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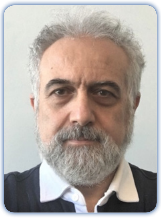

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Alternative recovery methods of heavy oil as an option to reduce greenhouse gas emission

Nearly 40% of energy consumption is met by oil (liquid hydrocarbons) in the world. Heavy oil/bitumen resources comprise more than 70% of the remaining oil reserves and their share in oil production is in increasing trend. These resources, however, require intensive steam injection to reduce the viscosity of oil, but steam generation is one of the contributors to carbon emission. For example, Canada is the 5th biggest producer of natural gas and 6% of this amount is consumed in heavy oil production. Based on the GHG emissions intensity of 68-77 kg for every barrel of oil produced via steam injection in Canada (mainly Alberta), the daily amount of GHG emissions is in the range of 91,300 to 103,400 tons. As such, reduction of steam use in heavy oil recovery is essential to mitigate greenhouse gas emission. This study summarizes the new approaches and methods (using chemical and solvent additives) to minimize the steam use in heavy oil recovery. Possible solutions to improve steam injection efficiency using chemical additives (surfactants, nanoparticles, nano solutions and ionic liquids) and even replacement to it by solvent injection and electrical methods for heating and optimization of these processes are outlined. Steam/solvent co-or alternate injection possibilities are also using laboratory and field scale numerical simulation trials as efficient methods also reducing the GHG emission. The GHG emissions of enhanced *in situ* bitumen recovery technique (e.g. Nano-based smart materials-solvent assisted SAGD) can be decreased by 20-70% comparison with the conventional one. In case of Alberta, Canada, the application of novel thermal/non-thermal *in situ* recovery technique can potentially reduce the GHG emission from 6.7 Mt to 23.5 Mt per year based on the current bitumen production. The core goal of this research is to decrease such an environmental footprint (including GHG emissions and water/natural gas consumption) and sustain a stable oil production at a comparable level of the conventional *in situ* heavy oil and bitumen recovery technique.

Biography

Tayfun Babadagli is working as a Professor in Civil and Environmental Engineering Department, School of Mining and Petroleum Engineering at the University of Alberta, where he holds an NSERC-Industrial Research Chair in Unconventional Oil Recovery. He has worked as Faculty at Istanbul Technical University, Turkey and Sultan Qaboos University, Oman. His areas of interest includes modeling fluid and heat flow in heterogeneous and fractured reservoirs, reservoir characterization through stochastic and fractal methods, optimization of oil/heavy oil recovery by conventional/unconventional enhanced oil recovery methods and CO2 sequestration. He has completed his Bachelor's and Master's degree from Istanbul Technical University and MS and PhD degrees from the University of Southern California, all in Petroleum Engineering. He was an Executive Editor for *SPE Reservoir Evaluation and Engineering* (Formation Evaluation part) between 2010 and 2013 and an Associate Editor of ASME *Journal of Energy Resources Technology* between 2011 and 2014. He is currently a Member of the JPT Editorial Committee. He has received SPE's A Peer Apart Award in 2013, elected as an SPE Distinguished Member in 2013 and was an SPE Distinguished Lecturer from 2013-2014. He is also the recipient of the 2017 SPE International Reservoir Description and Dynamics Award.

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