More Prone To Release? Transport of Dilbit by Pipeline

National Academy of Sciences Study for PHMSA

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NAS

Crude Oil Quality Association Meeting
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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Study Origins

Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 calls on PHMSA to:

"complete a comprehensive review of hazardous liquid pipeline facility regulations to determine whether the regulations are sufficient to regulate pipeline facilities used for the transportation of diluted bitumen.

In conducting the review, the Secretary shall conduct an analysis of whether any increase in the risk of a release exists for pipeline facilities transporting diluted bitumen."

Study Charge

- **PHMSA asked NAS to help conduct the study**
- **Asked to examine whether diluted bitumen has a higher likelihood of release compared with other crudes**

  Consider all plausible failure mechanisms—not corrosion only
- **If no increased likelihood:**

  Issue final report of findings in Spring 2013.
- **If increased likelihood:**

  Issue interim report in Spring 2013

  Then issue final report in Fall of 2013.

  Recommend ways to strengthen PHMSA regulations.

Outline of Presentation

- Study Process
- Progress and Status
- Input and Outreach
- Information Needed
- Next Steps

NAS Study Process

- NAS is a nonprofit, non-governmental, independent body
- Chartered to inform public policy decisions involving technical matters
- Expert committees conduct the studies
  - Members appointed by NAS, serve pro-bono
  - Seek a balance of expertise and perspective
  - No financial conflicts of interest

NAS Study Process

- Committees engage in "fact-finding"
- Fact-finding sessions are open to public
  - To obtain all relevant technical information
  - To gain varied perspectives on issues
- Committee meets privately to discuss evidence and prepare report
- Report is peer reviewed
- All findings and recommendations are final—not subject to review or changes by sponsoring agency
- Report released to public and sponsor simultaneously

Progress and Status

- 12-member committee appointed in Spring 2012
- Chaired by Mark Barteau, Director of Univ. Mich Energy Institute, chemical engineer
- 5 Corrosion Experts
  - Srdjan Nešić, Ohio University (NACE Fellow)
  - Joe Payer, University of Akron (NACE Fellow)
  - Brenda Little, Naval Research Lab (NACE Fellow)
  - Jim Dante, Southwest Research Institute
  - Frank Cheng, University of Calgary

Progress and Status

Multidisciplinary

- Pipeline Regulation
  - George Tenley, former PRCI and PHMSA
- Chemical Engineering
  - Scott Fogler, University of Michigan
- Pipeline Operations
  - Dick Rabinow, retired Exxon Mobil
  - OB Harris, retired ARCO Transportation
- Risk Management
  - Kent Muhlbauer, pipeline risk consultant
  - Mohammad Modarres, University of Maryland

Progress and Status

Major Committee Fact-Finding Activities

- July 23-24, 2012 Mtg., Washington, DC
- Oct 9-10, 2012: Subcommittee Mtg., Edmonton and Ft McMurray, AB
- Oct 23-24, 2012: Second Mtg., Washington, DC

Input and Outreach

U.S., Canadian, and Provincial Governments

- PHMSA
- National Energy Board of Canada
- Natural Resources Canada
- Alberta Innovates Energy and Environment
- Alberta Innovates Technology Futures

Environmental Interests

- Natural Resources Defense Council

Input and Outreach

- Pipeline Operators and Oil Producers
  - TransCanada
  - Enbridge
  - Kinder Morgan
  - Inter Pipeline
  - Suncor Energy
- Industry Associations and Technical Groups
  - American Petroleum Institute
  - Crude Oil Quality Association
  - Canadian Crude Quality Technical Association

Input and Outreach

- Other Technical Experts and Researchers
  - NACE and DNV
  - CanmetMATERIALS
  - CanmetENERGY
  - Pipeline Knowledge and Development, Inc.
  - Institute for Corrosion and Multiphase Technology
- Review of Technical Literature and Databases
  - Technical conferences (e.g., NACE, COQA)

