ROCKY MOUNTAIN
JOURNAL OF MATHEMATICS
Volume 21, Number 2, Spring 1991

MISCIBLE DISPLACEMENT IN POROUS MEDIA INFLUENCED BY MOBILE AND IMMOBILE WATER

ULRICH HORNUNG

1. Introduction. In this paper we present a new model for miscible displacement in porous media. The most commonly used model assumes that transport of solutes is governed by diffusion and/or dispersion and in addition by convection and/or advection. This results in an equation of the type of Model A (see Section 2); a discussion can be found in [**2**]. Assuming that the soil consists of both slowly and rapidly conducting pores one is led to the concept of aggregated or sorbing media. The equations describing Model B (see Section 2) have been studied in detail [**5**]. These ideas have been applied recently [**8**] to transport and exchange of ions.

Here we introduce the mathematical technique of homogenization to the process of modeling. This machinery starts from a micro-model and allows one to derive a macro-model as the limit in a certain sense; the result is Model C (see Section 2). This technique is the mathematical counterpart of what is known as averaging [**3**]. The mathematical model of homogenization was used in [**9**] for chromatography, and in [**6**] for heterogeneous catalysis. In forthcoming papers homogenization will also be used in the context of double porosity models for fractured media [**1**] and in connection with heat conduction in fractured rocks [**7**]. A mathematical comparison of Models A, B, and C is given in Section 3, a numerical comparison is contained in Section 4. A derivation of the new Model C is presented in Section 5.

2. Three Models. Before we present the models in question we introduce some notations.

Notations

$\vec{u}[ms^{-1}]$	= Darcy's velocity of the mobile water
$v[kgm^{-3}]$	= concentration of the solute in the mobile water
$w[kgm^{-3}]$	= concentration of the solute in the immobile water