Crude Butadiene and Mixed C4 Product

Product Summary

Crude Butadiene and Mixed C4 products are industrial hydrocarbon products made at NOVA Chemicals' ethylene manufacturing facilities in Joffre, Alberta and Corunna, Ontario. A major component of these products is 1,3-butadiene, a highly hazardous gas that is also generated naturally during the burning of wood (i.e. forest fires).

NOVA Chemicals' Crude Butadiene and Mixed C4 products are considered to pose a low risk for potential adverse impacts in the workplace and to the public when risk management controls are in place to minimize workplace exposure and accidental release. This is achieved by using closed equipment systems designed for the safe handling, processing, storage and transport of these products. These products are shipped as liquefied petroleum gas in railcars or pipeline to other industrial hydrocarbon processors that produce high purity gas and chemical products. There are no identified consumer product uses for these gas streams sold by NOVA Chemicals.

Product Use Information

Crude Butadiene and Mixed C4 products are only used in industrial applications primarily as a chemical feedstock to recover 1,3-butadiene, isobutylene, butenes and other 4-carbon chemicals. Parts of these products can be recycled back into ethylene manufacturing or used as fuel in process furnaces. Purified 4-carbon gases are used to manufacture a wide variety of industrial polymers and rubbers that are used in tires, automotive parts, adhesives, sealants, and coatings.

Human Exposure

There is very limited routine industrial workplace exposure to the Crude Butadiene and Mixed C4 products as they are handled in closed product systems meeting stringent industry design and operating standards. Any potential occupational exposure is restricted to accidental releases, emissions from process flares, storage and handling operations and fugitive emissions from process equipment (such as pumps or valves). Permitted occupational exposure to the most toxic component, 1,3-butadiene, is limited to less than 2 parts per million (ppm) exposure averaged over 8-hours of work or a 40-hour workweek in Canada and to less than 1 ppm in the United States. Workplace air quality measurements taken by NOVA Chemicals indicate that good equipment design, maintenance and good operating practices and procedures minimize general workplace exposures to levels well below workplace exposure limits. The American Conference of Governmental Industrial Hygienists (ACGIH) have established workplace biological exposure indices (BEI) for 1,3-butadiene.

General population exposure to the Crude Butadiene and Mixed C4 products from industrial facilities is limited since industrial air emissions are subject to federal and state/provincial environmental regulations. These regulations cover not only emissions of 1,3-butadiene, but also emissions of other volatile organic compounds. Measurements of emissions around industrial facilities during normal operations find levels ranging from not detectable to 1.5 parts per billion (ppb). In the United States, reported air emissions of 1,3-butadiene to the Toxic Release Inventory (TRI) decreased by 76% between 1988 and 2005. In Canada, emissions to air of 1,3-butadiene reported to the National Pollutant Release Inventory (NPRI) decreased by 77% between 1994 and 2006.

Health Information

Based on animal studies, the toxicity from a single (acute) exposure to Crude Butadiene and Mixed C4 products is considered low with minimal observable effects. Because all product components are gases at room temperature and pressure, toxic ingestion (swallowing), liquid aspiration (inhalation of liquid) or skin absorption is very unlikely.

In repeated exposure (chronic) toxicity testing of Crude Butadiene and Mixed C4 products, a species difference was reported between rats and mice. Minimal effects were reported in rats, with the no observable adverse effect levels (NOAELs) determined to be at the highest concentrations tested. In contrast, mortality (death) was observed in mice exposed to the high concentrations. Test data demonstrate that Crude Butadiene and Mixed C4 products can affect genetic material in mice.

Neither reproductive toxicity nor developmental toxicity (birth defects) was observed in rats exposed to similar mixed hydrocarbon streams. A major component of these industrial products, 1,3-butadiene, has been found to cause cancer in

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animal studies. The International Agency for Research on Cancer (IARC), in its re-evaluation of 1,3-butadiene in 2007, reclassified 1,3-butadiene as carcinogenic to humans. The U.S. Environmental Protection Agency (EPA) classified 1,3-butadiene as a known human carcinogen in 2002.

