Pressure And Entropy Variations Across The Weak Shock Wave Due To Viscosity Effects

MOSTAFA A. A. MAHMOUD
Department of Mathematics
Faculty of Science
Benha University
13518 Benha
EGYPT

Abstract:-The nonlinear differential equations describing the structure of shock waves are reduced to a system of two coupled nonlinear differential equations. An approximate analytical solution for such system is obtained. This solution enables us to obtain the flow variables and the entropy as explicit functions of the dimensionless coordinate x. The effects of viscosity and Mach number on the velocity, the pressure and the entropy across the shock wave are then investigated.

Key-Words:- Pressure, Entropy, Shock wave, Fluid, Approximate solution.

1 Introduction

The structure of one-dimensional shock waves is one of the important practical problems in gas dynamics. This problem interested many authors [1-9] for some years, and the search for solutions of Navier Stokes equations has always been their concern.

Early, Taylor [2] obtained an explicit solution of the Navier Stokes equations, by assuming a constant coefficient of viscosity while neglecting the heat conductivity.

Hamad [10]

for a variable coefficient of viscosity that is temperature dependent. The solutions obtained by Taylor and Hamad are given in the form $x = x\ (u)$ where x is the dimensionless distance coordinate and u is the dimensionless velocity. However, it is more useful to have the inverse relation for this solution, but actually no rigorous procedure exists to determine such inverse.

The aim in this paper is to suggest an analytical solution to the problem in the form $u = u\ (x)$. The other flow variables are therefore described as explicit functions of x . For the purpose of comparison with the results that were obtained by Hamad [10] and Taylor [2], the constants of integration in equation (4.7) and (4.8) (Hamad, [10]) are recalculated at the inflection point where we set the origin for the variable x .

For the distributions of velocity, pressure and entropy inside the transition region we propose in the present paper the analytic expression given in equations (17) , (19) and