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Physical Constants of Uranium Oxide

Date MSDS prepared and effective date 2002

SECTION I. MATERIAL IDENTIFICATION

Trade/Material Name: DEPLETED URANIUM OXIDE
Description: Metal Oxide (uranium)
Other Designations: DU, U, 238U, U-238, U_3O_8, triuranium octoxide

A byproduct of the gaseous diffusion enrichment cycle, DU is artificially depleted in the lighter isotopes (233U, 234U and 235U). The refined DU metal contains 0.2% 235U by weight. This depletion process effectively eliminates nuclear criticality concerns. Used in research and in applications where its high density and/or high atomic number are advantageous. Applications include radiation shielding materials, catalysts, and glass colorants.

Uranium metal oxidizes readily. In this MSDS, "uranium oxide" refers to an (unspecified) mixture of U_3O_8 with trace quantities of UO_3 and UO_2. Usually in powder form, this mix of oxides is not considered to be pyrophoric or flammable.

NOTE: Depleted Uranium (DU) is regulated by the U. S. Nuclear Regulatory Commission (NRC), or by authorized state agencies, which should be consulted for specific requirements on all aspects of the production and distribution of this

radioactive material.

SECTION II. INGREDIENTS AND HAZARDS

Ingredient Name: CAS Number: Percent: Exposure Limits:
Uranium Oxide: U3O8 1344-57-6 ca 100 * OSHA PEL: 0.05 mg/m3, 8-hr TWA

***ACGIH: 0.2 mg/m3, TLV-TWA**
0.6 mg/m3, Ceiling

Toxicity Data: Not Listed

NRC inhalation DAC: 2E-11 ●Ci/ml (occupational); 6E-14 ●Ci/ml air (effluent), insoluble.
***Defined for both soluble and insoluble uranium compounds.**

SECTION III. PHYSICAL DATA

Appearance & Odor: Uranium oxide is usually a dull, dark charcoal-gray or flat black colored powder (U308) with no detectable odor.
Boiling point: NA Specific Gravity (H2O=I): 8.30
Vapor Density (Air=1): NA Vapor Pressure: NA
Water Solubility (%): Insoluble Melting Point: >>1300 ●C
Evaporation Rate: NA % Volatile By Volume: NA
Molecular Weight: 842.09
Melting point for oxides is much higher than for metal (1132 ●C), but U3O8 decomposes to UO2 at 1300 ●C. {UO2 specific gravity = 10.96, melting point = 2878 ●C.}
{UO3 specific gravity = 7.29 (melting point NA)}

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point (Method): None reported. Limits: LEL %: None reported. UEL %: None reported.
NFPA Fire Hazard Symbol Codes: Flammability: 0, Health: 1, Reactivity: 0, Special: --**

****** Values determined by manufacturer, not found in NFPA guidebook references.**

Extinguishing Media: Uranium oxides are not considered flammable; but, if the oxidation of metal powder is not complete, there may be some potential for residual flammability/pyrophoricity. Use a dry chemical Class D or carbon dioxide extinguisher to fight small uranium fires. Flood large fires with water per DOT P.5800.3.

Unusual Fire or Explosion Hazards: Do not disperse metal powders or fines into a

dust cloud, which may be explosive. Water reactions may generate hydrogen gas, which is flammable. Flammability data pertains to uranium metal powders; oxides are not considered flammable, and no special data were found.

Special Fire-Fighting Procedures: Wear an approved self-contained breathing apparatus (SCBA) with a full-face piece operated in the pressure demand or positive-pressure mode.

SECTION V. REACTIVITY DATA

Chemical Incompatibilities: Uranium metal can react dangerously with carbon tetrachloride, chlorine, fluorine, nitric acid, nitric oxide, selenium, sulfur, and water (in finely divided form). Uranium oxide may react violently with BrF_3. No other specific incompatibilities were identified.

Conditions to Avoid: Do not create dusty work conditions.

Hazardous Decomposition Products: Uranium metal fume and/or oxide can be produced during uranium fires. Radioactive progeny (daughters) thorium-234, protactinium-234, and protactinium-234m (metastable) are produced by natural radioactive decay and are the source of the majority of the penetrating radiation. These isotopes can be concentrated in situations where the metal is melted, condensed, or dissolved, potentially elevating the observed external dose rate.

Stability/Polymerization: Material is stable in closed containers at room temperature under normal storage and handling conditions. Hazardous polymerization cannot occur. In the presence of moisture or humidity, uranium metal may react to evolve flammable hydrogen gas. For depleted uranium oxide, this hazard is greatly diminished or eliminated.

SECTION VI. HEALTH HAZARD INFORMATION

Summary of Risk: Uranium and its salts are both toxic and radioactive. Dermatitis, renal damage, acute necrotic arterial lesions, and possibly death may occur from extreme exposure. Inhalation of fine uranium particles presents increased radiation hazards; isolated uranium particles in the lungs may be a long-term cancer hazard. The more soluble uranium compounds are considered most toxic to the kidneys; the lung is the critical organ for insoluble respirable dusts or fines such as oxide powders. Uranium dusts are respiratory irritants, with coughing or shortness of breath as possible outcomes. Prolonged skin contact can cause damage to the basal cells. Radioactivity is the property of the spontaneous emissions of alpha or beta particles and gamma rays, by the disintegration of the nuclei of the atoms.

