



Risk Evaluation Determining Whether Environmental Emergency Planning is Required Under the  
***Environmental Emergency Regulations*** set under the  
***Canadian Environmental Protection Act, 1999***  
**(CEPA 1999)**

**Arsenic (CAS #: 7440-38-2)**  
***(Inorganic Arsenic Compounds)***  
**(CEPA 1999 – Schedule 1, #28)**

### **Summary of Risk Evaluation Analysis**

The Risk Evaluation Framework (REF), developed by Environment Canada, is applied to chemical substances in order to determine whether or not an environmental emergency (E2) plan should be required. For those substances that are evaluated as requiring an E2 plan, the next step is to determine a threshold quantity for the total quantity of the substance and the maximum storage container size on site. Within the REF, three categories are used to evaluate chemicals and assign threshold quantities. Shown below are the details within the three categories for *arsenic*:

#### **1. Environment Hazard**

##### **(Persistence, Bioaccumulation and Aquatic Toxicity Analysis)**

- According to Mackay *et al.* (2003), nickel, chromium, arsenic, and cadmium are classified as indefinitely persistent. As a result, *arsenic* is also classified as indefinitely persistent in the environment.
- No data are available to determine the bioaccumulative potential.
- For aquatic toxicity, it was determined that *arsenic* is moderately toxic (LC<sub>50</sub> at 96 hrs between 1 and 10 mg/L) based on the most sensitive species, fathead minnow (Dyer *et al.*, 1993).

## 2. Human Hazard

### (Inhalation Toxicity and Carcinogenicity Analysis)

- Since *arsenic* has a vapour pressure below 1.33 kPa at 20°C (HSDB, 2004; ATSDR, 2000); there is insufficient vapour from the substance to cause an inhalation problem.
- *Arsenic* is categorized as an International Agency for Research on Cancer (IARC) carcinogen with a classification rating of '1' (IARC, 1987; Genium, 2004) and as a United States Environmental Protection Agency (US EPA) carcinogen with a classification rating of 'A' (IRIS, 2000; Genium, 2004).

## 3. Physical Hazard

### (Flammability and Combustibility Analysis)

- *Arsenic* is a substance normally stable, even under fire exposure conditions, and is not reactive to water (CHRIS, 1999).

### Flammability and Combustibility Analysis Table

	Value	Vapour Cloud Explosion (Yes/No)	Combustible (Yes/No)	References
Boiling point (°C)	Sublimes at 613	No	No	(CHEMInfo, 2004; Lewis Sr., 2001; ATSDR, 2000)
Flash point (°C)	No data			(CHEMInfo, 2004; HSDB 2004; ATSDR, 2000)

## Threshold

The data from the above mentioned categories were used to determine the various environmental/human thresholds. The threshold quantities relate to: carcinogenicity, aquatic toxicity, inhalation toxicity, vapour cloud explosion, combustibility, and reactivity.

The threshold quantity for carcinogenicity is defaulted to 0.22 tonnes, if it meets the following criteria:

- 1) have an IARC rating of 1, 2A or 2B, or have a US EPA rating of A, B1, or B2;
- 2) be persistent in any media for greater than 5 years.

Threshold quantities assigned as a result of aquatic toxicity are based on the following table:

### Threshold Quantities Assigned as a Result of Aquatic Toxicity

Criteria	Extremely Toxic	Highly Toxic	Moderately Toxic	Slightly Toxic
<b>Persistence (water)</b>	≥ 6 months	≥ 2 months to < 6 months	N/A	N/A
<b>Bioaccumulation</b>	BCF ≥ 5000 or Log Kow ≥ 5	BCF ≥ 500 to < 5000 or Log Kow ≥ 4 to < 5 (unless BCF < 500)	N/A	N/A
<b>Acute Aquatic Toxicity (96 hrs LC<sub>50</sub> – mg/L)</b>	≤ 0.1	> 0.1 to ≤ 1	> 1 to ≤ 10	> 10 to ≤ 100
<b>Threshold Quantity Tonnes (lbs)</b>	<b>0.22 (500 lbs)</b>	<b>1.13 (2 500 lbs)</b>	<b>4.50 (10 000 lbs)</b>	<b>9.10 (20 000 lbs)</b>

