Gulf Strike Team
Bulletin Supplement

Responder Awareness – North American Crude Oil Shipments

The information contained in this document is advisory in nature and intended to raise awareness within the response community. It is not a standard or regulation, and it creates no new legal obligations.

Growth of North American Petroleum Production

North American crude petroleum production has rapidly risen over the past years. This growth is, in part, a result of non-traditional drilling techniques used to access shale and bitumen oil reserves. The main formations currently being tapped include Canadian Tar Sand formations, the Bakken Shale formation located in North Dakota, and the Eagle Ford Shale formation located in southwestern Texas. Additional areas of exploration include northeastern Colorado, central Florida, and the Pennsylvania region.

This petroleum production growth has outpaced the carrying capacity of the nation's current fixed infrastructure and pipelines. As a result, additional transportation capacity needs are being met by rail cars, tanker trucks, and barges to move these crude products to coastal refineries and distilleries. Areas seeing significant increases in commerce and maritime traffic include the Columbia River System, the Hudson River, and the Mississippi River and associated navigable waterways.

Unlike traditional crude oil reserves, these formations produce petroleum with varying physical properties and hazards. For example, Canadian Tar Sand Oil is so viscous that petroleum diluents are added to decrease the product's viscosity for easier transport. In some cases, rail cars laden with Tar Sand Oil must be heated until the product reaches a temperature at which it can be efficiently pumped. Conversely, oil from the Bakken Shale Formation is observed to behave like gasoline with a low viscosity, high volatility, high flammability and similar *b*enzene, *t*oluene, *e*thyl benzene, *x*ylene (BTEX) levels. Despite these generalizations, it is widely known that a single formation can produce oil with significantly varying characteristics based solely on geographic locations within that formation, and over-generalization can lead to inaccurate product data.

As this oil production continues to rise and more formations are identified through further exploration, pollution incidents involving these products may increase and consequently pose threats to responders and the environment. Area Committees and response organizations should be aware of these products, especially those that move through their areas of responsibility*. The Gulf Strike Team (GST) recently responded to multiple train derailments and a barge collision involving some of these products which produced valuable lessons learned to be shared amongst the response community.

Safety Data Sheets

Companies generate and maintain copies of Safety Data Sheets (SDS) for the crude oil they are transporting or refining. ***Responders should pay particular attention to SDS values that may have been 'estimated' instead of measured.*** Oil produced in formations can vary greatly from one geographic location to the next. Companies may also use generalized SDS for their products and may not be required to analyze the physical characteristics for each shipment of crude oil they are transporting. Physical properties within each load, regardless of formation 'generalities' may vary and pose their own unique hazards to responders. In one SDS reviewed for Bakken Crude Oil, physical properties such as the lower and upper explosive limits, auto-ignition temperature and vapor density were estimated. The hazard classification section was also broad in nature. However, a SDS for Eagle Ford Shale Oil listed specific physical property values and presented a robust and detailed discussion on the hazard classification. Treat each response uniquely and carefully review the product's SDS.

*****One source of awareness lies with the Pipeline and Hazardous Materials Safety Administration. PHMSA recently issued an Order to railroad carriers of Bakken crude oil to notify State Emergency Response Commissions of the expected movement of trains carrying 1,000,000 gallons or more of the oil. http://www.dot.gov/briefing-room/emergency-order

Hazard Awareness

The following hazards are situation specific and may not represent similar events or trends for responses in the future.

Canadian Tar Sand Oil

Diluents, a fluid used to lower viscosity, are added to bitumen based oils (Tar Sand Oil) in large enough quantities to make the original product easier to pump and transport. A diluent frequently used in large volume is Natural Gas Condensate. Natural Gas Condensate consists of many short chain hydrocarbons, which include various alkanes, alkenes, BTEX, and longer single chain chemical variants. Natural Gas Condensate can have a proper shipping name of Petroleum Distillates, N.O.S., which is classified as a dangerous good under the IMDG Code. Some of the hazards include: flammability; easily ignited by heat, sparks or flames; vapors forming explosive mixtures with air; toxicity through various routes of exposure; and being volatile at room temperature. Once the diluent is separated from the product, the original physical properties of the bitumen return which emulate characteristics of roofing tar. In a marine or aquatic environment, and under the right conditions, this dense product could sink to the bottom of the impacted waterway making recovery efforts far more challenging and time consuming than traditional recovery techniques.

Bakken Crude Oil

The GST recently responded to a spill of Bakken Crude Oil into the Mississippi River after a tank barge was breached during a collision. In this particular case the product was very volatile. Even under cool atmospheric conditions (approximately 45°F), air monitoring conducted around the damaged barge were registering Volatile Organic Compounds (VOCs) consistently at 200+ ppm. Benzene was detected directly adjacent to the floating oil within containment boom and measured at 40.2 ppm, which significantly exceeded OSHA's Short Term Exposure Limit (STEL) and Ceiling of 5.0 ppm and the ACGIH's Threshold Limit Value of 0.5 ppm, which is the occupational exposure limit for Coast Guard personnel. These atmospheric hazards were detected by the GST upon arrival approximately 12 hours after the incident occurred, and elevated levels of benzene persisted for several days into the response. In addition to physical measurements, subsequent laboratory analysis of the Bakken Crude Oil found naphthalene, a highly toxic polycyclic aromatic hydrocarbon, to be at 2000 ppm.

Eagle Ford Shale Oil

Eagle Ford Shale Oil is reported as having similar physical properties and hazards as Bakken Crude Oil with the addition of an ignition potential through static discharge. A visual comparison of these oils revealed both have low viscosity (slightly more than gasoline but less than motor oil); with Bakken Crude Oil being dark brown and Eagle Ford Shale oil light to medium brown in color.

Steps to Protect Responders

VOCs, including BTEX, can pose a direct hazard to the health of responders. Each type of oil presented above is acknowledged to contain these compounds, which during a response, present at a minimum an inhalation hazard to responders. One way to mitigate this hazard is to have the appropriate detection capabilities deployed to properly identify and quantify the hazard prior to impacting response personnel. Once quantified, appropriate personnel protective strategies can be implemented, such as the wearing of an air purifying respirator or self-contained breathing apparatus. ***It is important to note that the four gas monitors currently issued to Coast Guard Pollution Incident Responders, the BW Technologies GasAlert Quattro Multigas Monitors, do NOT directly measure for BTEX.*** Special air monitoring equipment may be required to properly identify BTEX hazards. Should a response event involve any of the above discussed oils, ensure that appropriate equipment is a part of the planning phase of a deployment to alert responders to a potential hazard.

Recommendations

Cautiously consider the product, its hazardous properties and values; recognize that hazard variations may exist.
Do not ascribe to any generalization for a product; fully understand the data provided through the product's SDS.
Properly detect, identify, and quantify hazards before taking action; use appropriate air monitoring equipment.
Develop effective protection strategies and mitigate hazards through safety protocols.

National Strike Force Resources

Each Strike Team maintains air monitoring equipment which can quantitatively and qualitatively identify BTEX hazards. Additionally, each Strike Team and the National Strike Force Coordination Center have a staff Industrial Hygienist who can help response personnel evaluate known and unknown risks, interpret SDS information, and help in the development and review of site safety plans.

FOSC/OSCs may contact the Gulf Strike Team's 24 hour emergency line at (251) 441-6601 should a need arise for air monitoring equipment, response personnel or consultation on safety protocols and response tactics.