

## Mixed C4 Product

### Product Summary

Mixed C4 Product is an industrial hydrocarbon product made at NOVA Chemicals' ethylene manufacturing facility in Corunna, Ontario. A major component of this product is 1,3-butadiene, a highly hazardous gas that is also generated naturally during the burning of wood (e.g. forest fires).

NOVA Chemicals' Mixed C4 Product is 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 this product. This product is shipped as a flammable gas by pipeline to other industrial hydrocarbon processors that produce high purity gas and chemical products. There are no identified consumer product uses for this gas stream sold by NOVA Chemicals.

### Product Use Information

Mixed C4 Product is only used in industrial applications primarily as a chemical feedstock to recover 1,3-butadiene, isobutylene, butenes and other 4-carbon chemicals. Parts of this product 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 used in a number of applications including tires, automotive parts, adhesives, sealants, and coatings.

### Human Exposure

There is very limited routine industrial workplace exposure to the Mixed C4 Product as it is handled in closed product systems that meet stringent industry design, operating and regulatory safety 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 work week 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 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 Mixed C4 Product 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. Ontario's Ambient Air Quality Criterion for 1,3-butadiene is 2 ug/m<sup>3</sup> (parts per billion, ppb) on an annual basis. Measurements of emissions around industrial facilities during normal operations find levels ranging from not detectable to 1.5 ppb. In Canada, emissions to air of 1,3-butadiene reported to the National Pollutant Release Inventory (NPRI) decreased by 93% between 1994 and 2016.

### Health Information

Based on animal studies, the toxicity from a single (acute) exposure to Mixed C4 Product 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. However Mixed C4 Product vapors may be mildly irritating to the nose, throat and respiratory tract. High vapor concentration may cause central nervous system (CNS) depression. Early to moderate CNS depression may be evidenced by, headache, dizziness and nausea. Frostbites would be the result of the cooling effect due to rapid evaporation of the material.

In repeated exposure (chronic) toxicity testing of Mixed C4 Product, a 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 Mixed C4 Product can affect genetic material in mice.

A major component of this industrial product, 1,3-butadiene, has been found to cause cancer in 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 and in 2012, reconfirmed the same. The U.S. Environmental Protection Agency (EPA) classified 1,3-butadiene as a known human carcinogen in 2002.

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### Environmental Exposure

Environmental exposure to Mixed C4 Product is limited since this product is only processed in closed systems in industrial facilities. All components are very volatile and are not expected to remain in water or on soil surface. The components are expected to partition primarily to air. The components are expected to degrade rapidly in the environment by primary reaction with photochemically produced hydroxyl radicals; the estimated half-life is in the order of a few hours. 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 this product can contribute to photochemical formation of ground level ozone and possible smog formation. This product contains no sulfur and no halogens and therefore is not associated with acid rain, stratospheric ozone depletion or climate change.

### Ecological Information

Due to its physical and chemical properties, Mixed C4 Product, if released from industrial processes, would distribute mainly into the atmosphere with no component persisting in the environment. Components of this product are considered to be harmful to aquatic life with long lasting effects.

### Physical Hazards

The Mixed C4 Product stream is colorless, extremely flammable gas at ambient temperature and pressure with a faint, sweet gasoline-like odor that can be detected at 0.45 ppm. The major hazard is due to its flammable and explosive character. Product is 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 Mixed C4 Product is kept within closed systems as pressurized or liquefied gas during production, storage, transportation and use. Since this product contains components that may react and polymerize, a polymerization inhibitor such as tertiary-butylcatechol (TBC) is typically added during storage and transport of this stream.

### 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 Corunna's producing and storage facility. 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 the Mixed C4 Product stream and other chemical 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 parties. Safety Data Sheets (SDS) 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](http://www.novachemicals.com).

NOVA Chemicals is a member of the American Chemistry Council (ACC) in the United States and the Chemistry Industry Association of Canada (CIAC) in Canada. Through these and other industry associations, we actively monitor and participate in public regulatory processes impacting Mixed C4 Product. 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.

*Updated: 09/14/2018*

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For detailed information on this product, please review the product Safety Data Sheet (SDS). 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](mailto: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](http://www.novachemicals.com):

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