Study on the channel selection mechanism of remaining oil in extra high water cut stage

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Abstract

The remaining oil at the high water cut stage state discrete phenomenon is particularly serious and the stress status is more complex. That recognize the residual oil channel selection mechanism is extremely important. This paper analysis the residual oil thought the general theory of equivalent effect force. Finally, the paper gives the remaining oil channel selection, and laid the theoretical basis for the further study of remaining oil production.

Keywords

Extra high water cut stage, remaining oil, channel selection.

1. Introduction

With the development of oilfield water injection [1-5], the residual oil distribution[6,7] and the stress state of remaining oil have changed greatly compared with the early stage of oil field development[8].

Characteristics of remaining oil that in the reservoir of high water cut force is more complex. The extra high water cut period of remaining oil channel to select the related research that is less currently. This paper analyzed the total pressure and the action point of the fluid applied the knowledge of Engineering Fluid Mechanics based on the previous studies. The remaining oil at high water cut stage is considered as equivalent particle and this paper analyzed the stress condition and the theory of channel selection for the remaining oil drop and oil slick that in different capillary tubes. In the end, the paper gives the theory of the channel selection mechanism of the remaining oil in extra high water cut stage.

2. Stress and action points of remaining oil in extra high water cut stage

2.1 Total pressure of remaining oil

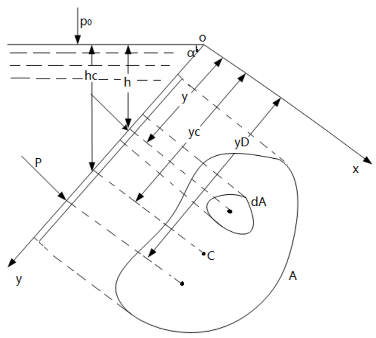

Fig.1 Total pressure acting on a plane

In order to find the total size of the pressure, first take a micro area dA in the plane A and that the from the depth to the surface is h.The above atmospheric pressure, The total pressure on the micro area dA is dP.

$$dP = pdA = \gamma hdA \tag{1}$$

According to the triangle relationship,

$$h = y\sin\alpha \tag{2}$$

y is the area element to ox axis distance, So can write

$$dP = \gamma y\sin\alpha dA \tag{3}$$

On the type of area integration and the total pressure is P

$$P = \int_A dP = \gamma\sin\alpha\int_A ydA \tag{4}$$

$\int_A ydA$ is the area moment of X axis represent for the area of A.

It is equal to the product of the area A and centroid coordinates y_C.

p_C stands the hydrostatic pressure that in the center of C.

$$P = \gamma\sin\alpha y_C A = \gamma h_C A = p_C A \tag{5}$$

It shows that the product of the size of total pressure acting on the arbitrary plane is equal to the area and the centroid point pressure of the plane. And this conclusion is also true for the pressure p_0 on the surface. Engineering encountered in the plane graphics are generally more rules of the geometry and centre of form relatively easy to determine.

Equation (5) is more convenient to use. The direction of the total pressure is bound to point to the role of the vertical surface according to the characteristics of the static pressure.

2.2 The function point of total pressure

The action point of the total pressure is called the center of pressure. The position of the center point D of the symmetric plane is only needed to determine the value of a coordinate.

According to the principle of mechanical torque on parallel force system, the force on the shaft torque and the torque is equal to the resultant force on the shaft, which can be written as

$$Py_D = \int ydP \tag{6}$$

Comprehensive analysis the Equation (4)(5)(6) , which can be written as

$$\gamma\sin\alpha y_C Ay_D = \int y\gamma y\sin\alpha dA \tag{7}$$

Reckon the Equation (6) can get

$$y_D = \frac{\int y^2 dA}{y_C A} \tag{8}$$

$\int_A ydA$ is the moment of inertia for the area of A relative to the X axis represent .That can be represented by J_x.

$$y_D = \frac{J_x}{y_C A} \tag{9}$$

According to the theorem of parallel moving axes of moment of inertia $J_x = J_C + y_C^2 A$, the moment of inertia J_x for the area of J_x relative to the X axis represent can be shown in J_C .

$$y_D = \frac{J_C + y_C^2 A}{y_C A} = y_C + \frac{J_C}{y_C A} \tag{10}$$

$\frac{J_C}{y_C A} > 0$, So $y_D > y_C$ that is to say the center of pressure D always below C that is the centroid of the plane.

3. Model and theoretical analysis of remaining oil channel selection

The remaining oil in the porous capillary needs to be considered. By determining the residual oil centroid, and then determine the force center. Connection center of action and the intersection of capillary wall. Division of the capillary zone. As is shown in the charts, o represent the center of action for oil droplets or oil film and the letters representation area that Less than flat area.

