



Re-Development of TVP/RVP Correlation for Western Canadian Crudes

Cameron Konecnik, P.Eng

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Desired Outcome



- Provided a highlighted awareness of vapour pressure considerations for industry.
- Concerning the measurement of Vapour Pressure:
 1. Determine best sampling method to minimize/eliminate loss of light ends.
 2. Validate the appropriate RVP test method suitable for crudes with high light end fractions.
 3. Validate the relationship between RVP and TVP for common Western Canadian Crudes.
- Provide details surrounding TransCanada's current vapour pressure project and gauge industry's interest to support such a project.

Definitions



- **Vapour Pressure** is the pressure exerted by a vapour in equilibrium with its solid or liquid phase.
- **Reid Vapour Pressure** (RVP) is the measure of the absolute vapour pressure exerted by a liquid at 100°F (37.8C) at a vapour-to-liquid ratio of 4:1.
- **True Vapour Pressure** (TVP) is vapour pressure of a mixture including any dissolved gases that may be present.

Vapour Pressure Considerations



1. Safety

- Tank Roof Issues, Fires, Explosions, etc.

2. Pipeline Limits

- CSA/ASME Limits for Low Vapour Pressure Pipelines
- Individual Pipeline Tariffs

3. Environmental Emissions

- EPA Title 40 Adherence

4. Pipeline System Volume Losses

5. Light Ends offer Little Refining Value

Why the Interest Now?



Many Accepted RVP Test Methods

- ASTM D323A, D323B, D6377; each of which may produce different results for the same crude.

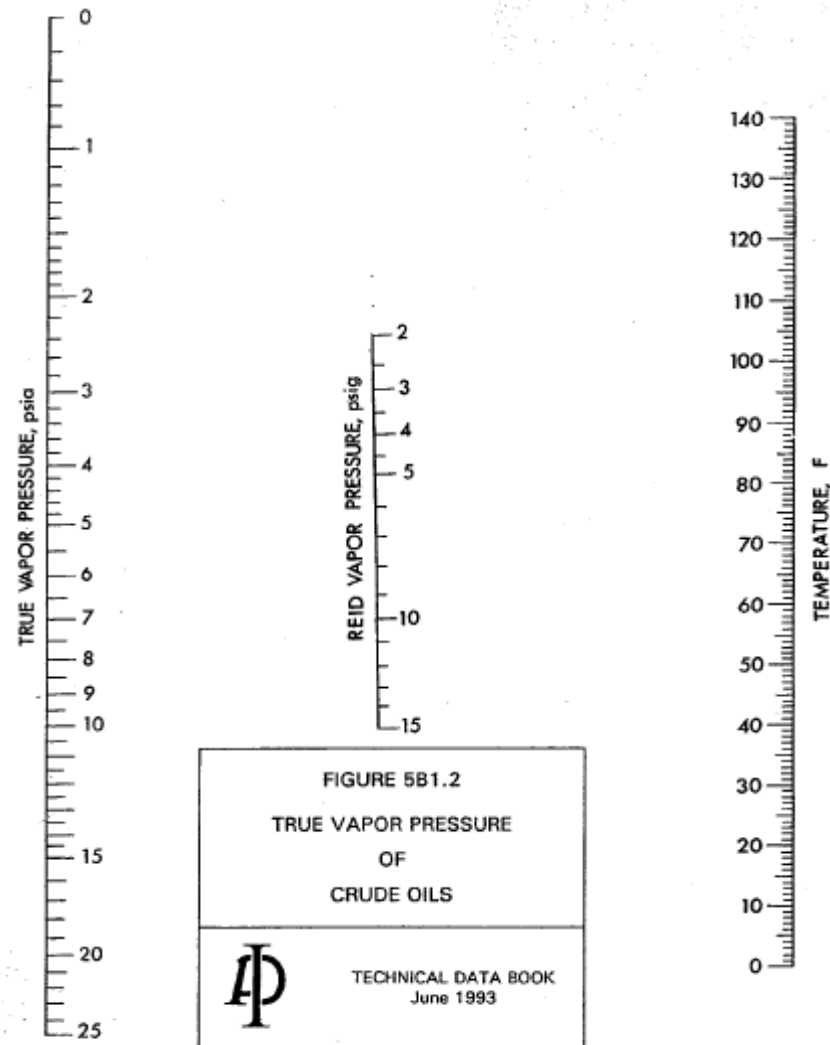
Vapour Pressure Test Results for TransCanada Commodities

- Routine testing is performed to ensure adherence to Tariff.
- RVP results are higher than expected relative to the assay values provided in Commodity Approval Process.

