정상상태에서 기울어진 판 위를 흐르는 유체 파장의 정전기장의 영향에 따른 변화

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The change as an effect of an electrostatic field of free surface wave of film flow down an inclined plane under in Steady-state

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Introduction

A thin layer of liquid has played an important role in engineering processes because it has a higher transfer surface of heat and mass than the volume of through-flow. For example there are condensors, reactors, evaporators and so on. One application of a thin layer of liquid film occur in the design of a space radiator. The designs of space radiators in present day have used heat pipes made of materials such as nickel and copper, etc. But these radiators are heavy, so the efficiency per unit area of radiating space is low. Therefore we are attracted objective developed for the designs of high performance and light-weight. One of designs is a thin layer of liquid film under an electrostatic field is proposed by Kim[1]. In the study, he proved a correlationship liquid film and electrostatic field. So in this study we will demonstrate experimently the effect of a film flow under an electrostatic field on inclined plane as a basis of his study. In order to prove it, we observed the surface wave of liquid film flow under an eletrostatic field on inclined plane in steady state. A following figure is a brief explaning figure.

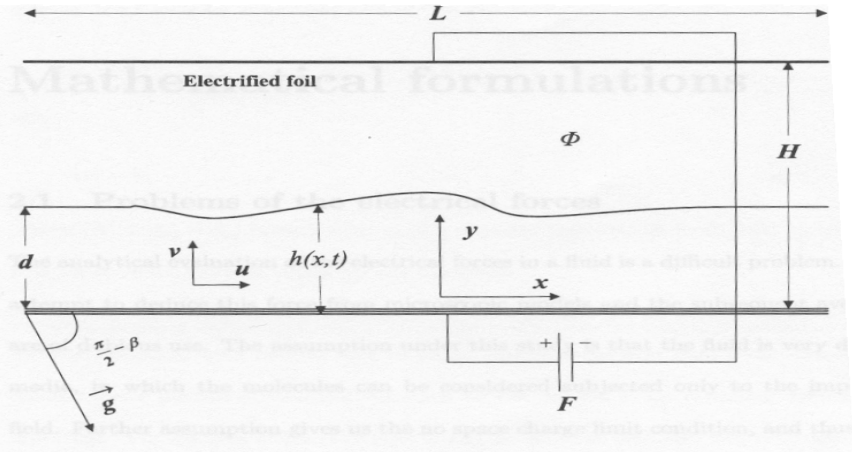


Figure 1. System configuration by Kim[3].

L : a length of the plane, H : a height of the electrified foil, d : a height of film flow h : a height of the surface wave, x-y : directions of the film flow, u-v : directions of the film flow. Therefore we will observe a change of the surface wave under electrostatic field on

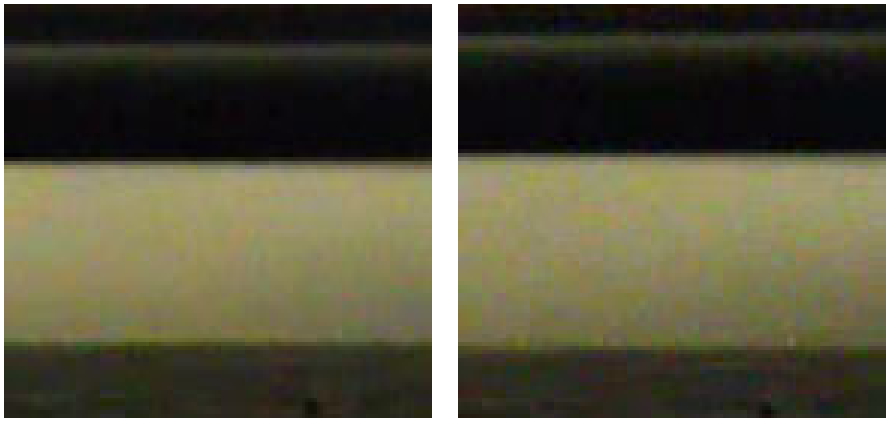
inclined plane when the wave is happened by pouring an amount of fluid in steady-state.