A substance is a candidate for a vapour cloud explosion if its flash point is < 23°C and its boiling point is < 35°C. A substance is considered combustible if its flash point is < 23°C or its boiling point is < 35°C. In accordance with the precautionary principle, the category with the lowest threshold will be used. For further explanation, please refer to the *Implementation Guidelines for Part 8 of the Canadian Environmental Protection Act, 1999 – Environmental Emergency Plans* (<http://www.ec.gc.ca/ee-ue/>).

### Conclusion

For *arsenic* # 28, the E2 hazard threshold was triggered by:

- 1) Aquatic toxicity at 0.22 tonnes;
- 2) Carcinogenicity at 0.22 tonnes.

Therefore, *arsenic* # 28 is recommended for addition to Schedule 1 of the *Environmental Emergency Regulations* under Part 3 with a threshold quantity of 0.22 tonnes.

## References

ATSDR (Agency of Toxic Substances and Disease Registry). *Toxicological Profiles for Arsenic*. Centre for Disease Control. PB/2000/108021. 2000. p. 232. World Wide Web accessed October 2004.  
<http://www.atsdr.cdc.gov/toxprofiles/tp2.pdf>

CHEMInfo. *Chemical Profiles – Arsenic*. Canadian Centre for Occupational Health and Safety. 2004. World Wide Web accessed October 2004.  
<http://ccinfoweb.ccohs.ca/cheminfo/search.html>

CHRIS (Chemical Hazards Response Information System). *Arsenic*. Canadian Centre for Occupational Health and Safety. 1999. World Wide Web accessed October 2004.  
<http://ccinfoweb.ccohs.ca/chempendium/search.html>

Dyer, S.D., G.L. Brooks, K.L. Dickson, B.M. Sanders, and E.G. Zimmerman. "Synthesis and Accumulation of Stress Proteins in Tissues of Arsenite-Exposed Fathead Minnows (*Pimephales promelas*)." 1993. *Environ.Toxicol.Chem.* 12: 913-924.

Genium. "Material Safety Data Sheet – Arsenic Acid." Release 58. CD-ROM. Genium Publishing Corp. Schenectady, NY. 2004.

HSDB (Hazardous Substances Data Bank). *Arsenic, elemental*. Canadian Centre for Occupational Health and Safety. U.S. National Library of Medicine. 2004. World Wide Web accessed October 2004.  
<http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>

IARC (International Agency for Research on Cancer). *Arsenic and Arsenic Compounds*. 1987. World wide web accessed October 2004.  
<http://www-cie.iarc.fr/htdocs/monographs/suppl7/arsenic.html>

IRIS (Integrated Risk Information Systems). *Inorganic Arsenic CAS #7440-38-2*. U.S. Environmental Protection Agency. 2000. World Wide Web accessed October 2004.  
<http://www.epa.gov/iris/subst/0278.htm>

Lewis Sr., R.J., *Hawley's Condensed Chemical Dictionary*. 14<sup>th</sup> Edition. John Wiley & Sons Inc. New York. 2001. pp. 91-92.

Mackay, D., E. Webster, D. Woodfine, T.M. Cahill, P. Doyle, Y. Couillard, and D. Gutzman. "Contributed Articles Towards Consistent Evaluation of the Persistence of Organic, Inorganic and Metallic Substances." 2003. ASP. Canadian Environmental Modelling Centre. Environment Canada. *Human and Ecological Risk Assessment*. 9: 1445-1474. ISSN: 1080-7039.

Cat. No.: En14-55/4-2011E-PDF  
ISBN: 978-1-100-19693-0

For information regarding reproduction rights, please contact Public Works and Government Services Canada at 613-996-6886 or at [droitdauteur.copyright@tpsgc-pwgsc.gc.ca](mailto:droitdauteur.copyright@tpsgc-pwgsc.gc.ca)

© Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment, 2011

Aussi disponible en français