Current Correlation of RVP to TVP

- Correlation as per equations/nomograph within the MPMS Chapter 19.2 (formerly API 2517).
- TVP dependant upon which RVP method is used.
- Questionable applicability for today's crudes vs. those in which the nomograph was derived.

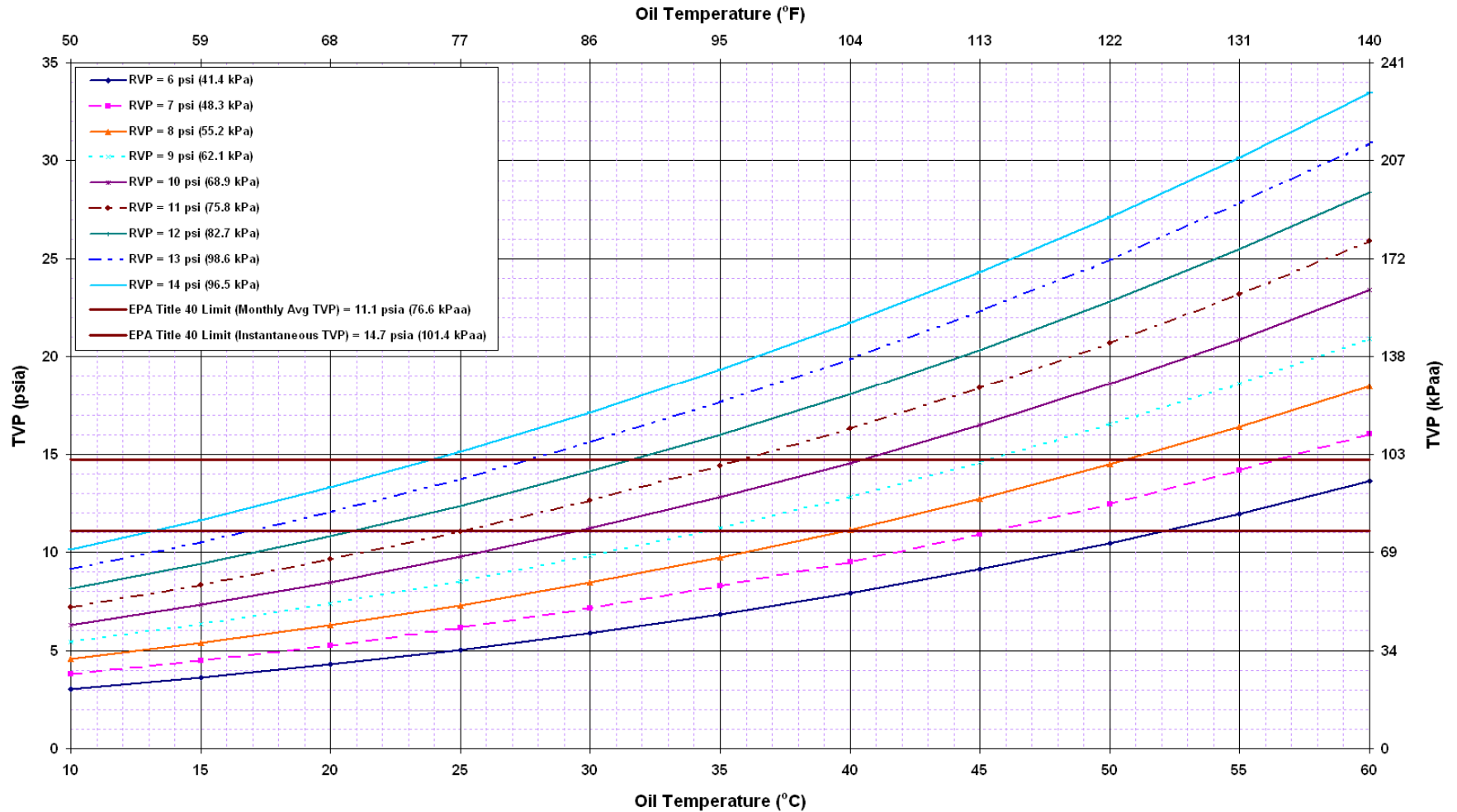
Nomograph for RVP/TVP



Nomograph Equations for RVP/TVP



TVP/RVP Correlation vs Oil Temperature



Historical Evaluation of Vapour Pressure



This topic is not new to Industry or CCQTA

True Vapor Pressure Method Development

11.30.2000 | Bob Falkiner / Imperial Oil Limited

Bob Falkiner updated the group on recent activities on Vapor Pressure test measurement on crude oil

Problems have been reported in the following areas:

- bias between D323 and correlated RVPE from D6377 for high VP crudes
- reference to TVP in various contracts and regulations with inadequate or incorrect definition
- incorrect reference to "TVP by D5191" in some condensate contract/regulation (D5191 not capable of measuring TVP)
- inability to properly estimate TVP in the presence of dissolved gases (methane, ethane etc)
- uncertainty in estimating or applying API TVP from bubble point measurements / calculations
- uncertain applicability of RVP for butane spiked heavy crude
- no standard ASTM definition or test method for TVP (most often reference is to API 2517 nomograph)

TransCanada Vapour Pressure Project



TransCanada Project with Maxxam Analytics

TransCanada contracted Maxxam Analytics in February 2012 to put forth a proposal aimed to accomplish the following:

1. Examine different sample collection methods and eliminate those that show high variability of results (loss of light ends).
2. Examine different RVP test methods and eliminate those with poor accuracy (assumed), precision and reproducibility.
3. Determine the thermodynamically derived TVP of the samples by use of gas chromatography.

Crude Oil Sampling – Evacuated Cylinder



TransCanada Vapour Pressure Project



After narrowing the sample collection method and RVP test method, multiple samples of Keystone commodities will be acquired throughout the year to correlate crude RVP to TVP. Objectives from this study are aimed to answer the following:

