MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

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TO: File for Light aromatic solvent naphtha (petroleum) (CAS# 64742-95-6)

FROM: Keisha Williams, Air Quality Division

DATE: June 16, 2015

SUBJECT: Screening Level Review for light aromatic solvent naphtha (petroleum)

Based on this review, the initial threshold screening level (ITSL) is 100 µg/m^3 (annual averaging time) in accordance with Michigan Department of Environmental Quality (MDEQ), Air Quality Division (AQD) Rule 336.1229 (1) (b) and 336.1232 (1) (a).

The following references or databases were searched to identify data to determine the screening level: United States Environmental Protection Agency's (EPA's) Integrated Risk Information System (IRIS), the Registry of Toxic Effects of Chemical Substances (RTECS), the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV), National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Hazardous Chemicals, MDEQ Library, International Agency for Research on Cancer (IARC) Monographs, Chemical Abstract Service (CAS) Online (April 1991- April 2015), National Library of Medicine (NLM), Health Effects Assessment Summary Tables (HEAST), National Toxicology Program (NTP) Status Report, EPA Aggregated Computational Toxicology Resource (ACToR) Database, EPA TSCATS database, EPA Superfund Provisional Peer Reviewed Toxicity Values, EPA Acute Exposure Guideline Levels for Airborne Chemicals, EPA High Production Volume Database, United States Department of Labor Occupational Safety and Health Administration Permissible Exposure Limits, Spacecraft Maximum Allowable Concentrations, California Office of Environmental Health Hazard Assessments Reference Exposure Levels, Chemical Safety Program Protective Action Criteria, Texas Commission on Environmental Quality Effects Screening Levels, and European Chemicals Agency Registered Substances Dossiers.

Background Information

An ITSL was established at 61 µg/m^3 (annual averaging time) by AQD in 1988 (MDNR, 1988). Light aromatic solvent naphtha (petroleum) has been used in the production of solvents, fuels, pesticides, cleaning products, and coatings (IUCLID, 2000).

Light aromatic solvent naphtha (petroleum) is also known as high flash aromatic naphtha (HFAN); petroleum naphtha; and aromatic naphtha, type 1. It is a complex mixture of C8-C10

aromatic hydrocarbons. As noted in documentation for the provisional peer-reviewed toxicity values (PPRTV) for HFAN, this mixture is further classified based on "a combined total of 75% trimethylbenzene and ethyltoluene isomers (of which at least 22% and 15% is ethyltoluene and trimetylbenzene, respectively)" (EPA, 2009). Chemical properties are listed in Table 1.

Table 1. Chemical properties of light aromatic solvent naphtha (petroleum)

Physical state at 25°C: liquid Molecular weight: 120 grams/mole Boiling point: 139-169°C Vapor pressure: 2.1-8.29 mmHg at 25°C

References: EPA, 2011; EPA, 2009

A number of benchmark values have been established to protect against adverse health effects via the inhalation route of exposure (Table 2). There have been no controlled human studies to investigate the health effects of this specific mixture. However, relevant epidemiological studies and case studies are available (IUCLID, 2000). With this, recreational inhalation of gasoline (which light aromatic solvent naphtha (petroleum) is a component) and naphtha vapors has been shown to induce intoxication, central nervous system depression, encephalopathy, tremors, ventricular fibrillation, and (in rare incidences) death (IUCLID, 2000; Tenenbein et al., 1984). Unfortunately, exposure concentrations of light aromatic solvent naphtha (petroleum) are not known in these cases.

Table 2. Benchmark values for light aromatic solvent naphtha (petroleum)

Agency	Benchmark Value
United States Environmental Protection Agency (EPA)	PPRTV reference concentration (RfC) for sub-chronic exposure: 1000 µg/m^3 and chronic exposure: 100 µg/m^3 (McKee et al., 1990; EPA, 2009)
Texas Commission on Environmental Quality (TCEQ)	Health effects screening levels for long-term exposure: 125 µg/m^3 and for short-term exposure: 1250 µg/m^3 (TCEQ, 2014)
Chemical Safety Program Protective Action Criteria (PAC)	PAC-1: 13 mg/m^3 PAC-2: 140 mg/m^3 PAC-3: 1700 mg/m^3 (Chemical Safety Program, 2012)

Evaluation of Cancer Risk

The International Agency for Research on Cancer (IARC) has classified this mixture as "not classifiable as to their carcinogenicity to humans (Group 3)" (IARC, 1989). In their evaluation, it was noted that very little data was available. In an epidemiological study, a significant association was found between increased risk for having prostate cancer and exposure to organic compounds defined as "mineral spirits", in which light aromatic solvent naphtha was grouped (IARC, 1989; Siemiatycki et al, 1987). One inhalation study in rats was described in which light aromatic solvent naphtha was given to groups of each sex at exposure concentrations of 0, 470, 970 and 1830 mg/m^3 for 6 hours/day, 5 days per week, for 6 or 12 months. 25 males and 25 females from each group were necropsied after 12 months of exposure, where (most notably) a splenic lymphoma was observed in a high-dose male rat and a uterine leiomyoma was observed in a high-dose female rat (IARC, 1989; Clark et al., 1989). A lack of studies led to a final determination that there was "inadequate evidence" to identify carcinogenicity in humans or animals. As a result, light aromatic solvent naphtha will not be regulated as a carcinogen by AQD.

