

CO₂ EOR, an Opportunity for a Sustainable Development of Mature Reservoirs

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1. Introduction

Today, there is a large consensus to identify the increase of the concentration of greenhouse gases in the atmosphere as the most probable cause for creating a global warming effect and hence inducing a potentially severe climate change. As CO₂ is one of the main greenhouse gases emitted by the human activity, the mitigation of CO₂ emission represents thus an important target for reducing greenhouse gas emissions in the atmosphere.

One option which to reduce such emissions is to capture CO₂ and store it in the underground. This option draws more and more attention as it presents the advantage of reducing both drastically and rapidly those CO₂ emissions allowing to maintain the concentration of CO₂ in the atmosphere within a certain limit that could moderate the effects of climate change.

For several reasons regarding public acceptance, regulatory regimes and financial considerations, storing CO₂ in mature hydrocarbon fields appears to be a quite attractive option. This constitutes an important driver for promoting tertiary CO₂ EOR processes as an efficient and economic means for redeveloping mature oil fields.

2. Key Features

The challenges in reducing greenhouse gas emissions and the necessity of properly addressing climate change issues will be discussed in a first step. In a second step, the key volumetric properties of CO₂ as well as its impact on the oil properties when it get dissolved in the oil phase will be recalled.

Advantages and drawbacks of a CO₂ injection will be discussed and the main steps of a methodology developed for estimating the gain in recovery factor will be presented. As a matter of example, the Weyburn case (Canada) will be briefly presented.

In a final step, the conversion into a CO₂ storage of an oil reservoir flooded by CO₂ will be addressed. Some specific aspects related to the necessity of ensuring the integrity of the storage over long periods of time (typically one thousand of years) will be discussed.

3. Conclusions

The necessity of reducing the CO₂ emissions emitted by the human activity provides a good opportunity for revisiting the merits of CO₂ EOR.

Due to its properties of good solvency in the oil phase, CO₂ injection appears to be an attractive EOR process. As the production of CO₂ results from a capture process, its cost will be lower than if it was to be generated on purpose. This contributes to improve the economics of a CO₂ EOR process.

After the end of the EOR phase, CO₂ injection can be continued leading to convert the oil reservoir into an underground storage. Specific simulation tools are needed. Using COORESTM, an IFP developed software simulations spanning over long periods of time and presenting the evolution of the CO₂ plume developed into the underground will be presented. Some key properties of this software will be underlined.

With the view of ensuring the integrity of the storage over long periods of time, some specificities of CO₂ such as its corrosive effect which can impact the wellbore integrity or the dissolution of the reservoir rock it induces will be addressed.

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Speaker's Biography

Francois Kalaydjian got an engineering degree from the School of Mines in France and a PhD in Physics from the University of Bordeaux.

He has been with IFP since 1988 starting as a research engineer in Petrophysics in the Reservoir Engineering Research Unit. He became the Director of this Unit in 1997 and then Deputy Director of Exploration and Reservoir Engineering in 2002.

In 2005 Francois Kalaydjian became Deputy Director for Sustainable Development being mainly involved in the development of CO2 capture and storage related activities.

Francois Kalaydjian is a member of several societies such as the Society of Core Analysts, the Society of Petroleum Engineers and the European Association of Geoscientists and Engineers for which he has been contributing to the organization of several international forums and conferences.

He has authored more than 10 patents and 60 scientific and technical papers.