

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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Item 3 of the provisional agenda

Listing, classification and packing

Classification of crude oil

Transmitted by the expert from the United States of America

Background

1. As noted in ST/SG/AC.10/C.3/2014/49, the significant increase in surface movement of crude oil within North America has led authorities within Canada and the United States of America to carefully consider transport safety impacts as well as potential impacts to the environment. These efforts have been prioritized based on a series of major accidents across North America involving crude oil transport by rail.

Discussion

2. Appropriately classifying dangerous goods based on the hazards they pose is a fundamental first step to ensuring the appropriate safety requirements are applied in transport. Central to this classification assessment for flammable liquid mixtures such as crude oil are the current provisions of Part 2 of the Model Regulations – specifically those which define liquids and gases. The Model Regulations define a gas as a material which is a gas at 20 °C and standard pressure of 101.3 kPa or a material which has a vapour pressure of more than 300 kPa at 50 °C (see 2.2.1.1). A liquid is defined as a substance with a vapour pressure at 50 °C of 300 kPa or less and is not completely gaseous at 20 °C and standard pressure of 101.3 kPa (see 1.2.1).

3. As evident from its current listing within the Dangerous Goods List, the Model Regulations generally consider petroleum crude oil to be most appropriately classified as a flammable liquid. However, it is clear from the liquid and gas definitions which include vapour pressure as a factor (300 kPa at 50 °C) that volatility is intended to be a consideration in establishing whether a material is a liquid or a gas for the purposes of transportation. Based on our research, the definitions applicable to Class 2 in 2.2.1.1 were introduced in the first Orange Book published in 1976, and included two sets of criteria to account for the criteria used in different regions globally. Almost all typical gases, even low-pressure liquefied gases, have a boiling point less than 20 °C and would be completely gaseous at 20°C at a standard pressure of 101.3 kPa. However some gases, such as nitrogen dioxide (or dinitrogen tetroxide) and some solutions/mixtures of gases in liquids may also have a vapour pressure greater than 300 kPa at 50 °C. As such, how and under what conditions the vapour pressure is measured becomes critical to this assessment.

4. The term “vapour pressure” has a strict and universally understood definition for pure substances. Vapour pressure is the pressure exerted by a vapour in thermodynamic equilibrium with its condensed phases at a given temperature in a closed system. It is this delegations’ understanding that the term “vapour pressure” as used in 2.2.1.1 and in 1.2.1

refers to this universally understood definition. However crude oils, particularly “light” crude oils may contain dissolved methane, ethane, propane, and butane gases (as well as other inorganic gases). The concentrations of these gases can vary widely upon where the crude oil is extracted and the presence of these gases could influence the classification of the material. As such, while the provisions of Part 2 defining liquids and gases are applied easily to pure substances, how these provisions should apply to complex mixtures such as crude oil is less defined and would benefit from further discussion within the Sub-Committee.

Next Steps

5. Based on the foregoing, the Sub-Committee is invited to consider whether the establishment of a correspondence working group to consider applicability of the current provisions of Part 2 of the Model Regulations to complex liquid/gas mixtures such as petroleum crude oil. Questions that could be considered by the working group include:

- (a) What methods are in use globally for the classification of crude oils today?
- (b) Do those methods provide a greater level of detail or specificity that might be appropriate for consideration within the Model Regulations?
- (c) How was the 300 kPa (43.5 psia) criteria at 50 °C (122 °F) developed? Was it intended to address complex mixtures such as crude oil?
- (d) Would specifying a particular method within the Model Regulations for vapour pressure measurement with respect to classification of crude oils (such as a vapour pressure at a specific temperature and liquid-to-vapour pressure) be appropriate? For example:
 - Does a vapour pressure measurement (at 37.8 °C (100 °F) with a vapour to liquid ratio of 4:1) determine a vapour pressure in line with the intent of 2.2.1.1(a)?
 - If such a ratio is not in keeping with 2.2.1.1(a), what liquid-to-vapour ratio might be?
- (e) What sampling and testing methods are appropriate for determining vapour pressure for mixtures containing dissolved gases that are not in equilibrium?

Conclusion

6. The expert from the United States looks forward to continued discussions within the Sub-Committee and to supporting the work of the correspondence working group on this topic if established.
