



RESEARCH PROJECT 2

TITLE:

SWIRLING STABILITY OF FLUID FLOW AT SUPERSONIC VELOCITY IN CYCLONE

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TABLE OF CONTENT

ABSTRACT

AKNOWLEDGES

CHAPTER 1: THE INTRODUCTION 4

INTRODUCTION

PROBLEM STATEMENT

OBJECTIVE

CHAPTER 2: LITERATURE REVIEW 8

THEORY

-STABILITY OF SWIRLING

-CYCLONE SEPARATOR

CHAPTER 3: METHODOLOGY 25

-DESIGN OF CYCLONE

-ANSYS SIMULATION METHOD

PROCEDURE

GEOMETRIC

PHYSICAL MODEL

SOLUTION METHOD

RESULT AND GRAPH

ANIMATION

CHAPTER 4: RESULT AND DISCUSSION 55

-SWIRLING STABILITY

CHAPTER 5: CONCLUSION AND RECOMMENDATION 76

-CONCLUSION

REFERENCE	77
APPENDIX	79

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CHAPTER 1

INTRODUCTION

ABSTRACT

Cyclone is device that use the angular momentum principle to separate the solid particle in the gas. There are many mechanism of working principle of cyclone in the industry. But not all of that mechanism is suitable for at that what we want. In this study, we are ready specific to focus on how the effect on the swirl stability when it flow at supersonic speed and also to study their flow behavior in the cyclone. By using mathematical modeling of k-epsilon RNG. In the standard k-epsilon model the eddy viscosity is determined from a single turbulence length scale, so the calculated turbulent diffusion is that which occurs only at the specified scale, whereas in reality all scales of motion will contribute to the turbulent diffusion. In this section, we used the numerical method k-epsilon RNG because it is more accurate to handle the high swirl flow. RNG is model to use for suitable condition with cyclone vortex. In this case of determine the stability of swirl then the use of RNG model is very better than Realizable. RNG k- ϵ model is design to handle the swirl flow compare to the Realizable k- ϵ model (Hreiz, 2011). The swirl number will shows the stability of swirling flow at velocity Mach 1 and velocity Mach 4. The vortex core region at velocity Mach 1 is very smooth when we compare to the velocity at Mach 4. In this study, we can summarized that the stability of swirling flow is can come in various form and at the same time when it is bounded with vortex. Streaky speaking, the stability of swirl in cyclone at supersonic speed is not stable. But in this experiment the slowed the velocity the stable it is. At the same time, the study of behavioral of supersonic flow in cyclone is a something news because of the vortex breakdown was found. Not much literature today was study about the supersonic flow in cyclone.

RESEARCH BACKGROUND

In this research, it study about how to design the cyclone separator that can stabilize the swirling of fluid flow at supersonic velocity. Generally, any device that is contact with the fluid dynamic, it is supposed to be need to run the analysis. This is because the physical behavior of fluid is always change for every condition for example physical state of fluid, temperature, pressure and so on will affect the efficiency of separator. Moreover, the device also need to design which is it can run in perfectly. At around thousand years ago, the study of fluid dynamic is already conduct in the laboratory. But, it is very high cost and hard to conduct in a large scale. To manifestos this problem, scientist, engineer and mathematician already design the tools that can predict and analyst the fluid dynamic without go to the laboratory. The device is a computer software that can analyst the fluid dynamic behavior by using the computer. This computer software is apply the CFD where it stand for Computational Fluid Dynamic. The CFD is the study of fluid dynamic by using mathematic to predict and analyst what would be happen to the fluid if we disturb any component of fluid in motion. The study of CFD is application from three basic fundamental where it is Conservation of Mass, Conservation of Momentum and Conservation of Energy. From this fundamental scientist can create an equation that can explain the behavior of fluid dynamic.

Supersonic flow is special parameter in this research because it deal with the aerodynamic knowledge. Straightly speaking, this research is using computer software to run the analysis. The CFD tool such as ANSYS FLUENT is very suitable to running this experiment without to go to laboratory. Also supported by k-epsilon method where it usable when deal with turbulent flow. The separation process between solid and gas usually use the cyclone device. This device is provide high efficiency of separation when we compare to the others device. Cyclone is device that use the angular momentum principle to separate the solid particle in the gas. There are many mechanism of working principle of cyclone in the industry. But not all of that mechanism is suitable for at that what we want. In this study, we are ready specific to focus on how the effect on the swirl stability when it flow at supersonic speed and also to study their flow behavior in the cyclone. There are many section that study the stability of swirl or also we know that vortex such as the areas in meteorology, astronomy, aeronautical engineering and others. The great ideal and several of method that study the supersonic behavior at today. In study of cyclone separation, they reported that the efficiency of separation process is depend on how much the particle can be remove. From this statement, so many literature talk about how to optimize the cyclone separator one of them is by using supersonic flow. The supersonic flow is the most important part that we need to consider first. Supersonic flow is also tend to disturb the swirling of flow because