

# ENHANCED OIL RECOVERY IN SANDSTONE AND CARBONATE RESERVOIRS



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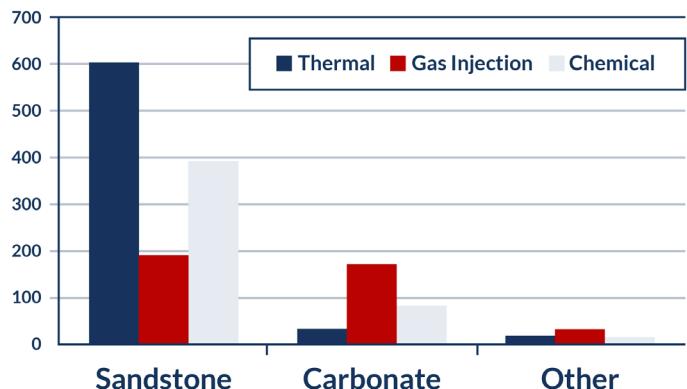
Formation type or lithology is one of the critical variables in enhanced recovery screening processes, and undoubtedly the consideration of heterogeneities through stochastic modeling can contribute to increasing the probability of project success. Severe changes in petrophysical properties, conditioned by the sedimentary environment, throughout petroleum reservoirs drastically affect the performance of enhanced recovery projects.

In the last decade, several projects have been carried out, being thermal and chemical methods the most widely applied in the world; note that 40% obey the thermal scheme. Likewise, it can be highlighted that enhanced hydrocarbon recovery projects have been developed mostly in sandstone reservoirs with high success rates.

## Sandstone Reservoirs

Sandstone reservoirs present greater potential for the successful application of enhanced recovery projects (78% of the projects), given the relative homogeneity of their properties with respect to other types of formations, such as carbonate formations.

Likewise, most of the technologies have been tested in pilot projects and at commercial scale with high success rates. We can cite the Duri Field project in Indonesia (Steam Injection) and the Carmopolis Project in Brazil (In-Situ Combustion) as iconic projects in the territory of enhanced recovery.



Source: Alvarado y Manrique, EOR Field Planning and Development Strategies

## Carbonate Reservoirs

Carbonate reservoirs tend to have low porosity and may be fractured. These two characteristics, along with oil-wetting properties, often result in lower recovery factors. When enhanced recovery strategies are applied, injected fluids are likely to flow through the fracture network, leaving the oil in the rock matrix.

The high permeability of the fracture network and low equivalent pore volume cause early breakthrough of injected fluids. Many enhanced recovery field projects in carbonate reservoirs have been referenced in the literature during the last decades (22% of the total). Although these projects demonstrate the technical feasibility of various EOR methods in carbonate reservoirs, gas injection (continuous or WAG mode) remains the most widely used in this type of lithology.

**"At Nakasawa Mining and Energy, we are committed to increase the probability of success of enhanced recovery projects, particularly thermal methods, we perform technical feasibility studies through a systematic workflow framed in Reservoir Characterization and Management."**