

## 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

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**Listing, classification and packing: miscellaneous**

## Classification and hazard communication provisions for crude oil – Comments on ST/SG/AC.10/C.3/2014/49

Transmitted by IPIECA

### Introduction

1. IPIECA (the global oil and gas industry association for environmental and social issues) appreciates the concerns expressed by the experts from Canada and the United States of America with respect to recent accidents involving rail movements of crude oil in North America as described by the expert from Canada at the forty-fourth session and as evident in document ST/SG/AC.10/C.3/2014/49. IPIECA and its members are committed to safety and environmental protection, including safety related to transport by rail in North America.
2. Many IPIECA members are actively engaged with governmental officials in Canada and the U.S. to address safety concerns related to transport by rail. 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 hereafter referred to as Bakken crude oil or the Bakken formation.
3. In relation to classification, two initiatives being undertaken by IPIECA members are relevant:
  - (a) Assembly of comprehensive information on the characteristics of crude oil derived from the Bakken formation; and
  - (b) Development of an American Petroleum Institute standard (i.e., API RP 3000), which is also being processed as an American National Standard, establishing the appropriate procedures for classifying crude oil in North America.
4. Both of these efforts are ongoing. To enhance discussions on classification issues raised in ST/SG/AC.10/C.3/2014/49, IPIECA anticipates providing an additional informal paper with information on the characteristics of Bakken crude oil. In addition, IPIECA plans to provide an informal paper forwarding the draft standard to solicit comments from Sub-Committee members and for information, when the draft standard is available for public comment.
5. In document ST/SG/AC.10/C.3/2014/49, the experts from Canada and the United States of America suggest that Bakken crude oil and perhaps other crude oils derived from newly implemented fracking technology pose a different hazard than crude oils extracted using conventional methodologies. IPIECA takes the opportunity in this informal paper to

briefly share some of its observations with respect to the questions raised by the experts from Canada and the U.S.

## Discussion

6. **Crude oil properties.** Crude oils are generally transported as Class 3 flammable liquids under UN 1267, Petroleum Crude Oil in packing groups (PG) I, II, or III depending on flashpoint and initial boiling point. In addition, crude oils posing a toxic inhalation hazard are transported as UN 3494. Within limits, the properties of crude oils derived from different geological formations differ. Physical chemical properties such as flashpoint, boiling point, and dissolved gas content commonly vary among crude oils.

7. **Density.** Density is another variable, and industry practice is to subdivide crude oils into light, medium, and heavy categories based on density. Bakken crude oil is a light crude oil. Light crudes are common and are not unique to newer drilling technologies. They typically are less dense due to higher concentrations of more volatile hydrocarbon fractions. Light crudes may vary in degree of hazard based on the criteria for packing groups of flammable liquids. They may be assigned to PG I, II, or III, or transported as not subject to the UN Model Regulations as permitted by special provision 223 if the classification criteria are not met.

8. **Flammable gas content.** Underground, at high pressures, flammable gases including methane, ethane, propane, and butane are present in crude oil as dissolved gases. As the crude oil rises to the surface and is subsequently processed and stored awaiting transport, these gases are liberated from the liquid. When transported, crude oil typically retains some dissolved gases. Butane is normally present in the highest concentration followed by lower concentrations of propane and ethane and trace amounts of methane. The concentrations can vary widely depending on where the crude oil was extracted. The presence of these dissolved gases and other liquids (e.g., pentanes) can influence crude oil classification and the assignment of packing groups.

9. The UN Model Regulation's definition of a *gas* in 2.2.1.1(a) and a corresponding definition of a *liquid* in 1.2.1 limit the amount of gas that may be dissolved in crude oil offered for transport under UN1267. Under 2.2.1.1(a), a substance is a gas if it has a vapour pressure of more than 300 kPa at 50°C. In 1.2.1, a liquid is defined as a substance exhibiting a vapour pressure of 300 kPa at 50°C or less. These provisions are particularly relevant to complex substances such as crude oils consisting of a wide range of hydrocarbon molecules. A crude oil with high dissolved gas content and exhibiting a vapour pressure higher than 300 kPa at 50°C must be transported as a gas (under an appropriate Division 2.1 entry) even though less volatile components might still remain as liquids at 50°C. Conversely, when a crude oil exhibits a vapour pressure of 300 kPa or less at 50°C, irrespective of dissolved flammable gas presence, the substance must be transported as a liquid under UN 1267 (or UN 3494).

