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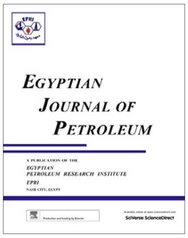

FULL LENGTH ARTICLE

Formula of definite point overburden pressure of reservoir layers

M. Karimi [a,*], **M.R. Adelzadeh** [b], **M. Mohammadypour** [c]

[a] *National Iranian South Oil Company, Reservoir Research Centre, Iran*
[b] *National Iranian South Oil Company, Petroleum Engineering, Iran*
[c] *National Iranian South Oil Company, Scientific and Research Affairs Centre, Iran*

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Abstract Overburden pressure, P_{ob}, is pressure imposed on layers during the different hydrocarbonic layers operations by the weight of overburden layers. Practically, the geological layers structure varies in matrix and porous media during well head treatment operations such as acidizing, hydraulic fracturing and fluid injection when drilling and completion. So, three structural quantity inter-granular space (IGS), inter-fracture space (IFS) and fracture width (FW) affect fluid conductivity and layers P_{ob} alternations.

Using the petrophysic and geological information and the content of tables under the reservoir conditions, P_{ob} was formulated for a drilled layer point in various porosity ranges.

Since reservoir layers mostly have heterogeneity characterizations, and timely and repeatedly need to control the type of cutting lithology, drilling mud and reservoir pressure by geologists and drillers, the equations derived are effective in wellhead and bottom hole operations for the calculations in which the overburden pressure plays a key role.

1. Introduction

The classified parameters in three tables of inter-granular distance (IGS), inter-fracture space (IFS) and fracture width (FW) have been defined for the reservoir layers which have endured the pressure of upper layers. These structural parameters are applicable in other equations in acidizing, stimulation, and drilling in other references. Classifications are designed based on a total survey on the various characteristics of reservoir cuttings and core samples through macroscopic and microscopic methods, in which are utilized the characteristics such as the size and situation of particles, color, the percent of clay, qualitative and quantitative examination of porosity and permeability, the property of consolidating and un-consolidating layers with static and dynamic tests in the laboratory and wellhead using tin sections and whole plugs in different sectional areas, and as well as other servicing companies reports. On the other hand, the effect of viscosity that has been related empirically and experimentally to the overburden pressure by the density of fluids, time, and weight of fluids engaged can approach/highlight the properties between

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* Corresponding author.
E-mail address: karimioilm@gmail.com (M. Karimi).

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Nomenclature

Physical quantities

ρ	density
V	volume
V_b	bulk volume
V_p	pore volume
W	weight
L	length
h	depth of desired point or layer to the surface
A	sectional area of layer
A_w	sectional area of well
g	acceleration of gravity
T	temperature
μ	viscosity
P	pressure
φ	porosity
S	saturation
S_o	oil saturation
S_w	water saturation
d_1	inter-granular space
d_2	inter-fracture space
d_3	width fracture

Subscripts

r	rock
b	bulk
d	dry
w	water
o	oil
ob	overburden pressure

Numbers

A	for conversion Kgf to bar

Functions, etc

μ_O	oil viscosity equation
P_{ob}	overburden pressure equation in a point of depth

fluid and rock in the basement. The model is easy enough to code up for software applications making its widespread use on injective and oil layers. The proposed formula is derived in the framework of the fluid displacement process in the laboratory and geological elements in field dimensions, and is applicable in reservoir engineering, reservoir geology and geophysics.

Porosity, mineral composition, inter-granular elastic behavior, and fluid properties are primary factors. These factors are dependent upon overburden pressure, fluid pressure, microcracks, age, and depth of burial [16,24,26,28,30]. Any variation of the density will affect the weight of the overlying water and, consequently, will affect the pressure that acts on a given horizontal surface. Formation pressures are vital to the safe planning of a well. Accurate values of formation pressures are used to design safe mud weights to overcome fracturing the formation and preventing well kicks [13,4,5,25]. Reduction of sediment porosity and increase in density of layers under overburden pressure in the sea floor are important subjects in earth sciences. Data and samples from the deep Sea drilling Project allow a new look at these subjects, and are used to establish profiles of laboratory values of density and porosity versus depth in the sea floor [2,12–14,21]. The dynamic displacement experiments studied the effect of the confining pressure on porosity and absolute permeability. These experiments were conducted on small, consolidated rock samples under overburden pressure up to 6000 psig and a room temperature of 23 °C. The pore pressure was maintained at atmospheric conditions. The examination of experimental results shows a decrease in porosity and permeability with an increase in overburden pressure [11,20,22,23]. In references above, the role of porosity, density, load of fluid, fluid volume, effect of temperature and pressure, depth and types of sedimentary on the overburden pressure of a layer and geological structures are clearly observed. In general, all previous findings have been focused on the overburden pressure of a special point with different parameters under ambient conditions [1,3,6–11,14,15].

Before beginning the overburden pressure equations of oil wells in this paper, at first some of the primary methods used to calculate overburden pressure are enumerated in Eqs. (1–5) as follows:

The overburden pressure at a depth z (for a continuously stratified fluid) which is a function of parameters z, P_0 and g is given by

$$P(z) = P_0 + g\int_0^z \rho(z)dz \tag{1}$$

$\rho(z)$ is the density of the overlying rock at depth z and g is the acceleration due to gravity. P_0 is the datum pressure, like the pressure at the surface. Equation implies that gravitational acceleration is a constant over z since it is placed outside of the integral. Strictly speaking, for almost all boundary conditions, g should appear inside the integrand since g is a function of the distance from mass. However, since g varies little over depths which are a very small fraction of the Earth's radius, it is placed outside of the integral in practice for most near-surface applications which require an assessment of lithostatic pressure. In deep-earth geophysics/geodynamics, gravitational acceleration varies significantly over depth, demanding that g be taken, at least, as a function of depth [17].

The hydrostatic pressure is the weight of the fluid column per unit of area at a depth Z. Fluid in this condition is known as hydrostatic fluid. The hydrostatic pressure can be determined from a control volume analysis of an infinitesimally small cube of fluid [13]. Since pressure is defined as the force exerted on a test area ($P = F/A$, with p: pressure, F: force normal to area A, A: area), and the only force acting on any such small cube of fluid is the weight of the fluid column above it, hydrostatic pressure can be calculated according to the following formula:

$$p(z) = \frac{1}{A}\int_{z_0}^{z} dz' \int\int_A dx'dy'\rho(z')g(z') = \int_{z_0}^{z} dz'\rho(z')g(z') \tag{2}$$

p is the hydrostatic pressure (Pa). ρ is the fluid density (kg/m^3), g is gravitational acceleration (m/s^2), A is the test area (m^2), z is the height (parallel to the direction of gravity) of the test area (m), z_0 is the height of the zero reference point of the pressure (m).