most importantly the waterjet machine works with various types of high pressure pump. The high pressure pump provides designated flow rates of water at a consistent high pressure. Finally, a waterjet machine table is where the material to be cut is placed. The maximum area that the XY motion control system can move is by determine the length and the width of the machine table (Hashish et al., 1997).

As the popularity of waterjet has grown, there are several reasons why waterjet has become the recent versatile and flexible machining tool. The combination of water and abrasive in material cutting allow waterjet to cut with a wide-ranging variety of material. The materials are included copper, brass, aluminium, brittle materials and flammable materials. Not only that there is no heat affected zone (HAZ) on materials because the little heat formed by the waterjet is absorbed by the water and passed into the catch tank (Hace & Jezernik, 2004). Moreover waterjet machine is one kind of cutting process that is more environmentally friendly. Typically, the abrasive use for abrasive waterjet is garnet where garnet is a non-reactive mineral that is biologically inert (Hace & Jezernik, 2004).

1.2 PROBLEM STATEMENT

Waterjet machine used in industrial application nowadays only use in larger size. The cost of producing one waterjet machine depends on the size of the bed which will indicates the cost of the waterjet machine itself. Meanwhile the cost of purchasing one whole set water jet machine may ranges from hundred thousand up to half a million. Considering to its industrial size, once the waterjet machine is being placed, it is fixed and difficult to move and consuming many space to be installed. Thus the problems mentioned are common therefore this project is carried out to develop a miniature waterjet machine for university used with expected result to minimize the size of waterjet machine and able to make the waterjet moveable.
1.3 OBJECTIVES

This purpose of this study are as follows

1.3.1 To design a miniature waterjet machine by using product design and development concept.

1.3.2 To develop a low cost miniature waterjet machine.

1.4 PROJECT SCOPE

This project is related in developing a waterjet machine for the universities used that will comes in smaller size and minimum production cost. This project will focus on main components of waterjet machine which are the pump, pipe and cutting head, machine bed and CNC controller. Thus to achieve the purpose on developing miniature waterjet machine, the type of components that will be reduced in size are the pump, machine bed and CNC controller. However this product development process will be done according to VDI guidelines 2221 (VDI, 2004). This product development guideline divides into four main phases that contain several work stages that have to be worked out. Therefore, at the end of these phases the design of the product will be carried out.