Procedures

We let the silicone oil as steady-state out of the pump on an inclined bottom plate, settle the angle of the inclined plate and flux of the pump and wait some minutes for a steady-state of film flow. We measure a thickness of flowing stream. And Settle distance between static electricity plate and the surface of stream. Turn on the power supply connecting with an applied static electricity equipment.
Then we pour some silicone oil for producing a surface wave. When the wave goes down on inclined plane, take a photograph of surface wave with camera connected with computer. Like this method, performance the experiment as different angle. Therefore survey how to change flowing stream under the static electricity plate as size of static electricity and as angle of the inclined plate.
If you were to be supply quickly voltage power supply, static electricity would be generate too much. So you must survey supplying slowly voltage to power supply.
As the distance between the surface of film flow and static electricity plate, the value which static electricity is generated too much is different. So it is important that we control the value. You must remove electric conductors form an applied static electricity equipment while it working.

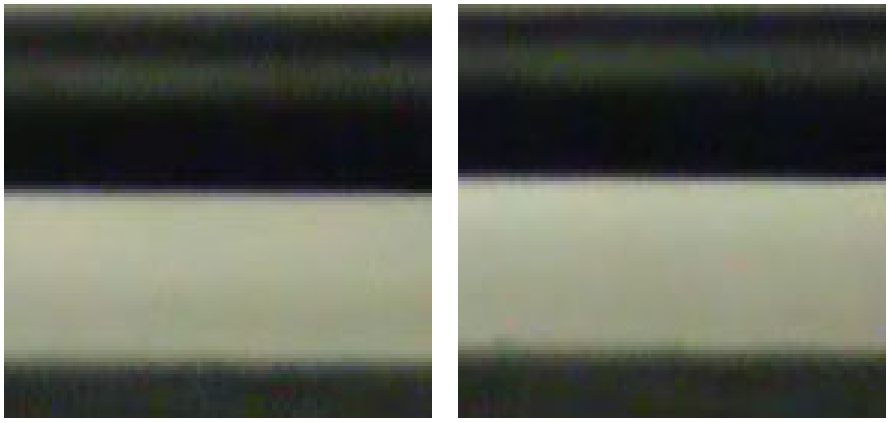
Data

In following figure angle is one of an inclined plane, distance is one of between an inclined plane and the surface of film flow. The thickness is one of a film flow



(a) (b)

Figure 2. the height of the surface wave (angle : 15°, distance : 1cm, thickness : 1.3mm)
(a : no electrostatic field b : electrostatic field-2V)



(a) (b)

Figure 3. the height of the surface wave (angle : 30°, distance : 1cm, thickness : 1.3mm)
(a : no electrostatic field b : electrostatic field-2V)

Conclusion

The experiment was designed to observe the thin film under the static electricity in order to get the relationship between static electricity field and fluid specific like velocity and wave height. The experiments conducted in several different conditions let us know the fact that the fluid velocity and wave height are influenced by the static electricity.

The results we have obtained from the experiment is a little bit slight. So we could not distinguish the difference without microscope connected with computer due to the force of gravity which is much greater than static electricity. When we analyed the result we have obtained from microscope, we obtained following facts. First, we discovered the height of surface wave of the thin film under an electrostatic field is higher than it which has no effect of the static electricity. And we obtained the effect of an electrostatic field is larger as the inclined angle is higher. Because the effect of gravity for film flow is less when the angle of an inclined plane is larger.

We have concerned a lot about every possible errors that could drive us a wrong experiment result, but a few incorrect manipulations were made.

The static electricity was supplied from generator to copper plate through the wire discharging electricity slightly. And maybe the static electricity was not distributed over the plate uniformly. The fact we could not help keeping the static electricity field is the main reason for the error.

References

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