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THE ROLE OF ACOUSTICS STREAMING

Sonika

Assistant Professor (Physics), GTC, Bahadurgarh, Haryana

ABSTRACT

The aim of the present paper is to examine the role of acoustics in Applied Physics and how this application is present in almost all aspects of modern society with the most obvious being audio and noise control industries. The paper covers boundary layer like driven streaming including Schlichting streaming, Rayleigh streaming, Eckart streaming in the bulk fluid and surface acoustic wave driven streaming. Acoustic streaming is a well known phenomenon within acoustics community and how that acoustic can be problematic phenomenon is the aim to present this paper.

Keywords: *Schlichting streaming, Rayleigh streaming and Eckart streaming.*

I. INTRODUCTION

The term “acoustic streaming” has become a generic term to describe the time averaged streaming that is introduced in any fluid flow that is dominated by its fluctuating components. Its acoustic origins may be traced to the work of Rayleigh(1893,1896).He considered the streaming motion that is induced by standing sound waves between plane walls, but in more modern times streaming of another kind, often referred to as the ‘quartz wind’ was observed when ultrasonics come into general use. Such streaming, which may be generated by any source that projects a high-intensity beam of sound into a body of fluid was associated in liquids (Meissner, 1926). If we talk about the quartz wind this takes place in the main body of the fluid, in Rayleigh streaming it is associated with boundary layers at solid surfaces. This paper is examined on the work of Rayleigh (1883,1896) and Lighthill(1978,1987) to discuss both the quartz wind and the Rayleigh type of streaming. Amongst other applications we make brief mention of only a few rectified diffusion is influenced by the presence of acoustic streaming(Gould,1974;Church,1988;Davidson,1971).Davidson(1973) also demonstrates the significant enhancement of heat transfer from a heated body. When acoustic streaming is present at large streaming Reynolds number, an area that has also been studied experimentally by Leung and Wong (1985). The role of acoustic streaming in acoustic levitation and positioning, to which the example in finds application, has been studied by Burse and Wong (1981) and Lee and Wong (1988). So, acoustic streaming may be effective in enhancement of contaminated surfaces, localized micro-mixing, development of micro-actuators such as micro-manipulators for small particles.

II. Types of Acoustic streaming

The streaming known as the quartz wind was observed when ultrasonics came into general use, and may be generated by any source that projects a high-intensity beam of sound into a body of fluid. It was originally, in the 1920s, associated with quartz oscillations in liquids, but subsequent observations were made in the air by Walker and Allen (1950). The streaming motion is forced by the action of a Reynolds stress, but it may be noted that the gradient in momentum flux that forces this acoustic streaming is associated with the dissipation of acoustic energy flux.

1. **Boundary- Layer driven streaming:-** Flow driven by viscous stresses on boundaries and caused by boundary layer effects between a solid and a fluid. Boundary-Layer driven streaming consists of two types of streaming which occur always together:-outer and inner boundary-layer streaming.
 - 1.1. **Outer boundary-layer streaming:-** Rayleigh analysed acoustic streaming when a standing wave is present between parallel plates and explained that the air motion is called by a nonlinear second order effect.
 - 1.2. **Inner boundary-layer streaming:-** The study of inner boundary layer streaming was developed by schlichting, who investigated on incompressible oscillating flow over a flat plate and calculated the two-dimensional streaming field inside the boundary layer.
2. **Jet driven streaming:-** The mechanism relies on the fact that a viscous fluid behaves quite differently during the suction and ejection periods. During the suction periods the flow comes from all directions, while during the ejection period a jet is produced.

3. **Gedeon Streaming**:- It is associated with travelling wave, as opposed to a standing wave as for the period. In boundary layer and jet driven streaming there is no net mass transport.
4. **Eckart streaming**:- Eckart streaming or quartz wind generated by the dissipation of acoustic energy in the fluid.

III. CONCLUSIONS

In this paper we discuss Rayleigh-type acoustic streaming induced by a plane standing wave in a rectangular parallelepiped is numerically studied on the assumption that the streaming motion is an incompressible flow and induced by the so called limiting velocity on the outer edge of acoustic boundary layer. Lighthill (1978a,b,1997) has made significant contributions, namely the quartz wind and Rayleigh streaming. Both are associated with flows that are dominated by their fluctuating components, and owe their origin to the action of Reynolds stresses. The streaming of the Rayleigh type is a phenomenon that occurs more widely than those origins suggest.

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