Environmental Exposure

Environmental exposure to Crude Butadiene and Mixed C4 products is limited since these products are only processed in closed systems in industrial facilities. All components are very volatile and are not expected to remain in water or on the soil surface. The components are expected to partition primarily to air. Since all components partition primarily to air, biodegradation is not expected to play a major role in the degradation of the Crude Butadiene and Mixed C4 products. The components are expected to degrade rapidly in the environment from physical processes, with no component persisting in the environment. The half-life of components ranges from a few hours for 1,3-butadiene to 48 hours for butane. Industrial volatile organic compound emissions and spills are regulated in Canada and in the United States and must be reported to regulatory agencies. Air emissions from these products can contribute to photochemical formation of ground level ozone and possible smog formation. These products contain no sulfur and no halogens and therefore are not associated with acid rain, stratospheric ozone depletion or climate change.

Ecological Information

Due to their physical and chemical properties, Crude Butadiene and Mixed C4 products if released from industrial processes would distribute mainly into the atmosphere with no component persisting in the environment. Calculated component toxicity values indicate moderate toxicity to aquatic organisms but exposure to aquatic life for any component is expected to be minimal.

Physical Hazards

Crude Butadiene and Mixed C4 product streams are colorless, extremely flammable gases at ambient temperature and pressure with a faint, sweet aromatic odor that can be detected at 0.45 ppm. The major hazard is due to their flammable and explosive character. Products are easily ignited and on release can quickly form a flammable mixture in air. Containers may explode when heated or exposed to direct flames. Industrially produced Crude Butadiene and Mixed C4 products are kept within closed systems as pressurized or liquefied gas during production, storage, transportation and use. Since these products contain components that may react and polymerize, a polymerization inhibitor such as tertiary-butylcatechol (TBC) is typically added during storage and transport of these streams.

Risk Management at NOVA Chemicals

Risk management priorities focus efforts on controls and improvements in process design, operation and maintenance of our industrial facilities and transportation equipment to prevent accidental releases and minimize the potential for fires or explosion. Use of suitable packing materials and sealing technology minimizes releases from pump seals, valve packings, pipe connections or gaskets. Ongoing preventative Leak Detection and Repair (LDAR) programs are in place at both Joffre's and Corunna's producing and storage facilities. Emergency response teams are prepared and equipped to rapidly respond to on-site and off-site incidents. Processes are designed to eliminate possible ignition sources and undergo periodic detailed Process Hazard and Risk Assessment reviews (HAZOPs). Product polymerization and reactivity potential are controlled by adding polymerization inhibitors or by maintaining process conditions to minimize these risks.

All processing, storage, and transport are conducted in closed systems designed to minimize the potential for exposure or releases to the environment. Industrial Hygiene programs periodically review workplace potential exposures to ensure controls are in place and effective. Personal protective equipment is used to prevent exposure in those situations where exposure cannot be controlled using engineering controls or other methods.

NOVA Chemicals continues to carefully review relevant information on the safety and suitability of Crude Butadiene and Mixed C4 streams and other petrochemical products for their known and intended end uses. In addition, NOVA Chemicals is committed to sharing information on the safe handling and end use of our products with customers and other interested

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parties. Material Safety Data Sheets (MSDS) are provided to our customers and can be accessed by interested members of the public electronically at the NOVA Chemicals' website at www.novachemicals.com.

NOVA Chemicals is a member of the American Chemistry Council (ACC) in the United States and the Canadian Chemical Producers' Association (CCPA) in Canada. Through these and other industry associations, we actively monitor and participate in public regulatory processes impacting Crude Butadiene and Mixed C4 products. We also seek to better understand health and environmental challenges related to all our products. We actively support industry-sponsored product testing initiatives and other industry initiatives supporting responsible actions, sound science and life cycle stewardship of our products.

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For detailed information on this product, please review the product Material Safety Data Sheet (MSDS). In the case of an emergency involving this product, please call our 24-hour hotline at 1-800-561-6682 or 1-403-314-8767.

For more information on this product risk profile, please contact us at 1-412-490-4063 or email us at stewardp@novachem.com.

For more information on any NOVA Chemicals' product, please contact us at the nearest location below during business hours or visit our website at www.novachemicals.com:

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