Medical Conditions Which May Be Aggravated by Contact: None reported.

Target Organs: Respiratory system, skin, eyes, kidneys, liver, blood, lymphatic system, and bone marrow.

Primary Entry Route(s): Inhalation of dusts or fines, ingestion, skin or eye contact.

Acute Effects: Nausea, vomiting, shortness of breath and coughing.

Chronic Effect(s): Primarily the effects of radiation from insoluble compounds. Possibilities include pneumoconiosis, pulmonary fibrosis, lymphoma, osteosarcoma, and lung cancer.

Eye Contact: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes.

Skin Contact: Immediately wash with soap and water. Decontaminate body surfaces following radiation
standards (procedures). Be careful not to abrade skin, in order to avoid systemic uptake.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. Seek professional medical assistance.

GET MEDICAL HELP (INPLANT OR COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. Follow established procedures including radiation monitoring programs. NOTE TO PHYSICIAN: Following significant ingestion, gastric lavage, with 2% bicarbonate solution, is recommended. A 5% bicarbonate solution has been used by some poison control specialists in radiation treatment. Depending on the solubility of the material, follow--up bioassay (urine) sampling can be used to assess the severity of a potential assimilation.

Carcinogenicity: The NTP, IARC, and OSHA do not specifically list uranium and its compounds as
carcinogens; because of its radioactivity it is considered a carcinogen if inhaled, ingested, or injected. The ACGIH lists uranium and its compounds as an A1 (Confirmed Human) carcinogen. NIOSH also lists uranium and its compounds as a confirmed carcinogen.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Procedures: Accidental leaks or spills of uranium and its compounds must

be planned for well in advance of starting any work procedure. Special radiation procedures are required, and professional assistance may be needed. Notify safety or health physics personnel, evacuate all non-essential personnel, and provide adequate ventilation. Clean-up personnel need protection against contact with, and inhalation of, dust or oxides.

Waste Management/Disposal: Follow all applicable federal, state, and/or local regulations governing the disposal of radioactive waste and contaminated materials.

OSHA Designations:
Listed as Air Contaminant (29 CFR 1910.1000)
See OSHA Guideline for Uranium and Insoluble Compounds
EPA Designations:
RCRA Hazardous Waste (40 CFR 261.33): Exempted from RCRA regulation as Source Material.
SARA Extremely Hazardous Substance (40 CFR 355): Not listed.
SARA Section 313 Toxic Chemical (40 CFR 372.65): Not listed.
Reported in EPA TSCA Inventory: Yes
Transportation Data (49 CFR 172.101-2):
Proper Shipping Name: Radioactive Material, Low Specific Activity, n.o.s.
Identification Number: UN 2912
DOT Hazard Class: Radioactive Material, Class 7 UN Register: UN 2912

SECTION VIII. SPECIAL PROTECTION INFORMATION

Personal Protective Equipment:

Goggles: Wear safety glasses with side shields. In dusty environments, wear chemical safety goggles and a face shield, per OSHA eye- and face-protection regulations.

Respirator: For emergency operations, entry into unknown atmospheres, or atmospheres immediately dangerous to life or health (IDLH), wear a SCBA with a full-face piece operated in the pressure demand (positive pressure) mode. If significant oxide or powder formation has become airborne or the concentrations exceed OSHA, and/or NRC limits, wear a properly fitted NIOSH-approved air-purifying respirator equipped with HEPA cartridges. Because each type of respirator has an assigned protection factor, respirator selection should be done by an industrial hygienist, health physicist, or other qualified individual.

Other: Wear impervious gloves, boots, aprons, etc., as appropriate, to prevent prolonged or
repeated skin contact.

Workplace Considerations:

Ventilation: Provide local ventilation as required to maintain exposure below the USNRC DAC (Derived Air Concentration) and OSHA PELs specified in Section 2.

Safety Stations: Where powders, fines, dusts, or fumes of the metal are likely to be present, make emergency eye wash stations, safety/quick-drench showers, and washing facilities available in the work area. At a minimum, emergency eyewashes and showers should meet the design and performance requirements of the current ANSI Z358.1 Emergency Eyewash and Shower Standard.

SECTION IX. SPECIAL PRECAUTIONS

Storage Segregation: Store uranium oxide in closed containers; prevent access by unauthorized personnel. Depending on quantity stored, containers and area may require special signs or postings based on RQ and dose rate. Deliberate breaching of a container seal or gasket to prevent buildup of hydrogen gas, which may evolve from oxidation reactions of residual metal with moisture, can minimize the potential for explosive situations.

Contamination: Practice good personal hygiene. Always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or
smoking. Do not eat, drink, or smoke in work areas. Do not allow exposure of personnel with open wounds or cuts. Use radiation monitoring equipment, if available, responsive to alpha and beta emissions.

Handling/Storage: Do not allow moisture contamination of storage facilities or containers. Moisture contact may complete the oxidation of any residual metal and evolve potentially
explosive concentrations of hydrogen gas. Follow established federal and state regulations for the use and storage of radioactive materials.

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