1. INTRODUCTION

Pollutant dispersal modelling is a subject that has been extensively studied, as it is vital to the safety of all levels of society, from communities to countries. Whether it is used for prediction, design or analysis, the results affect the populus in general. In recent years, as this planet becomes more crowded, people are forced to live in the immediate vicinity of industrial plants which pose a possible danger. At the same time, production of energy, chemicals, paper and other products that have toxic waste or by-products, is greatly increasing as the technological level of humanity on the whole increases. Thus there is a need for more accurate pollutant dispersal modelling than that which was acceptable in the past. It is no longer practical to add large safety factors to the results of a calculation to compensate for the inaccuracies in the calculation. Also, the near-field flow characteristics are now of more interest than before. Consequently, there has been a concentrated effect to improve the accuracy of the models.

In the case of the dispersal of a pollutant into the atmosphere, one must consider a flow field with two gaseous species. The equation describing the diffustion of one species into another can be written (Ref. 1, p 577) :

$$\frac{\partial \rho_A}{\partial t} + \underline{\nabla} \cdot \rho_A \underline{v} = \underline{\nabla} \cdot \rho D_{AB} \underline{\nabla} c + r_A \qquad (1)$$

where :

r_A = chemical production

ρ_A = mass concentration of dispersing gas

ρ = total mass concentration

c = mass fraction of dispersing gas

D_{AB} = molecular diffusivity of dispersing gas into air.

In the case under consideration, there are no chemical reactions, so $r_A = 0$. In the analysis, the dispersing gas is assumed to be of the same density as air, i.e., neutrally buoyant. Then equation (1) can be written as :

$$\frac{\partial c}{\partial t} + \frac{\partial c u_i}{\partial x_i} = \frac{\partial}{\partial x_i} D_{AB} \frac{\partial c}{\partial x_i} \qquad (2)$$

(Note that the usual summation convention is inferred by repeated indices). If it is further assumed that

$$u_i = \bar{u}_i + u_i'$$

and

$$c = \bar{c} + c'$$

and equation (2) is averaged in time, we obtain :