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The document was prepared in accordance with the guidelines of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006. Concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

## **SECTION 1: Identification of the substance/mixture and of the company/undertaking**

### **1.1 Product identifier**

Name of Substance:	Lead monoxide, Lead(II) oxide
EC number:	215-267-0
CAS number (EC inventory):	1317-36-8
Index-No	082-001-00-6
Reach registration number	01-2119531110-62-0027

### **1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses:

1. Use of lead metal in lead oxide production under industrial conditions.
2. Use of lead oxides in lead stabiliser production under industrial conditions.
3. Use of lead oxides in lead acid battery production.
4. Use of lead oxides in crystal glass production.
5. Use of lead oxides in production of ceramic ware.
6. Use of lead oxides in rubber production.
7. Use of lead oxides in explosive manufacture.
8. Professional use of adsorbents.
9. Professional use of paints and pigments.
10. Professional use of lead oxides as laboratory agents and in chemical analysis.

No specific uses advised against have been identified, other than legal restrictions on the use of lead.

### **1.3 Details of the supplier of the safety data sheet**

ZM SILESIA SA Oddział Huta Oława w Oławie  
Ul. Sikorskiego 2  
55-200 Oława, Poland

Tel: +48 71 318 73 01

E- mail: [sekretariatolawa@silesiasa.pl](mailto:sekretariatolawa@silesiasa.pl)

### **1.4 Emergency telephone number**

In case of emergency Tel. +48 71 318 73 01

## **SECTION 2: Hazards Identification**

### **2.1 Classification of the substance or mixture**

Classification in accordance with the Classification Labelling and Packaging Regulation EC (no) 1272/2008

Acute toxicity, Oral (Category 4), H302 Acute toxicity, Inhalation (Category 4), H332 Carcinogenicity (Category 2), H351 Reproductive toxicity (Category 1A), H360 Df Effects on or via lactation, H362 Specific target organ toxicity - repeated exposure (Category 1), H372 Acute aquatic toxicity (Category 1), H400 Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 Label elements

Labelling in accordance with the Classification Labelling and Packaging Regulation EC (no) 1272/2008

Hazard pictograms



Signal word: Danger

Hazard statements

H302 Harmful if swallowed.

H332 Harmful if inhaled.

H351 Suspected of causing cancer.

H360Df – May damage the unborn child. Suspected of damaging fertility.

H362 May cause harm to breast-fed children.

H372 Causes damage to organs through prolonged or repeated exposure.

H410 Very toxic to aquatic life with long lasting effects

Precautionary statements:

P202 Do not handle until all safety precautions have been read and understood.

P263 Avoid contact during pregnancy/while nursing.

P273 Avoid release to the environment.

P281 Use personal protective equipment as required.

P308 + P313 If exposed or concerned: Get medical advice/attention.

P405 Store locked up.

P501 Dispose of contents/containers to the officially prescribed waste facility out.

Restricted to professional users.

## 2.3 Other hazards

None known

## **SECTION 3: Composition/information on ingredients**

### 3.1 Substances

Product name	Lead monoxide
Chemical formula	PbO
CAS-No.	1317-36-8
EC-No.	215-267-0
Molar mass	223,2 g/mol
Percentage	> 99wt%
Reach registration number	01-2119531110-62-0027

**Hazardous ingredients according to Regulation (EC) No 1272/2008**

Component	Classification	Concentration
<b>Lead monoxide</b> Included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH)		
	Acute toxicity, Category 4, H302 Acute toxicity, Category 4, H332 Carcinogenicity, Category 2, H351 Reproductive toxicity, Category 1A, H360FD Effects on or via lactation, H362 Specific target organ toxicity - repeated exposure, Category 2, H373 Acute aquatic toxicity, Category 1, H400 Chronic aquatic toxicity, Category 1, H410 M-Factor: 1	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 3.2 Mixtures

Not applicable.

## SECTION 4: First Aid Measures

### 4.1 Description of first aid measures

In case of ailments caused by inhalation of dust: move the person to fresh air and consult a doctor.

In case of ingestion: rinse the mouth with water. Call a doctor. Proceed in accordance with the doctor's instructions.

In case the substance gets in the eyes: lift the eyelid and rinse thoroughly under running water; consult a doctor in case of irritation.

