Production characteristics of horizontal wells: modelling and experimental work

by

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Abstract

Oil recovery by means of the horizontal well production technique has become the rule rather than the exception in modern exploitation of reservoirs. The reason for this is that most oil reservoirs have a strong layered structure with the thickness of the oil column often as little as 10m. Recovery by means of the conventional vertical wells is not economic for such reservoirs. For this reason, long horizontal wells (length up to 2km) are drilled which follow the reservoir, thus increasing the contact area of the well with the reservoir and in such a way increasing the volume of oil which can be recovered.

There are a number of specific problems related to oil production by means of horizontal wells. Given the length of the well, there is a sizeable pressure loss associated with fluid flow in the well. In cases where one is dealing with high-permeability reservoirs, the pressure loss in the well may be of the same order as the driving pressure required to get oil out of the reservoir. If that is the case a severely skewed production profile will be the result: large oil production at the production end of the well and little production at the end of the well. A skew production profile is undesirable since it leads to an uneven depletion of the reservoir which can severely limit the profitability. For this reason it is imperative to have good models which allow one to predict the production characteristics of horizontal wells.

In this paper we present models of horizontal wells which have been developed. Owing to the different length scales in the problem, the models are essentially 1-D models in the space coodinate The flow in the reservoir is taken into account in a simplified manner which is justified by the fact that along most of the well the flow from the reservoir to the well is a radial-type flow. The equations which describe the transients of the flow in a well are a set of coupled, non-linear pde's.

Since a well consists of a perforated pipe into which fluid flows through the perforations, special attention is paid to the influence of radial inflow on pressure losses. A simple model to account for radial inflow is constructed and data from experiments is presented which shows the validity of the model.

Results of transient simulations are presented. These results show some special features which may occur under the production of oil by means of horizontal wells.