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Prediction of Vortex Flow Visualization using different Fluids by Towing Tank Method

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***Abstract*—This paper presents a powerful surface based techniques for experimental work of complex flow fields resulting from towing tank method, these flows have a characteristics which is independent of the medium and its velocity, but depends only upon a parameter called Reynolds numbers which is a non dimensional number formed by the velocity, geometrical parameter and kinematic viscosity of fluid. There are many situations where one needs to compare with two or more data sets. it may be experimental results, physical parameter, flow visualization through photographs and so on. This paper focuses on the comparative flow visualization (Streamline) of vortex flow between two different fluids like water and diesel by identifying the physical parameter using towing tank based experimental setup and also predict the experimental results with MINITAB for the regression analysis.**

***Index Terms*— Fluids, Vortex flow, Visualization Techniques, Towing tank Method.**

I. INTRODUCTION

A flow visualization of the vortex flow has been presented in this paper. The flow visualization of decay of advection methods has implemented. These process are simulated by the novel technology called as flow animation with bland between warped version to represent the image of the vortex through the simulation based towing method with number of rare end images with photography. This method is also called as the image based flow of high frequency method. Some images are represented through the noise of frequency modulation and referred by the image flow visualization depends on component required for the measurement. Many of the vortex flow can be rewrite through the arrow mark of the direction at the leading edge of the component and the rare flow measurement and also called as the streamline of the given component. The topological images can be generated by adding extra emulsion to the image. Most of the image based flow to predict the unsteady flows, defined on arbitrary meshes; this will give a better achievement of the high performance of graphical solution of the any components [1].

Many of the primary and the secondary flow generated using the standard device called as the digital PCs and image can be developed. Whereas in image based flow measurement through the spinning activity of component known as the turbulent flow of the fluid. Any spiral motion with closed streamlines is vortex flow. The motion of the fluid spinning rapidly from the center to the outer area of the component called as

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vortex. Vortex is also called as the irrotational flow of the fluid. Continuous decreasing in the vortex from the center to the extreme end of the fluid means form maximum to zero. The speed and force of fluid decrease progressively with distance from the center, the free vortex flow potentially pressurized from the externally applied speed and the force [6].

II. Litrature Review

Visualization is insight view of the large number of datasets produced by these simulations. The ranging of the texture effect through the arrow plots for dense fluid [1]. The flow pattern can be measured in many separate regions. In the measured flow region, the speed and force changes continuously from the center to the extreme end of the fluid as well as magnitude. This trend is also found, but to a lesser extent, in the external flow region [2].

Much research has been carried out relating to the interaction of an out flow or jet with a cross flow. On the other hand, information for the case where fluid is drawn from a free stream into an inlet seems to be limited. Some research relating to suction through small holes to control boundary layer flows are reported [3]. The mechanism of capitation erosion may be explained in terms of the pulsation of a vapour bubble. The bubble of the surface generated at the opening end of the component, is greater enough to expand and collapse where the movement of the flow is happen from the surface depending on the flexibility of the component and the fluid. The non-dimensional buoyancy of the bubble and the stand-off distance of the bubble. When the bubble start to congesting and bombarding form the fluctuation of the vortex flow, the jet of water start initiating the cavity at the component [4]. Ocean currents are sometimes referred to as marine currents or tidal stream and are the resultant of gravitation effects of the planets and the moon. Due to this stream line the environmental changes experienced form day today activity varies continuously with different modified regions [5].

Flow visualization by injecting streaks of dyes into water is a popular technique and provides an excellent opportunity to view the formation and development of small flow features such as boundary layer and vortical structures at relatively high Reynolds numbers [7].

III. Objective and Scope of The Work

The objective of this work is to analyze the use of vorticity in the field line approach and to study the numerical visualization of the incompressible flows. Field line visualization techniques are used to analyze the particle trace and the seeding strategy of the flow field. According to theory of physics, fluid dynamics is a sub discipline of fluid mechanics that deals with fluid flow of the natural science. In the fluid field of mechanics there are several sub disciplines including aerodynamics and hydrodynamics. Fluid dynamics has wide range of applications, such as calculating forces, moments and displacement on an aircraft, which depends on the physical parameter like temperature, pressure, speed, velocity and time.

The goal of this work is to understand and quantify the vortex visualization of the surface films using different geometric models. The salient feature of surface properties, free surface interactions is to analyze the beauty of the natural visualization in presence of density and viscosity parameter. The dynamics of a vortex ring formation with a free surface are like those of wave motion. Both processes involve local area of the surface covered by the model and displacement, results in visco elastic behavior of the interface. In this approach, techniques such as flow visualization tunnel and towing tank method are used. The techniques are inspired by the traditional flow illustration drawn by Dallmann and Abraham and Shaw in early 1980's, this work investigates the surface visualization of vortex by varying physical parameters.