Example Claims

Pipeline Failure Mechanism/Concern	NRDC Claim http://www.nrdc.org/energy/files/tarsandssafetyrisks.pdf)	Alberta Innovates Counter Claim http://www.ai-ees.ca/media/39178/dilbit-versus-conventional-crude_new_nov28.pdf)
Erosion from abrasion	**Dilbit contains larger sediment loads and harder sediments**, risking erosion of inner wall	Sediment loads are below what is allowed by tariff. Limited data on particle size and hardness of sediments in crudes
Hydrogen embrittlement	**Dilbit contains higher sulfur content**--10 to 15 times higher than other crudes, risking hydrogen sulfide stress corrosion cracking	Some dilbits have higher sulfur content, while others do not. Sulfur content does not correlate to hydrogen sulfide content
Chloride stress corrosion cracking	**Dilbit contains higher chloride** content--risking chloride stress corrosion cracking	Chloride stress corrosion does not occur in carbon steel pipes
Corrosion from acids	**Dilbit is 15 to 20 times more corrosive than conventional crudes**; higher operating temperatures make a more corrosive environment	TANs are higher for dilbit than conventional crudes, but TANs are not reflective of corrosivity of crudes. Napthanic are stable under pipeline operating temperatures.

Issues Being Examined

- What is "diluted bitumen"?
  - Dilbit, synbit, dil-synbit, syncrude …
  - How is "it" distinguishable from other crudes, including those that are routinely blended and diluted?
  - What is the range of dilbit's chemical and physical properties relative to other crudes?

- How do pipelines operate, with or without dilbit?
  - Where and how much diluted bitumen is moved through pipelines in Canada and the U.S?
  - How is diluted bitumen readied for transport?
  - How is diluted bitumen moved in pipelines?
  - **Any difference with other crudes**?

Issues Being Examined

- How do pipelines fail?
  - Evidence of frequency/types of failure from incident records
  - Possible failure mechanisms
    - Internal corrosion (including MIC)
    - External corrosion, coating disbondment
    - Stress corrosion cracking
    - Operational issues, including leak detection
- Does diluted bitumen have chemical or physical properties that would initiate any of these failures mechanisms?
- Does it have operational requirements that would adversely affect them?
- **Any more (or less) so than other crudes?**

Information Needs

- Chemical and Physical Properties of Product
  - Water, CO_2, Oxygen (quantities, ranges, extremes, and introduction opportunities **unique to dilbit?)**
  - Acids, Organic compounds, H_2S (relevant?)
  - Sand and other sediment; size and amount
  - Viscosity and density
  - **Similar data needed for other crude oils**

Information Needs

- Operational Parameters and Practices
  - Temperature and pressure levels/cycling
  - Flow velocity, type, and maintenance, DRA use?
  - Dedicated vs batch operations?
  - Tank cleaning practices, how often upgrader upsets? contaminant sources?
  - Changes in set points for pumps, control and safety systems?
  - **Compared to other crude oils?**

- Integrity Management Practices
  - ILI methods
  - Cleaning practices
  - Inhibitor use
  - Leak detection
  - Risk assessment practices
  - **Compared with pipelines when carrying other crudes?**

Next Steps

- Data from industry--upgraders/pipelines/refiners
  - Chemical and physical properties of product
  - Pipeline operating and maintenance practices
  - Incident and inspection data
  - Risk assessment plans and studies
- Technical literature
  - Industry, government, academia, consultants
- Review PHMSA safety regulations and programs

Next Steps

- Next Meeting: Jan/Feb 2013 (TBD)
- Fourth meeting? If needed, early Spring
- Final Report will Depend on Conclusions
  - Spring 2013
  - Fall 2013

Thank You

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- Slides from meetings:

http://www.trb.org/PolicyStudies/DilbitCommittee.aspx

- Committee Roster and Meeting Agendas:

http://www8.nationalacademies.org/cp/projectview.aspx?key=49461

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