10. In practice, crude oils in transport are not known to exhibit vapour pressures in the range of the 300 kPa at 50°C. For example, for Bakken crude oil, the highest reported vapour pressure at 50°C is 115 kPa<sup>1</sup> – well below the 300 kPa at 50°C threshold – so that it must be transported as a liquid under UN1267. Dissolved gases and volatile components can have the effect of reducing initial boiling point and flashpoint values and thereby

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<sup>1</sup> Based on *A Survey of Bakken Crude Oil Characteristics Assembled for the U.S. Department of Transportation* submitted by the American Fuel & Petrochemicals Manufacturers (AFPM Survey), dated May 14, 2014.

influence the assignment of packing groups. Their presence in Bakken crude oils commonly results in assignment to packing groups I or II.

11. It is important to note that the presence of dissolved gases is not unique to Bakken crude oils, and IPIECA is unaware of any data substantiating any fundamental difference between Bakken crude oil and other light crude oils.

12. Other liquid substances on the Dangerous Goods List contain dissolved gases so that any adjustment to the classification criteria accounting for dissolved gases in crude oil could affect other listed substances, including petroleum distillates, paints (e.g., fast drying paints), ethylene oxide/propylene oxide mixtures, and ammonia solutions.

13. **Volatility.** Document ST/SG/AC.10/C.3/2014/49 asks what parameter or method is most appropriate for quantifying volatility. For practical reasons, boiling point and flashpoint serve as proxies for more complex methods of rank ordering flammable liquids into three packing groups (degrees of danger). While more accurate calculation methods are available for assessing volatility, the practical aspects of replacing the current flammable liquid criteria using flashpoint and boiling point for classifying and assigning packing groups require careful consideration.

14. **Additional considerations affecting the risks in transport.** While ST/SG/AC.10/C.3/2014/49 focuses on the flammable gas content of crude oil, there are other characteristics of crude oil that should be taken into account when assessing risk, particularly in comparison to single component flammable liquids. Factors believed to reduce risk, include:

(a) **Smaller flammable vapour plumes.** Crude oils produce smaller flammable vapour plumes than do other single component flammable liquids. Crude oils are complex substances where only a fraction represents substances meeting flammable liquid criteria. For example, in the case of Bakken crude oil, approximately 40% of the crude<sup>2</sup> is made up of flammable liquids (with flashpoints ranging from low values to 60oC) with the balance consisting primarily of hydrocarbons not subject to the UN Model Regulations. All else being equal, at 60oC, the maximum volume of flammable vapours produced by a Bakken crude oil would be four tenths the volume produced by a single component flammable liquid.

(b) **Reduced risk associated with tank fire engulfment.** Unlike pure substances which boil off completely at a single boiling point, complex substances have a boiling point range. Bakken crude oils have a boiling range of less than 0oC to over 500oC<sup>3</sup>. When compared with single component flammable liquids, pressure build up in a fire engulfed tank containing crude oil and release of vapours through tank relief valves proceed more slowly given the higher temperatures required (and consequently higher amounts of heat) to boil off the crude oil.

15. **Coordination with the UN Sub-Committee of Experts on the GHS (UNSCEGHS).** IPIECA notes that additional consideration of dissolved gas content for classification of flammable liquids may have relevance to many substances regulated as dangerous goods, and the implications of adjusting the classification criteria could be far reaching. In this respect, IPIECA would assume that any effort to re-examine classification criteria would be coordinated with the UNSCEGHS.

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<sup>2</sup> Based on information from a Bakken crude oil assay described in the AFPM Survey dated May 14, 2014.

<sup>3</sup> Based on AFPM Survey showing a typical Bakken crude oil with an initial boiling point of -20°C and with 90% of its composition distilled off at 495°C.

16. **Summary.** It is IPIECA's opinion that:
- (a) The current provisions in the UN Model Regulations account for the safety concerns associated with flammable gases dissolved in liquids, including as they pertain to crude oils;
  - (b) Preliminary information on Bakken crude oil indicates that it is not unique among light crude oils that are transported throughout the world. IPIECA plans to provide supplementary information on Bakken crude oil to the Sub-Committee in time for discussions at the 45th session;
  - (c) To comprehensively evaluate the risk of crude oil, other factors additional to flammable gas content should be considered. Characteristics such as the low flammable liquid content and the range of boiling points could result in reduced risk in comparison to single component flammable liquids;
  - (d) A standard providing guidance on the classification of crude oil is under development and IPIECA intends to submit the draft standard in a subsequent informal paper to invite comments from the Sub-Committee and for information purposes, when the draft standard is available for public comment;
  - (e) Any classification changes that are made should not be unique to any one substance. If they are made, changes should be applied consistently to all regulated substances with similar properties. Changes related to dissolved flammable gases have the potential of far reaching effects, potentially impacting many other dangerous goods. A comprehensive identification of the short comings of the existing classification system should be developed before changes to the existing system are considered; and
  - (f) Should the Sub-Committee deem changes necessary, coordination with the UNSCEGHS would be necessary in order to maintain consistency among all those applying the provisions of the GHS.
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