In case of contact with the skin: wash the skin with water and soap. Consult a doctor in case of irritation. Remove contaminated clothes.

Instructions for the doctor: lead poisoning may be detected through lead marking in the blood and/or urine. Check the level of delta-aminolevulinic acid.

### 4.2 Most important symptoms and effects, both acute and delayed

Typical clinical manifestations of lead poisoning include weakness, irritability, asthenia, nausea, abdominal pain with constipation, and anaemia.

### 4.3 Indication of any immediate medical attention and special treatments needed

Symptoms of poisoning may occur after several hours; therefore medical observation for at least 48 hours after the accident is recommended. In case of ingestion, induced vomiting or application of laxatives may be appropriate; treat as for lead poisoning.

There needs to be regular blood monitoring to confirm exposure controls are adequate.

## **SECTION 5: Firefighting Measures**

### **5.1 Extinguishing media**

Recommended extinguishing media: sprayed water, foam, carbon dioxide (CO<sub>2</sub>), dry extinguishing media, neutral powder extinguisher.

Not recommended extinguishing media: do not use a pressurized water jet to extinguish fire, since the product is dusty

### **5.2 Special hazards arising from the substance or mixture**

In case of fire lead oxides and lead vapours may be generated.

### **5.3 Advice for fire fighters**

Personal protective means for firefighters: in case of fire use oxygen respirators during firefighting.

Further recommendations: Residues from fire and residues of extinguishing water must be eliminated in accordance with the national and regional regulations.

## **SECTION 6: Accidental Release Measures**

### **6.1 Personal precautions, protective equipment and emergency procedures**

Avoid formation of dust. Wear suitable respiratory protective equipment. See section 8 for further details.

### **6.2 Environmental precautions**

Do not allow to enter sewers / surface or ground water. In case of spillage to water course or public sewers inform responsible authorities.

### **6.3 Methods and materials for containment and clearing up**

Arrange for recovery or disposal in suitable containers. Dispose contaminated material as hazardous waste. Ensure adequate ventilation.

### **6.4 References to other sections**

See sections 8 and 13 for further advice.

## **SECTION 7: Handling and Storage**

### **7.1 Precautions for safe handling**

Always read the information in the label.

Use safety measures to comply with the legally determined limit values of lead concentration in the air (NDS) in accordance with the state of technology, air-tight sealing, (extractors, wet cleansing, etc.), protection of the respiratory system.

### **7.2 Conditions for safe storage, including any incompatibilities**

Store in roofed premises at a room temperature.

The packaging must be closed. Humidity impairs the quality.  
 Do not store together with foods and fodders.

### 7.3 Specific end uses(s)

Specific Exposure Scenarios to be included as an Annex.

## SECTION 8. Exposure Controls/Personal Protection

### 8.1 Control parameters

#### Human Toxicity values

OELs - Lead and inorganic compounds (as Pb):

	Limit values – 8 hours mg/m <sup>3</sup>	Limit values – short term mg/m <sup>3</sup>
Austria	0.1 inhalable aerosol	0.4 inhalable aerosol
Belgium	0.15	
Denmark	0.05 inhalable aerosol	0.10 inhalable aerosol
European Union	0.15 inhalable aerosol	
France	0.1 inhalable aerosol	
Germany (AGS)	0.1 inhalable aerosol	
Hungary	0.15 inhalable aerosol 0.05 respirable aerosol	0.60 inhalable aerosol 0.2 respirable aerosol
Italy	0.15 inhalable aerosol	
Poland	0.05	
Spain	0.15 inhalable aerosol	
Sweden	0.1 inhalable aerosol 0.15 respirable aerosol	
Switzerland	0.1 inhalable aerosol	0.8 inhalable aerosol
United Kingdom	0.15	

#### Biological action levels, inorganic lead

EU	70 µg/dL
Poland	50 µg/dL 30 µg/dL (for women)
Germany	40 µg/dL 30 µg/dL (for woman, age below 45 year`s)
UK	60 µg/dL 30 µg/dL (for woman of reproductive capacity)
France	40 µg/dL 30 µg/dL (for woman of reproductive capacity)

