Miscible Thermal Methods Applied to a Two-Dimensional, Vertical Tar Sand Pack, With Restricted Fluid Entry

Abstract
This study was conducted to qualitatively investigate the recovery of bitumen from Athabasca tar sand in a two-dimensional vertical model using a solvent (naphtha). Both homogeneous tar sand packs and tar sand packs with a high-permeability channel near the base, simulating a fracture connecting the inlet and the outlet, were considered in this study. The experimental runs were conducted utilizing naphtha injection, naphtha injection with conductive heating, steam injection, and naphtha injection followed by steam injection.

It was found that naphtha injection is technically successful in recovering bitumen from a two-dimensional system. Recoveries as high as 73.5 per cent were obtained. The process, however, tends to be inefficient, because the richest sample recovered contained only 48 per cent bitumen. Recovery depends on the rate of displacement, being higher at lower rates. Gravity segregation is an important part of the recovery mechanism in homogeneous packs. Continued naphtha injection opens a flow channel, but sweeps the inlet portion of the pack more completely than the outlet region. Formation plugging may occur due to flocculation of the asphaltenes. The plugging was found to occur only after large volumes of injection, and thus it was not a major problem.

Conductive heating at the base of the tar sand pack, combined with naphtha injection, increases bitumen recovery. However, when a highly permeable channel is present, conductive heating and gravity segregation are not very effective.

As regards steam injection, the steam action is concentrated around the inlet, and does not directly contact the bulk of the pack. However, naphtha injection prior to steam injection in a homogeneous tar sand pack is highly effective in opening a steam-flow path. Thus, steam is concentrated more toward the outlet, and recovery is greatly increased. On the other hand, naphtha injection, prior to steam injection, when a highly permeable channel is present, is ineffective, because the naphtha is immediately vaporized and produced.

The results of this study - being one in a series of tar sand projects - help point to the type of miscible-thermal process which is likely to be most successful in the in-situ recovery of bitumen from the Athabasca tar sands.

INTRODUCTION

THE TAR SANDS of Athabasca, Cold Lake, Peace River and Wabasca, located in northeastern Alberta, contain some 780 billion barrels of hydrocarbons”. Although it is certain that, with an increase in oil prices, it will become economical to process tar sands by surface mining methods, it is equally certain that, for ratios of overburden to ore thickness greater than the present limiting value of 3.0, the vast majority of the tar sands will require the use of an in-situ recovery method. The present paper deals with such a method, involving the use of solvents in combination with heat. The results of an experimental project, one of a series on tar sands, are described and discussed.

Background, General Considerations And Objectives

It is well known that steam injection, if carefully engineered, can lead to economic recovery of heavy oils.
Looking for more?

Some of the OnePetro partner societies have developed subject-specific wikis that may help.
Miscible displacement can be used as a secondary recovery process just after primary recovery of the oil or as a tertiary recovery method at the end of water injection process. The main oil recovery mechanisms during miscible flood are extraction, dissolution, vaporization, solubilization, condensation, or other phase behavior change involving the crude oil, viscosity reduction, oil swelling and solution gas drive, but the primary mechanism must be extraction[2]. In practice, solvents that are miscible with crude oil are more expensive than water or dry gas, so instead of continues solvent inj Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of SPE copyright. Abstract Interest in chemical enhanced oil recovery (CEOR) processes has intensified in recent years because of rising oil prices as well as the advancement in chemical
formulations and injection techniques. Introduction Conventional recovery from oil reservoirs based on natural depletion by energy of fluid is referred to primary production. However, after pressure decline due to production, it is required to increase reservoir pressure by injecting water or gas as a secondary recovery.