1. Is the RVP/TVP relationship all encompassing across crude types or would each crude type require specific correlations?
2. Is there seasonal variation which would affect the correlation (spiking in winter months)?
3. Is the data sufficient to invoke industry acceptance towards “updating” the currently accepted MPMS 19.2 TVP correlation?

Project Cost Forecast and Specifics



PHASE 1: Test Method and Sampling Method Determination

- TransCanada has contracted Maxxam Analytics to design the experiment, collect all samples and run the RVP and TVP analysis (approximately 60 samples from a single batch commodity type).
- Results from this phase will aid in deciding the next steps forward.
 - Sampling method
 - Test Method
- Phase 1 project cost estimated at \$25,000 CAD



PHASE 2: Continued Sampling and Data Acquisition

- Once the RVP test method and sampling technique is finalized we will employ those methods in the acquisition of many samples of different crude types.
- Although unknown at this time, each “data point” will involve an RVP & TVP analysis performed on the specific crude batch (likely in duplicate). Cost per “data point” is estimated at \$500 CAD to 1000 CAD.
- Estimated to examine 5 different crudes (initially) with approximately 30 “data points” per crude collected throughout the year. Total estimated cost of project is between \$100,000 CAD to \$200,000 CAD.

Project Go-Forward and Closing Remarks



- Evaluate Industry interest to support the project and continue testing through the spectrum of Western Canadian crudes.
 - TransCanada would be willing to support a broader based industry project.
- Evaluate the whole industry (producer, pipeline, storage, refinery) risks and costs associated with high RVP crudes.
- Evaluate existing pipeline tariff criterion to ensure facilities are operated safely and in compliance with environmental requirements.
- Examine the effects high RVP crudes have on the industry as a whole, and influence producer behaviour regarding the acceptability of particular blend stocks.

Questions