#### DN(M)ELs for workers:

Exposure pattern	Route	Descriptors	DNEL/DMEL (appropriate unit)	Most sensitive endpoint
Acute - systemic effects	Dermal (mg/kg bw /day)	NA	NA	NA
	Inhalation (mg/m <sup>3</sup> )	NA	NA	NA
Acute - local effects	Dermal (mg/cm <sup>2</sup> )	NA	NA	NA
	Inhalation (mg/m <sup>3</sup> )	NA	NA	NA

## MATERIAL SAFETY DATA SHEET

Long-term - systemic effects	Systemic (µg lead /dL blood)	NOAEL = 40 µg/dL  NOAEL = 10 µg/dL	40 µg/dL  10 µg/dL	Adult neurological function Developmental effect on foetus of pregnant women
Long-term – local effects	Dermal (mg/cm <sup>2</sup> )	NA	NA	NA
	Inhalation (mg/m <sup>3</sup> )	NA	NA	NA

### Ecological toxicity values

Reliable acute aquatic toxicity test results (tests conducted with soluble lead salts)

Test organism	Species	Endpoint	Value
Algae	<i>Pseudokirchneriella subcapitata</i>	72h EC50 (pH>6.5-7.5)	52.0 µg Pb/L
		72h EC50 (pH<7.5-8.5)	233.1 µg Pb/L
Invertebrates	<i>Daphnia magna</i>	48h EC50 (pH>7.5-8.5)	107.5 µg Pb/L
	<i>Ceriodaphnia dubia</i>	48h EC50 (pH>5.5-8.5)	73.6 µg Pb/L
Fish	<i>Oncorhynchus mykiss</i>	96h LC50 (pH>6.5-8.5)	107.0 µg Pb/L
	<i>Pimephales promelas</i>	96h LC50 (pH>5.5-8.5)	194.2 µg Pb/L

Listed values are for tests performed at most sensitive pH. Other organisms have also been evaluated in the chemical safety report. References are listed in section 16.

Reliable chronic toxicity test results (tests conducted with soluble lead salts)

Compartment	Species	Value (EC <sub>10</sub> , NOEC)
Freshwater	<i>Hyalella azteca</i> (42d, mortality)	8.2 µg Pb/L (dissolved lead)
Marine water	<i>Mytilus trossolus</i> (48h, developmental abnormalities)	9.2 µg Pb/L (dissolved lead)
Freshwater sediment	<i>Tubifex tubifex</i> (28d, reproduction)	573 mg Pb/kg dw
Marine sediment	<i>Neanthes arenaneodentata</i> (28d, growth)	680 mg Pb/kg dw
Terrestrial (plants)	<i>Hordeum vulgare</i> (yield based on root)	57 mg Pb/kg dw
STP Micro-organisms (Protozoa)	Protozoan community (24h-LC10)	1.0 mg Pb/L

Listed reports are for most sensitive organisms. References are listed in section 16.

The following Predicted No Effect Concentrations have been derived for the above environmental compartments:

Compartment	PNEC Value
Freshwater	6.5 µg Pb/L (dissolved lead)
Marine water	3.4 µg Pb/L (dissolved lead)
Freshwater sediment (with/without bioavailability correction)	41.0/174.0 mg Pb/kg dw
Marine water sediment	164.2 mg Pb/kg dw
Terrestrial	147.0 mg Pb/kg dw
STP Micro-organisms	0.1 mg Pb/L

## 8.2 Exposure controls

### Engineering measures

Technical measures and appropriate working operations should be given priority over the use of personal protective equipment. See section 7.1.

### Individual protection measures

Protective clothing needs to be selected specifically for the workplace, depending on concentrations and quantities of the hazardous substances handled. The chemical resistance of the protective equipment should be enquired at the respective supplier.

Eye protection: Safety Glass

Skin protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications EN 374 standard.

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Respiratory protection: Required when dusts are generated. Recommended Filter type: Filter P 3 (EN 143) for solid and liquid particles of toxic and very toxic substances.

