Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods **13 June 2014**

Forty-fifth session
Geneva, 23 June – 2 July 2014
Item 4 (c) of the provisional agenda
Listing, classification and packing: miscellaneous

Classification and hazard communication provisions for crude oil – Bakken crude oil data

Transmitted by IPIECA

Introduction

1. As noted in informal document INF.17 (45th session) (submitted by IPIECA) commenting on document ST/SG/AC.10/C.3/2014/49, a number of studies are being conducted in order to better understand the potential risk that Bakken crude oil[1] poses in transport and to ascertain whether Bakken crude oil poses risks different from other crude oils that are transported. With recent progress in data reporting, IPIECA hereby draws the Sub-Committee's attention to available data specific to Bakken crude oil.

Data Now Available

2. In response to safety concerns, considerable data on Bakken crude oil is available. Reports include:

(a) *TSB Laboratory Report LP148/2013*; prepared on behalf of the Transportation Safety Board of Canada; dated March 11, 2014. The report is available at http://www.tsb.gc.ca/eng/enquetes-investigations/rail/2013/R13D0054/lab/20140306/LP1482013.asp. The report includes data from the testing of samples taken from 9 railway tank wagons that remained intact following the Lac-Mégantic, Quebec incident (hereafter referred to as the "TSB data" or "TSB");

(b) *A Survey of Bakken Crude Oil Characteristics Assembled for the U.S. Department of* Transportation*;* submitted by the American Fuel & Petrochemical Manufacturers; dated May 14, 2014. The report is available at http://www.afpm.org/. The survey covers data on 1,400 samples provided in response to a U.S. Department of Transportation (DOT) request (hereafter referred to as "AFPM data" or "AFPM");

[1] While ST/SG/AC.10/C.3/2014/49 refers to "North American shale oil," the primary focus is on crude oil derived from the Bakken geological formation underlying parts of Montana and North Dakota in the U.S. and Saskatchewan and Manitoba in Canada. This crude oil is referred to as Bakken crude oil.

(c) *Staff Analysis of Crude Oil Samples Submitted to PHMSA;* compiled by the American Petroleum Institute dated May 19, 2014. The presentation is available at http://www.api.org/news-and-media/news/newsitems/2014/may-2014/~/media/Files/News/2014/14-May/Staff-analysis-of-Data-Submitted-to-PHMSA.pdf.
The presentation summarizes data from 200 Bakken crude oil samples collected and tested in response to a U.S. DOT request (hereafter referred to as the "API data" or "API").

(d) *North Dakota Petroleum Council Bakken Crude Characterization Task Force Presentation of Preliminary Results*; dated May 20, 2014. The presentation is available at http://ndoil.org/image/cache/0519_Bakken_Quality_Study_2.pdf. The presentation summarizes testing data from 152 samples taken at 15 well locations and 7 locations where railway tank wagons are loaded and includes supplemental data from producers of crude oil (hereafter referred to as "NDPC results" or "NDPC").

3. While the studies introduced in paragraph 2 (c) and (d) are pending, the preliminary results, along with the final reports introduced in paragraph 2 (a) and (b), provide considerable information on the characteristics of Bakken crude oil. A summary of key points of the available data is provided below.

IPIECA Observations

4. **Summary data results.** Key information provided from the four data sources relevant to classification and safe transport of Bakken crude oil is as follows:

Property		**TSB**	**AFPM**	**API**	**NDPC**
Initial Boiling Point ASTM D86 (^{o}C)	Avg	46.6 ^{o}C	29 ^{o}C	33 ^{o}C	37.5 ^{o}C
	Min	43.9 ^{o}C	2.2 ^{o}C[2]	26 ^{o}C	33 ^{o}C
	Max	50 ^{o}C	67 ^{o}C	66 ^{o}C	42 ^{o}C
Flashpoint (^{o}C)	Avg	-	-27 ^{o}C	-	< 23 ^{o}C
	Min	<-35 ^{o}C	-59 ^{o}C[3]	-	
	Max	<-5 ^{o}C	50 ^{o}C[4]	-	
Vapour pressure at 50 ^{o}C	Avg	-	-	-	-
	Min	-	96 kPa	-	-
	Max	-	115 kPa	-	-
API gravity ASTM D5002	Avg	-	> 37	42.7	41
	Min	40.5		38.6	36.7
	Max	41.8		47.1	46.3
C2 – C4 Liq. Vol % IP344 (C2 means a hydrocarbon gas with 2 carbon atoms (e.g., ethane); C4 means a hydrocarbon gas with 4 carbon atoms(e.g., n-butane))	Avg	-	-	-	5.5%
	Min	-	5.9%	-	3.5%
	Max	-	11.9%	-	9.4%
Vapour pressure at 37.8 ^{o}C (kPa) ASTM D6377	Avg	-	-	81 kPa	81 kPa
	Min	62 kPa	-	25 kPa	61 kPa
	Max	66 kPa	-	106 kPa	99 kPa
Rail tank car gauge pressure at destination (kPa)	Avg	-	57 kPa	-	-
	Min	-	29 kPa	-	-
	Max	-	78 kPa	-	-

[2] Lower values were based on testing using ASTM D7169 which consistently provides lower values for Bakken crude oil.