Review of Relevant Studies for Non-carcinogenic Effects

In 1988, an ITSL was derived using the Nau et al. (1966) study, where the lowest observable adverse effect level (LOAEL) was approximately 250 mg/m^3 based on increases in hematocrit and changes in the polymorphonuclear/lymphocyte ratio (MDNR, 1988). As noted in the PPRTV review document, this study used a test substance that "does not meet the current ASTM standard for HFAN" (EPA, 2009). As a result, the Nau et al. study will not continue to be used for ITSL derivation.

The PPRTV RfC values (EPA, 2009) were derived using the study presented by McKee et al. (1990), where the LOAEL was observed in rat dams after exposure to 506 mg/m^3 petroleum naphtha for 6 hours/day during gestation days 6-15. The critical effect was a significant decrease in body weight of dams at the end of the exposure duration. To determine the human equivalent concentration (HEC), the exposure duration was adjusted to account for 24 hour per day exposure (Equation 1). Since experimental values for animal and human blood: gas partition coefficients were not known, the default value of 1 was used for the dosimetric adjustment between species (EPA, 2009). As shown in Equation 2, the $LOAEL_{HEC}$ was divided by a composite uncertainty factor of 1000 to obtain the RfC for chronic exposure. The following uncertainty factors were utilized: 10 for intraspecies extrapolation, 10 for sub-chronic to chronic extrapolation, 3 for interspecies extrapolation, 3 for LOAEL to NOAEL extrapolation, and 1 for database deficiencies (EPA, 2009).

Equation 1. $Duration\ adjusted\ LOAEL_{HEC} = LOAEL\ x \frac{exposure\ hours}{24\ hours} x\ dosimetric\ adjustment$

$$Duration\ adjusted\ LOAEL_{HEC} = 506 \frac{mg}{m^3} x \frac{6\ hours}{24\ hours} x\ 1 = 126.5 \frac{mg}{m^3} \approx 125 \frac{mg}{m^3}$$

Equation 2. $RfC\ for\ chronic\ exposure = duration\ adjusted\ LOAEL_{HEC}\ x \frac{1}{uncertainty\ factors}$

$$RfC\ for\ chronic\ exposure = 125 \frac{mg}{m^3}\ x \frac{1}{1000} = 0.125 \frac{mg}{m^3} \approx 0.1\ \frac{mg}{m^3}$$

$$RfC\ for\ chronic\ exposure = 0.1\ \frac{mg}{m^3}\ x \frac{1000\ \mu g}{mg} = 100 \frac{\mu g}{m^3}$$

Using AQD Rules 229 (1) (b) and 232 (1) (a), this RfC is readily applied as an ITSL. Therefore, the ITSL for light aromatic solvent naphtha (petroleum) is 100 µg/m^3, annual averaging time.

References

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

September 9, 1988

TO: File

FROM: Catherine Simon

SUBJECT: Petroleum Naphtha (CAS No. 64742-95-6)

For purposes of establishing permit limitations, the acceptable ambient concentration for the C9-C10 fraction of petroleum naphtha is 61 µg/m^3 on an annual average basis. This value was derived from animal toxicity studies (Nau et al, 1966) in which rats and monkeys were exposed by inhalation to various concentrations of petroleum naphtha. Rats exposed to 50 ppm of the C9-C10 fraction for 8 hours per day, 5 days per week for up to 715 hours showed no detectable changes from normal. This value was considered a no observable effect level (NOEL). Monkeys exposed to 50 ppm of this same fraction for 7 hours per day, 5 days per week for up to 90 exposures showed no effects except for an increase in hematocrit and a shift in the polymorphonuclear/lymphocyte ratio. This value was considered a lowest observable effect level (LOEL).

An uncertainty factor of 1000 was applied to this data to derive the AAC as follows:

$$AAC = \frac{50\ ppm\ x \frac{8hr}{24hr} x \frac{5\ days}{7\ days}}{1000} = 0.012\ ppm$$

Assuming a molecular weight of 125 (Nau et al, 1966), this value is equivalent to 61 µg/m^3.

$$AAC = 0.012\ ppm\ x \frac{125}{0.0245} = 61 \frac{\mu g}{m^3}$$

REFERENCES

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