### **Control of environmental exposure**

One or more of the following measures may if necessary be taken to reduce emissions to water:

- Chemical precipitation: used primarily to remove the metal ions
- Sedimentation
- Filtration: used as final clarification step
- Electrolysis: for low metal concentration
- Reverse osmosis: extensively used for the removal of dissolved metals
- Ion exchange: final cleaning step in the removal of heavy metal from process wastewater

One or more of the following measures may if necessary be taken to reduce emissions to air:

- Electrostatic precipitators using wide electrode spacing: Wet electrostatic precipitators:
- Cyclones, but as primary collector Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values Membrane filtration techniques can achieve
- Ceramic and metal mesh filters. PM10 particles are removed
- Wet scrubbers

Lead compound removal from treatment works should be at least the minimum default 84% removal used in the CSR. Solid material collected from on-site treatment must be sent for metal recovery or treated as hazardous waste. Waste water treatment sludge must be recycled, incinerated or landfilled and not used as agricultural fertiliser.

### 9.1 Information on basic physical and chemical properties

a) Appearance:	Solid, powder
Colour:	yellow, yellow-green
b) Odour:	None
c) Odour threshold:	Not applicable
d) pH:	8 – 9 at 100 g/l 20 °C
e) Melting point:	886°C
f) Boiling point/boiling range:	1470°C
g) Flashpoint:	Does not flash
h) Evaporation rate:	No information available
i) Flammability:	The product is not flammable
j) Upper/lower flammability limits:	Not applicable
k) Vapour pressure:	No information available
l) Vapour density	No information available
m) Relative density	9,53 g/cm <sup>3</sup> at 20 °C
n) Water solubility	0,072 g/l at 20 °C
o) Partition coefficient: n-octanol/water	Not applicable
p) Auto-ignition temperature	No information available
q) Decomposition temperature	No information available
r) Viscosity, dynamic	No information available
s) Explosive properties	Not classified as explosive
t) Oxidizing properties	No information available

### 9.2 Other information

No data available

## SECTION 10: Stability and Reactivity

### 10.1 Reactivity

Not considered as reactive substance

### 10.2 Chemical stability

Expected to be stable under normal conditions of use.

### 10.3 Possibility of hazardous reactions

No hazardous reactions expected under normal conditions of use.

### 10.4 Conditions to avoid

Avoid excessive exposure to heat.

### 10.5 Incompatible materials

Strong oxidizing agents.

### 10.6 Hazardous decomposition products

No decomposition if used as directed.

## SECTION 11: Toxicological Information

### 11.1 Information on toxicological effects



The toxicity of this substance has been assessed using test data on lead monoxide and also using read-across from studies with similar inorganic lead compounds.

**(a) Acute toxicity**

LD<sub>50</sub> (oral, rat) > 2000 mg/kg  
LD<sub>50</sub> (dermal, rat) >2000mg/kg  
LC<sub>50</sub> (4 hr inhalation, rat) > 5mg/L

Lead monoxide and other inorganic lead compounds have generally been found to be of relatively low acute toxicity by ingestion, in contact with skin, and by inhalation. Nevertheless current EU regulations require this substance to be classified as harmful by ingestion and inhalation.

**(b) Skin corrosion/irritation**

Studies of lead monoxide and similar compounds have shown that sparingly soluble inorganic lead compounds are not corrosive or irritating to the skin of rabbits. This is supported by the lack of reports of irritant effects from occupational settings. No symptoms of respiratory irritation were noted in rats during long-term inhalation studies involving lead monoxide.

**(c) Serious eye damage/irritation**

Studies of lead monoxide and similar compounds have shown that sparingly soluble inorganic lead compounds are not corrosive or irritating to the eyes of rabbits.

**(d) Respiratory/skin sensitisation**

There is no evidence that lead monoxide causes respiratory or skin sensitisation.

**(e) Germ cell mutagenicity**

The evidence for genotoxic effects of highly soluble inorganic lead compounds is contradictory, with numerous studies reporting both positive and negative effects. Responses appear to be induced by indirect mechanisms, mostly at very high concentrations that lack physiological relevance.

**(f) Carcinogenicity**

An inhalation study of lead monoxide in rats showed that it did not induce, initiate or promote tumours of the lung. However, there is evidence that soluble lead compounds may have a carcinogenic effect, particularly on the kidneys of rats. However, the mechanisms by which this effect occurs are still unclear. Epidemiology studies of workers exposed to inorganic lead compounds have found a limited association with stomach cancer. This has led to the classification by IARC that inorganic lead compounds are probably carcinogenic to humans (Group 2A).

**(g) Reproductive toxicity**

Exposure to high levels of lead monoxide may cause adverse effects on male and female fertility, including adverse effects on sperm quality. Prenatal exposure to lead and its compounds is also associated with adverse effects on neurobehavioural development in children.

