MINING TECHNOLOGY FOR NATURAL BITUMEN AND HEAVY OIL

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Summary

Tar sand (also known as oil sand and bituminous sand) is a sand deposit that is impregnated with dense, viscous petroleum-like material called bitumen. Tar sand deposits are widely distributed throughout the world and the various deposits have been described as belonging to two types: (a) stratigraphic traps and (b) structural traps although gradations between the types of deposit invariably occur.

The only commercial operations for the recovery and upgrading of bitumen occur in northeast Alberta, Canada, near to the town of Ft. McMurray where bitumen from the Athabasca deposit is converted to a synthetic crude oil.

Methods for the recovery of bitumen from tar sand are based either on mining combined with some further processing or operation on the tar sands in situ. The mining methods are applicable to shallow deposits, characterized by an overburden ratio less than 2.0, i.e., the overburden depth to thickness of tar-sand deposit is less than 2.0.

The Athabasca deposit is mineable within current concepts of the economics and technology of open-pit mining. Because of the chemical and physical properties of the bitumen, non-mining (in situ) recovery techniques have not had the same degree of success as recovery operations.

However, heavy oil, which has a varying degree of mobility in the reservoir, can be successfully recovered by use of non-mining secondary and tertiary recovery techniques.

The lack of mobility of bitumen requires a mining step followed by the hot water process that is, to date, the only successful commercial process to be applied to bitumen recovery from mined tar sand. Many process options have been tested with varying

degrees of success and one of these options may even supersede the hot water process at some future date.

1. Mining Technology for Natural Bitumen and Heavy Oil

Proposed methods for recovery of heavy oil from reservoirs and bitumen from tar sand deposits are based either on in situ processes or on mining combined with some further processing or operation on the tar sands in situ. The typical in situ recovery methods are not applicable to heavy oil or to bitumen.

Heavy oil recovery or bitumen recovery require a degree of thermal stimulation of the heavy oil or bitumen perhaps that addition of an additive to water/steam that will encourage flow of the heavy oil or bitumen to the well.

But, in general terms, bitumen in its immobile state is extremely difficult to move to a production well. Extreme processes are required, usually in the form of a degree of thermal conversion that produces free-flowing product oil that will flow to the well and reduce the resistance of the bitumen to flow.

Enhanced oil recovery techniques are applied in a manner suited for optimum production of heavy oil. The fluids produced from the underground wells are transported by a mine pipeline system to a central separation and holding facility.

Only a few pumps are usually required to transport the fluids produced from the subsurface production area to the surface.

One approach toward recovering a significant portion of heavy oil from a reservoir is to use a combination of petroleum recovery and mining technologies. This approach is often referred to as quaternary recovery.

Through the use of mining technology, access is developed below the petroleum reservoir within or beneath a permeability barrier. Underground development consists of providing room for subsurface drilling and petroleum production operations as well as a life-supporting atmosphere and safe working conditions.

Petroleum technology is used for producing the petroleum resources. Wells are drilled at inclinations from the horizontal to the vertical upward into the reservoir. Wells produce as a result of a combination of pressure depletion and gravity drainage.

The alternative to in situ processing is to mine the tar sands, transport them to a processing plant, extract the bitumen value, and dispose of the waste sand. Such a procedure is often referred to as oil mining.

This is the term applied to the surface or subsurface excavation of petroleum-bearing formations for subsequent removal of the heavy oil or bitumen by washing, flotation, or retorting treatments.

Oil mining also includes recovery of heavy oil by drainage from reservoir beds to mine shafts or other openings driven into the rock, or by drainage from the reservoir rock into mine openings driven outside the tar sand but connected with it by bore holes or mine wells.

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Biographical Sketch

Dr. James G. Speight has a Ph.D. in Organic Chemistry from the University of Manchester, England, and works for CDW Inc. as an Author/Lecturer/Technical and Business Advisor. Previously, he was Chief Executive Officer at the Western Research Institute (19901998). Chief Executive Officer. Dr. Speight has thirty years of experience in areas associated with the properties and processing of conventional and synthetic fuels. He has participated in, as well as led, significant research in defining the use of chemistry of heavy oil and coal. He has well over three hundred publications, reports, and presentations detailing these research activities. Dr. Speight is currently editor of the journal Petroleum Science and Technology (formerly Fuel Science and Technology International), editor of the journal Energy Sources, and co-editor of the journal Reviews in Process Chemistry and Engineering. He is recognized as a world leader in the areas of fuels characterization and development. Dr. Speight is also Adjunct Professor of Chemistry and Adjunct Professor of Chemical Engineering at the University of Wyoming as well as Adjunct Professor of Chemical and Fuels Engineering at the University of Utah. Dr. Speight is the author/editor/compiler of nineteen books and bibliographies related to fossil fuel processing and environmental issues. As a result of his work, Dr. Speight was awarded the Diploma of Honor, National Petroleum Engineering Society, For Outstanding Contributions to the Petroleum Industry in 1995 and the Gold Medal of Russian Academy of Sciences (Natural) for Outstanding Work in the Area of Petroleum Science in 1996. He has also received the Specialist Invitation Program Speakers Award from NEDO (New Energy Development Organization, Government of Japan) in 1987 and again in 1996. Dr. Speight also received the degree of Doctor of Sciences from the Scientific Research Geological Exploration Institute (VNIGRI), St. Petersburg, Russia For Exceptional Work in Petroleum Science in 1997.