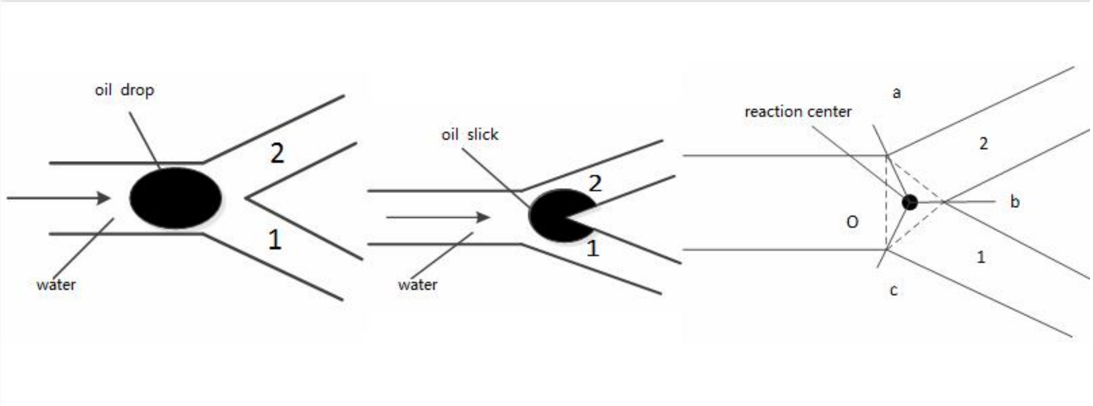

Fig. 2 Two channel selection model of oil droplets or oil film

As is shown in the Fig.2 that in the role of water drive if the center of action for o moved into the area of cob and it select the 1 channel. if the center of action for o moved into the area of aob and it select the 2 channel. if the center of action for o moved into the area of aoc and it circle round.

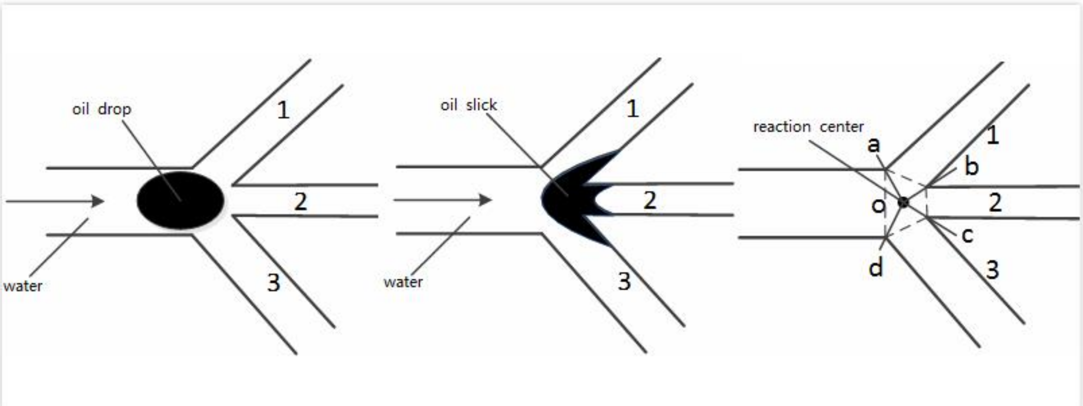

Fig. 3 Two channel selection model of oil droplets or oil film

As is shown in the Fig.3 that in the role of water drive if the center of action for o moved into the area of aob and it select the 1 channel. if the center of action for o moved into the area of cob and it select the 2 channel. if the center of action for o moved into the area of cod and it select the 3 channel. if the center of action for o moved into the area of aod and it circle round.

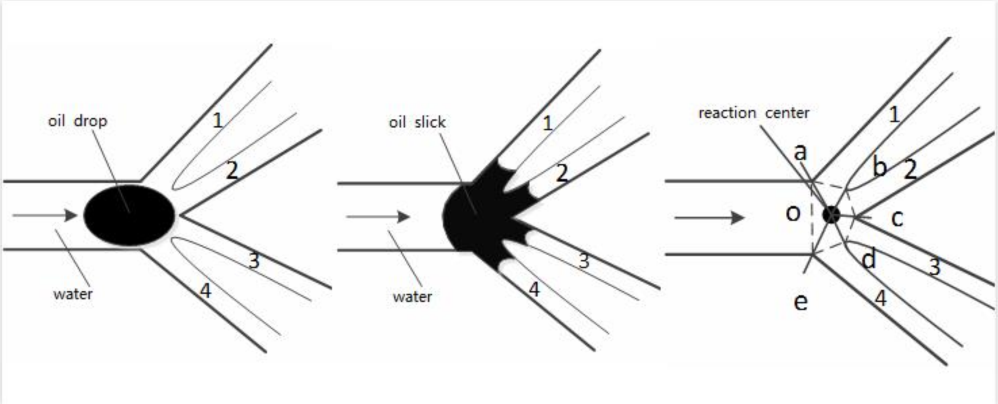

Fig. 4 Two channel selection model of oil droplets or oil film

As is shown in the Fig.4 that in the role of water drive if the center of action for o moved into the area of aob and it select the 1 channel. if the center of action for o moved into the area of cob and it select the 2 channel. if the center of action for o moved into the area of cod and it select the 3 channel. if the center of action for o moved into the area of eod and it select the 4 channel. if the center of action for o moved into the area of aoe and it circle round.

When the center of the action changes, the channel selection also changes. Therefore, the key to solve the problem of channel selection is to determine the center of action.

4. Conclusion

In extra high water cut stage, the remaining oil drops and the oil film select the channel according to the force of the point of its action.

Acknowledgment

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