**(h) STOT-single exposure**

Lead monoxide has been found to be of relatively low acute toxicity by ingestion, in contact with skin, and by inhalation, with no evidence of any local or systemic toxicity from such exposures.

**(i) STOT-repeated exposure**

Lead monoxide is a cumulative poison and may be absorbed into the body through ingestion or inhalation. Inorganic lead compounds have been documented in observational human studies to produce toxicity in multiple organ systems and body function including the haemotopoetic (blood) system, kidney function, reproductive function and the central nervous system.

**(j) Aspiration hazard**

Not applicable

Additional toxicological information:

Toxicokinetics: Lead monoxide is slowly absorbed by ingestion and inhalation and poorly absorbed through the skin. If absorbed, lead will accumulate in the body with low rates of excretion, leading to long-term build up. Part of risk management is to take blood samples from workers for analysis to ensure that exposure levels are acceptable.

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**SECTION 12: Ecological Information**

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**12.1 Toxicity**

Inorganic lead compounds are expected to be acutely toxic in the environment and also to present a long term hazard to aquatic organisms. Toxicity will depend on the level of free lead ion in solution, which in turn is affected by pH, water hardness, salinity, etc. Lead toxicity is expected to be greater in softer waters.

**12.2 Persistence and degradability**

Lead monoxide is an inorganic substance and does not degrade. It is persistent in the environment. Biodegradation is not relevant for inorganic substances.

**12.3 Bioaccumulative potential**

Lead monoxide is considered to be bioaccumulating in the environment, and may accumulate in aquatic and terrestrial plants and animals.

**12.4 Mobility in soil**

Lead monoxide is sparingly soluble and is expected to be adsorbed onto soils and sediments. Mobility is expected to be low.

**12.5 Results of PBT and vPvB assessment**

The PBT and vPvB criteria in Annex XIII of the REACH Regulation do not apply to inorganic substances.

**12.6 Other adverse effects**

No information available.

### **SECTION 13: Disposal Considerations**

#### **13.1 Waste treatment methods**

Requires special procedures. It should be transported and handled in a special manner (dangerous product). Do not eliminate in an incinerating plant.

Contaminated containers: Contaminated containers should be treated in the same way as the product itself.

Empty containers contaminated externally with lead minium are not accepted for transport (ADR). Notice Directive on waste 2008/98/EC.

### **SECTION 14: Transport Information**

#### **14.1 UN Number**

ADR/RID: 2291

#### **14.2 UN Proper shipping name**

ADR/RID: LEAD COMPOUNDS, SOLUBLE, N.O.S. (Lead Monoxide)

#### **14.3 Transport hazard class(es)**

ADR/RID: 6.1

Classification code: T5

#### **14.4 Packing group**

ADR/RID: III

#### **14.5 Environmental hazards**

ADR/RID: environmentally hazardous

#### **14.6 Special precautions for user**

None

#### **14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code**

Not transported by sea in large quantities

### **SECTION 15: Regulatory Information**

#### **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**

1. Chemical Substances and Preparations Act (Law Gazette No. 11/2001 Item84) along with the subsequent amendments.

2. Directive of the Minister of Health of September 28, 2005 (Legal Gazette 201/2005 Item1674) - List of dangerous substances with their classification and marking.

3. Directive of the Minister of Health of July 3, 2002 regarding data sheet for dangerous substances and dangerous preparations, (Legal Gazette No. 140/2002 Item 1171) along with the subsequent amendments.

4. Directive of the Minister of Labour and Social Policy of November 29, 2002 regarding the maximum acceptable concentrations and intensities of harmful factors in the working environment. (Law Gazette No. 217/2002 Item 1833) along with the subsequent amendments.

