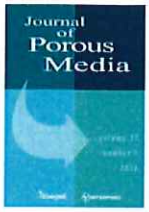

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CAPILLARY FORCES BETWEEN TWO PARALLEL PLATES CONNECTED BY A LIQUID BRIDGE

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ABSTRACT

Liquid flow between porous and nonporous materials plays an important role in many science and engineering applications such as oil recovery from fractured porous media. The capillary continuity between porous matrix blocks via formation of liquid bridges is a key contributor to the gas–oil gravity drainage mechanism in a gas invaded zone of naturally fractured reservoirs, which increases the height of the continuous liquid column in a fractured formation, thereby enhancing the recovery of oil. However, the role of capillary forces information or break-up of liquid bridges between porous matrix blocks remains a controversial topic. In an attempt to improve an understanding of this problem, a force balance is presented for the concave liquid bridges formed between two horizontal parallel plates. The force balance allows development of a simple model that can be used to find a relationship between the net capillary force, contact angle, and liquid bridge volume. Three different regions including: (I) repulsive net capillary force, (II) attractive net capillary force, and (III) nonexistence regions have been identified. Region I is considered as a region of liquid bridge break-up while Region II is considered as a region of liquid bridge formation. The findings improve an understanding of the formation and break-up of the liquid bridges, which is important in oil recovery from naturally fractured reservoirs during a gravity drainage process.

KEY WORDS: fractured porous media, matrix block, liquid bridge, capillary continuity, net capillary force, contact angle, liquid bridge volume