IV. Experimental Setup

Typical qualitative analysis vortex wave forms of the kind discussed here are made in long, narrow wave tanks where plane waves can be generated mechanically with relative ease. Because a key goal of this work is to concurrently study the effects of vortex flows on surface properties on the dynamics of both capillary gravity waves and vortex rings, such a tank arrangement was not possible. An experimental set-up that allows for the generation of capillary gravity waves in the same tank that is used for vortex ring study was therefore developed. This marks an improvement over previous workers who have used separate tanks for characterizing free-surface properties. The glass-walled tank used in these experiments has dimensions 122 cm *X* 182.8cm and 14cm deep and has a 1.2 cm thickness.

Because of the tank dimensions, a long, exceptionally straight wave maker, positioned along one wall, would have been necessary to ensure perfectly plane waves. Aluminium powder is being used to identify the proper vortex formation in the tank with the movement of the bodies of different geometrical shapes. A carrier is being used to move the geometrical shapes. The carrier is placed on a channel to move the geometrical shapes from one end of the tank to other end. The height of the carrier is placed in such a way that the body floats on the surface of the medium.

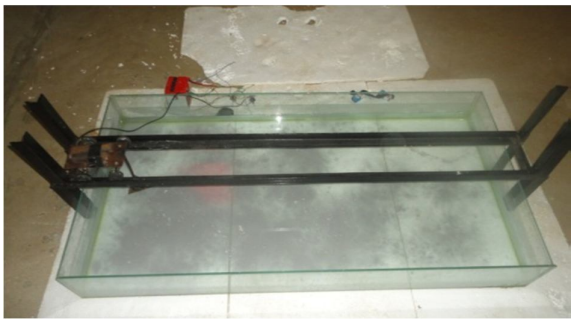


Figure 1: Towing Tank

A. Tachometer (Non Contact Type Sensor) and Aluminum Powder

It is used in order to find the speed of the trolley wheel which in turns sliding over the bridge which is connected to model. Aluminum powder used in order to get the better visualization for testing. Aluminum powder having atomic wt 26.98 and particle size around 200 mesh.

Figure 2: Tachometer

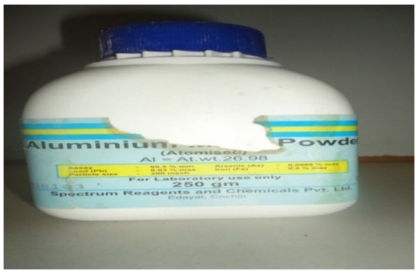


Figure 3: Aluminum Powder

B. Trolley

Trolley consists of a flat plate at the top end and four rubber wheels to run over the path way.

Figure 4: Trolley

C. Geometrical Models

Figure 5: Circular

Figure 6: Triangular

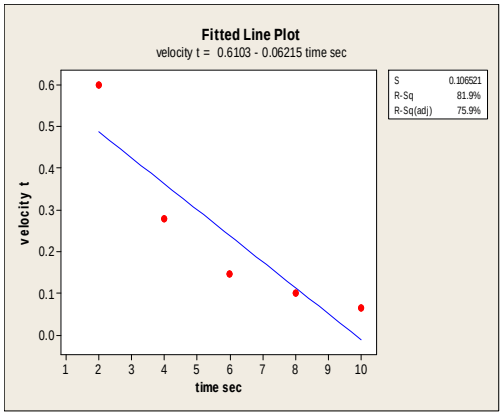
Figure 7: Drop like structure

V. Results & Discussion

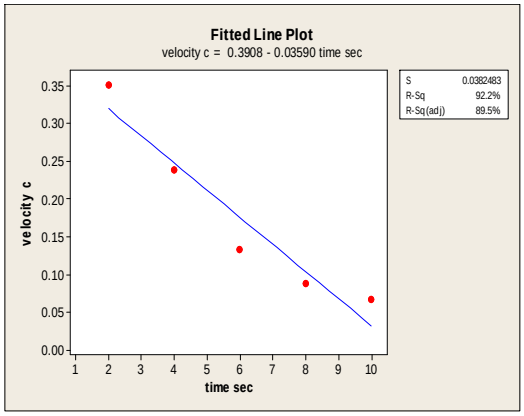
The objective of this work is the approach generated from the numerical and the photography of the incompressible flow in order to study the vortex field. We present a field line visualization technique that uses a specialized particle advection and seeding strategy.

