LABORATORY MEASUREMENT OF THE RESIDUAL GAS SATURATION

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Abstract : The determination of residual gas saturation by water drive is based on various types of laboratory coreflood experiments. Using systematic cross checks, we have compared the results obtained by the various techniques, and penalizing effects observed in each experiment (effect of trapped gas compression for flooding experiments, effect of trapped gas diffusion for spontaneous imbibition experiments) have been investigated. Some emphasis has been given to the study of this diffusion process, which has been found to be very important at ambient conditions but negligible at reservoir conditions. Finally, we propose simplified but reliable procedures for the determination of the residual gas saturation.

NTRODUCTION

'o evaluate the quantity of gas which can be produced from a ;as field with natural water drive, it is critical to know he residual gas saturation behind the water front.

In this paper, we will discuss only the trapping of gas at onstant pressure, keeping in mind that the effect of ressure decline on trapped gas decompression should be also onsidered.

However, the measurement of the residual gas saturation Sgr) is quite critical, as this value may range over a wide nterval, which is a function of :

the texture of the porous network : aspect ratio (pore diameter/throat diameter) ;

- the total clay content, and location of clays minerals in the pores.

We have found values of Sgr ranging between :

- 60 to 70 % for vuggy dolomites, poorly connected vugs ;

- 10 to 15 % for chalk with low aspect ratio ;

- 15 to 40 % for various sandstones (various degrees of cementation and clay content).

Several authors (4, 5, 6, 7, 8) have already studied this problem of Sgr measurement, with various procedures (water injection or water imbibition through a porous plate) under various experimental conditions (laboratory or reservoir conditions).

We have extensively investigated this problem for one of our North Sea Gas fields, with unconsolidated to poorly consolidated sandstone reservoir samples. We have performed the same type of experiments as already reported, but we also included experiments of gas trapping by spontaneous imbibition. A phenomenon of trapped gas diffusion was observed and investigated in detail.

Finally, we have compared our laboratory results with field data (from openhole resistivity logs) and validated simplified laboratory procedures.