geoconvention
Virtual Event
September 21-23
2020
CSPG • CSEG • CWLS • GAC • MAC • IAH

Bitumen Transportation Bottleneck Solved? How Transporting Alberta's Solid Bitumen via Rail Compares to Pipelines

Jason, C. Droboth[1], Bezawit F. Haile[2], Emma M. Dizon[1], Ana K. Ortega-Perez[3]
[1]University of Calgary, [2]University of Toronto, [3]University of Alberta

Summary

Optimizing the transportation of heavy oil and bitumen supplies is of particular importance to Alberta's economy; while there are vast quantities available, transporting bitumen to international markets has unique challenges that are directly related to its physical properties - high viscosity, specific gravity, etc. - but also related to its negative public image. In a scenario wherein after completion of the Trans Mountain Pipeline expansion, Canada is unable to build any more oil pipeline capacity to tidewater, rail transportation becomes increasingly essential - not simply as a temporary backup for pipeline transportation, but as a permanent part of the transportation mix. Transporting solid bitumen to port facilities by rail could provide a safer, cost-effective, and scalable export solution, with potential to significantly reduce life-cycle greenhouse gas emissions associated with the development, transportation, and use of these resources (Figure 1, BitCrude 2019). In this academic study, we investigate the technical feasibility of this innovative approach.

Theory / Method / Workflow

Transporting bitumen via pipelines requires either dilution or upgrading to help it flow at lower temperatures (Banerjee 2012). Although it is claimed that transporting bitumen by pipeline is safer, more affordable, and emits fewer greenhouse gases when compared to rail transportation, transporting it by rail in its solid-state may have compelling advantages (Nimana et al., 2017).

Proposed solid bitumen rail transportation solutions, like BitCrude™, DRUbit™, CanaPux™, and others claim to offer an economically attractive, safe, and environmentally friendly alternative (BitCrude 2019, ConocoPhillips 2019, CN Innovation 2020). This presentation shares the findings of a 6-month study conducted by a team of engineering, science, and policy graduate students from across Canada, in which some of the most influential technical, economic, environmental, policy, and social factors in shipping solid bitumen via rail are investigated.

In particular, this research analyzes the feasibility of large-scale rail transportation of solid bitumen by focusing on 3 specific claims (BitCrude 2019, ConocoPhillips 2019, CN Innovation 2020):

1. ***Transporting it is more efficient:*** unlike current methods, 100% of the volume and mass transported is bitumen, resulting in lower transportation costs per unit of bitumen and lower GHG emissions accrued during transportation;
2. ***It is safer to transport:*** solid bitumen is non-flammable since the combustible component, diluent, is not present. In the event of a spill, unlike diluted bitumen, solid bitumen is non-toxic to marine life, easy to clean up, and floats on water;
3. ***It does not require significant new transportation infrastructure:*** bitumen can be transported in intermodal shipping containers, integrating well into the existing national and international containerized intermodal freight transportation system. Existing policy and regulation frameworks allow for this integration since solid bitumen is classified as a non-dangerous good.

This report summarizes a technical analysis that evaluates how environmental conditions affect bitumen's physical properties like viscosity, density, flammability, and ecological toxicity during transportation. In addition, some of the most influential economic, environmental, policy, and social factors that might influence the viability of this method of transportation are investigated.

Acknowledgments

Authors are scholarship recipients of CREATE REDEVELOP Grant #386133824, a collaborative research and training experience in responsible energy development funded by NSERC. We would also like to acknowledge Prof. David Eaton and Dr. Celia Kennedy for their assistance.

Transporting ***Diluted*** Bitumen via Pipeline or Rail	Transporting ***Solid*** Bitumen via Rail
65% Bitumen = Lower transportation efficiency	100% Bitumen = Higher transportation efficiency
35% Diluent = Flammable	0% Diluent = Non-flammable
Liquid at STP = Hard to clean up spills	Solid at STP = Easy to clean up spills
Liquid at STP + 35% Diluent = Toxic to marine life in spills	Solid at STP + 0% Diluent = Non-toxic to marine life in spills
Requires new pipelines = expensive, long time to completion, declining public approval, inflexible infrastructure	Uses existing intermodal container rail and shipping infrastructure = Can be implemented immediately, higher public approval, flexible long-term infrastructure
Classified as a dangerous good = Strict transportation regulations	Classified as a non-dangerous good = Can be transported alongside most goods

Figure 1: Comparative list presenting some of the top supposed advantages that may make solid bitumen rail shipment an attractive solution to transportation capacity constraints.

References

Banerjee, D. K. (2012) *Oil sands, heavy oil, and bitumen: from recovery to refinery.* PennWell, Tulsa, Oklahoma.

BitCrude. (2019). How BitCrude Works. Retrieved from https://www.bitcrude.ca/.

CN Innovation. (2020). CanaPux. Retrieved from https://www.cninnovation.ca/.

ConocoPhilips. (2019). ConocoPhillips Canada Signs Agreement for 50,000 bbl/d of Capacity. Retrieved from http://www.conocophillips.com/news-media/story/conocophillips-canada-signs-agreement-for-50-000-bbl-d-of-capacity/

Nimana, B., Verma, A., Di Lullo, G., Rahman, M., Canter, C. E., Olateju, B., Zhang, H., & Kumar, A. 2017. Life Cycle Analysis of Bitumen Transportation to Refineries by Rail and Pipeline. *Environmental Science & Technology*, 51(1), 680-691. DOI https://doi.org/10.1021/acs.est.6b02889.