In triangular, circular, and the drop like structure model velocity with respect to time were taken. Due to the small variation in the density of water and the diesel in the graph, resistant offered by the diesel is slightly more than compare to the water due to the viscosity difference and there may be a less velocity can be easily plotted.

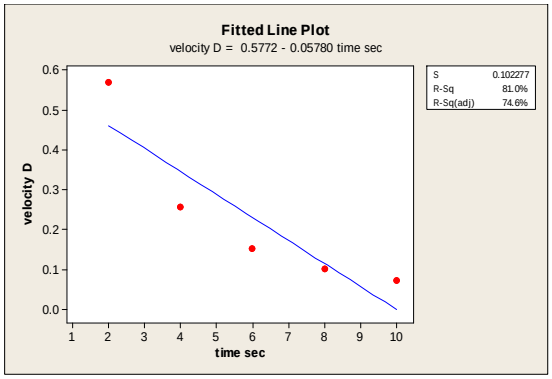
Graph 1: Velocity Vs time (Diesel as a medium)



Velocity Vs time (Triangular)

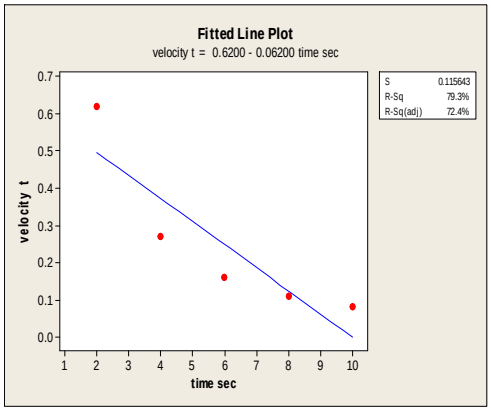


Velocity Vs time (Circular)

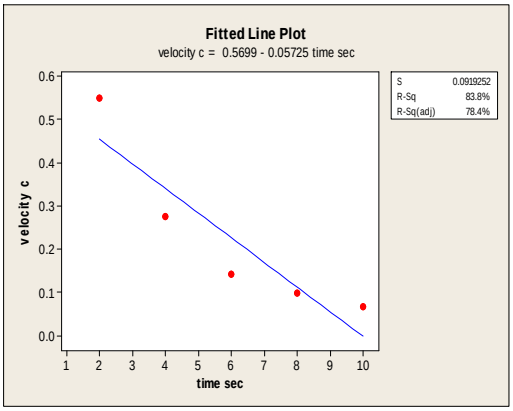


Velocity Vs time (Drop like structure)

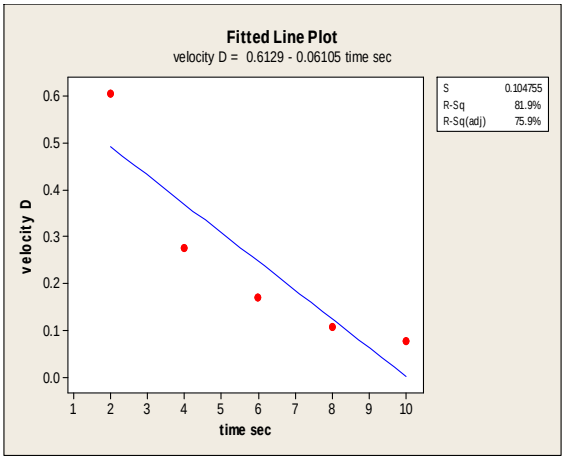
Graph 2: Velocity Vs time (Water as a medium)



Velocity Vs time (Triangular)



Velocity Vs time (Circular)



Velocity Vs time (Drop like structure)

VI. Conclusions

1. Different vortex of different geometrical models such as triangle ,circle and drop like structure have been found, visualized and photographed .Different geometrical bodies show different vortex which depends on the resistance offered by the drag medium or fluid

2. In water the density is high than compare to diesel and but the viscosity is less than the diesel, so that the visualization effect play an important role due to the variation of viscosity. Hence the surface visualization of vortex can be achieved qualitatively using water and diesel, in that water gives better performance that diesel.
3. We have compared parameter like speed, velocity and time with respect to drag medium over the surface of the fluid. We concluded that there is a slight variation in the velocity with respect to time between the water and diesel. Hence vortex field is minimum in diesel due to the less density and high viscosity and water get better vortex formation in the field line approach.
4. Experimental results obtained using towing tank method with the MINITAB achieves a good results and the regression analysis ranges from 0.79 to 0.92.

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