[3] Flashpoint methods used may not be recommended for lower flashpoint values (i.e., less than 30^{o}C).

[4] One value at this level. Other 76 values were all below 20^{o}C.

5. **Variability of crude oil.** In document ST/SG/AC.10/C.3/2014/49, the Experts from Canada and the U.S. assert "Differences in the chemical makeup of the raw material can vary day-to-day and from well head – to well head." While crude oils may vary somewhat, the variations experienced are not as large as has been implied, as demonstrated by NDPC's statistical evaluation of the data. Findings show consistency among crude oils sampled in the study. Descriptive statistical analyses of the 152 samples in the NDPC study show normal bell shaped curve distributions for density (reported as API gravity), initial boiling point (based on ASTM D86 testing as recognized in 2.3.4 of the Model Regulations), light end concentrations (reported as total C2 to C4 concentration in liquid volume %), and vapour pressure (based on ASTM D6377 measured at 37.8^{o}C). See pages 30 to 33 of the NDPC results. Further, the data identified in paragraph 3 show that there is significant consistency across all of the crude oil properties tested in four completely separate studies.

6. **Vapour pressure**. As already noted in UN/SCETDG/45/INF.17 by IPIECA, the maximum vapour pressure reported for Bakken crude oil was 115 kPa (see AFPM data) which is well below the 300 kPa at 50oC threshold for flammable liquids under the UN Model Regulations. The considerable vapour pressure data at 37.8oC also lend support to the conclusion that Bakken crude oil consistently warrants classification as a liquid and that dissolved gas concentrations are well within established limits for liquids (based on vapour pressure). For UN1267, required design pressures of 400 kPa for UN portable tanks; 690 kPa for rail tank cars under US and Canadian regulations; and 400 kPa for tank wagons under the European regulations concerning the international carriage of dangerous goods by rail (RID; see 6.8.2.1.14 of RID) would all appear appropriate given anticipated design pressures (calculation pressure under RID).

7. **Classification**. Based on available Initial Boiling Point (IBP) data, most IBP values are close to 35oC based on test method ASTM D86 – either above or below the threshold value. The data indicate that the Bakken crude oil sampled should be assigned to either Packing Group I or II. The four data sources presented in paragraph 2 indicate the crude oil should be classified as follows:

Data Source	Classification	Packing Group
TSB	Class 3	PG II
AFPM	Class 3	PG I or II
API	Class 3	PG I or II
NDPC	Class 3	PG I or II

8. **Initial boiling point (IBP) testing**. Authorized test methods for assessing initial boiling point were first introduced in paragraph 2.3.4 of the UN Model Regulations in the 16th revised edition based on TDG/GHS collaborative discussions on ST/SG/AC.10/C.3/2007/11 (Germany). Paragraph 2.3.4 includes a reference to ASTM D86 (ISO 3405) to assess IBP, and, for crude oils, this method is commonly used. The variability of test results concerning this ASTM test method was raised in two of the above studies referenced in paragraph 2 (AFPM and NDPC). NDPC results on 4 sample crude oils showed that interlaboratory IBP test results based on D86 differed from 11.9oC to 19.5oC among test laboratories. In addition, the Canadian Crude Quality Technical Association (CCQTA) notes, "Atmospheric distillation methods such as ASTM D86 are insensitive to

non-condensable components such as methane, ethane and propane and the resulting IBP will not reflect their presence or absence in a sample."[5] The TDG and GHS Sub-Committees may wish to invite ASTM and ISO to review the D86 test procedures in light of the demonstrated variations and the CCQTA observation or alternatively consider a different test procedure for evaluating initial boiling point in the case of substances such as crude oils.

9. IPIECA appreciates the Sub-Committee's consideration of the above information and hopes that the information will further enlighten the discussion on document ST/SG/AC.10/C.3/2014/49.

[5] http://www.ccqta.com/files/CCQTA%20Information%20Regarding%20the%20Measurement%20and%20Reporting%20of%20Light%20Ends%20and%20Vapor%20Pressure%20of%20Live%20Crude%20oil.pdf