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Capillary and Viscous Effects in Porous Media

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I. INTRODUCTION

In this paper the role played by capillary and viscous forces in statistically homogeneous porous media containing two or more fluids which are in low Reynolds number flow is discussed in the light of some recent experimental results and some new mathematical models. The special case of quasistatic displacement of one fluid by another fluid is also included. The effects of preferential wettability of the pore surface by the fluids and of the microscopic pore morphology on the type of fluid motion observed are emphasized. Macroscopic properties represent average behavior of a sample containing many pores. Therefore, the pore scale properties are essential for an understanding and an explanation of the macroscopic properties. Throughout this chapter pore scale and macroscopic scale are treated side-by-side in an attempt to emphasize the relationship between the two scales. Flow phenomena of the type discussed in this paper are of importance in many fields of technology, e.g., petroleum production, groundwater hydrology, fuel cells, nuclear reactors, to name just a few.

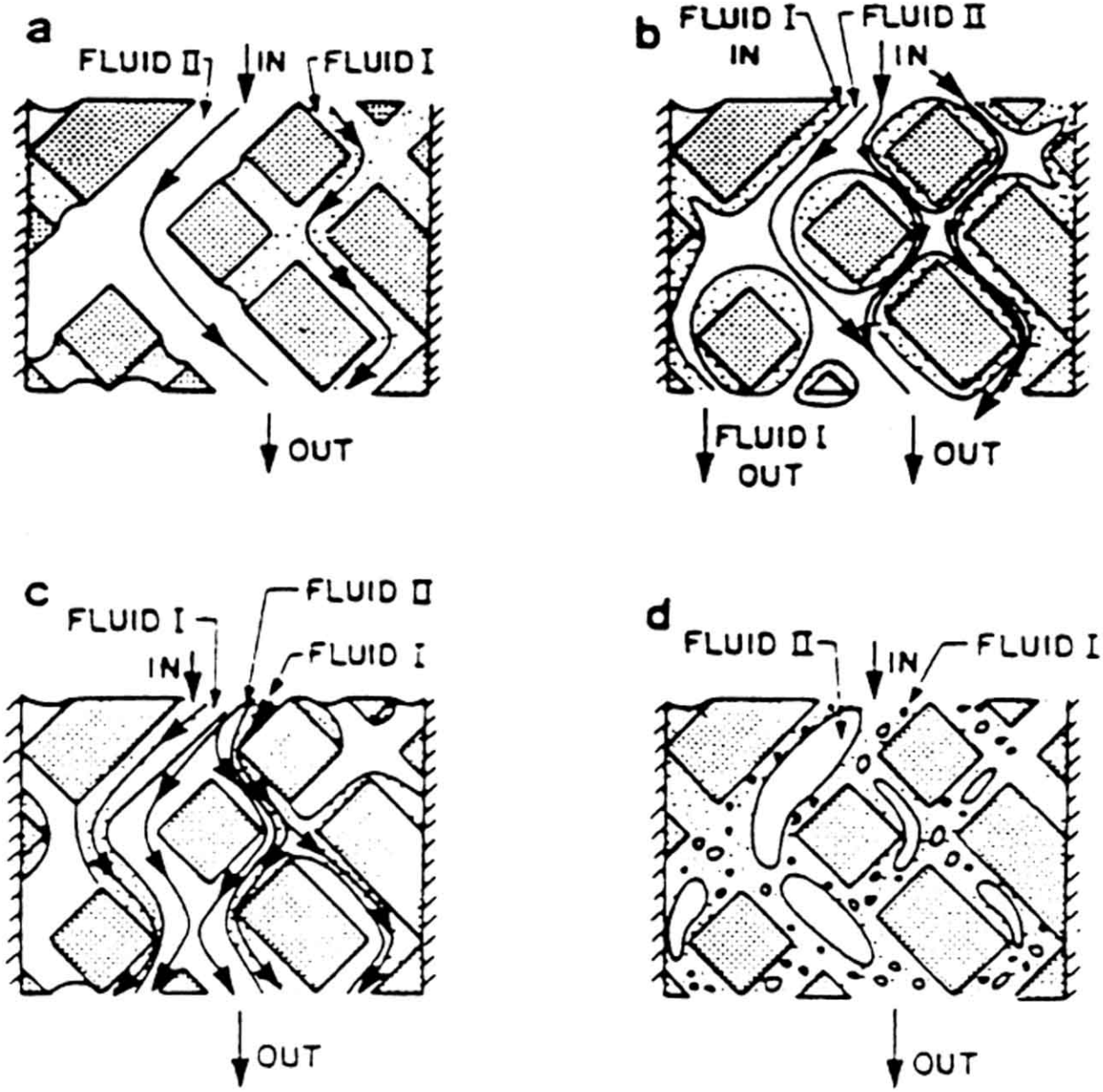

Figure 13. Two-dimensional representation of different patterns of cocurrent steady two-phase flow in porous media (Dullien, 1992b).