5. Directive modifying the directive regarding data sheet for dangerous substances and dangerous preparations, Directive of the Minister of Health of December 14, 2004 (Legal Gazette z 2005. Nr 2 Item 8).
6. DIRECTIVE (EC) NO. 1907/2006 OF THE EUROPEAN PARLIAMENT AND THE EUROPEAN COUNCIL of December 18, 2006 regarding Registration Evaluation and Authorisation of Chemicals(REACH) and creation of the European Chemicals Agency, modifying the directive 1999/45/EC and repealing the directive of the European Council (EEC) No. 793/93 and the directive of the European Commission (EC) No. 1488/94, as well as the directive of the European Council 76/769/EEC and the directives of the European Commission 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC
7. Contract ADR 2009-2011.
8. Directive (EC) No. 1272/2008 regarding classification, marking and packaging of substances and mixtures, modifying and repealing the directives 67/548/EEC and 1999/45/EC as well as modifying the directive (EC) No. 1907/2006 (REACH)

## **15.2 Chemical Safety Assessment**

A Chemical Safety Assessment has been carried out for this product.

## **SECTION 16: Other Information**

### **H Statements used in Section 2 and 3**

- H332 Harmful if inhaled.
- H302 Harmful if swallowed.
- H351 Suspected of causing cancer.
- H360Df – May damage the unborn child. Suspected of damaging fertility.
- H362 May cause harm to breast-fed children.
- H372 Causes damage to organs through prolonged or repeated exposure.
- H410 Very toxic to aquatic life with long lasting effects
- H400 Very toxic to aquatic life.

### **List of Abbreviations**

- Acute Tox.: Acute Toxicity
- CAS No: CAS Registry Numbers
- Carc.: Carcinogenic
- CLP: Classification, Labeling and Packaging of chemicals
- DN(M)EL: Derived No-Effect Level or Derived Minimal Effect Level
- DW: Dry weight
- EC No: European Commission number
- EC Name: European Commission Name
- EHS: Environmentally hazardous substance
- IARC: International Agency for Research on Cancer
- IBC: International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk
- LC<sub>50</sub>: Lethal Dose, 50%
- LD<sub>50</sub>: Lethal Dose, 50%
- MARPOL 73/78: International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
- NOAEL: No observed adverse effect level.
- NOEC: No Observed Effect Concentration

OELs: Occupational Exposure Limits  
P Statement: Precautionary statement  
PNEC: Predicted No-Effect Level  
PBT: Persistent, bio-accumulative, toxic  
REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals  
Repr.: Reprotoxic  
STOT: Single Target Organ Toxicity  
SDS: Safety Data Sheet  
vPvB: Very Toxic Very Bio-accumulative  
WW: Wet weight

### **References from Section 8.1**

#### Acute Toxicity data:

Diamond JM, Koplisch DE, McMahon III J and Rost R. (1997). Evaluation of the water-effect ratio procedure for metals in a riverine system. *Environmental Toxicology and Chemistry*, Vol 16, No 3, pp. 509-520, 1997.

Grosell M, Gerdes R, Brix KV (2006). Influence of Ca, humic acid and pH on lead accumulation and toxicity in the fathead minnow during prolonged water-borne lead exposure. *Comparative Biochemistry and Physiology, Part C* 143 (2006) 473-483.

Grosell M (2010b). The effects of pH on waterborne lead toxicity in the fathead minnow, *Pimephales promelas* - 24 February 2010. Testing laboratory: University of Miami, USA.

Davies PH, JP Goettl, JR Sinley and NF Smith (1976). Acute and chronic toxicity of lead to rainbow trout *Salmo Gairdneri*, in hard and soft water. *Water Research*, Vol 10, pp 199-206.

Roger JT, Richards JG, Wood CM (2003). Ionoregulatory disruption as the acute toxic mechanism for lead in the rainbow trout (*Oncorhynchus mykiss*). *Aquatic Toxicology* 64 (2003) 215-234.

Schubauer-Berigan MK et al. (1993b). pH-dependent toxicity of Cd, Cu, Ni, Pb and Zn to *Ceriodaphnia dubia*, *Pimephales promelas*, *Hyalella azteca* and *Lumbriculus variegatus*. *Environmental Toxicology and Chemistry*, Vol 12, pp. 1261-1266, 1993.

Spehar RL, Fiandt JT. (1986). Acute and chronic effects of water quality criteria-based metal mixtures on three aquatic species. *Environ Toxicol Chem* 5:917-931.

#### Chronic Toxicity Data:

Aery N C and Jagetiya B L (1997). Relative toxicity of Cadmium, Lead and Zinc on Barley. *Commun. Soil Sci. Plant Anal.*, 28(11&12), 949-960. Testing laboratory: Dept. of Botany, University College of Science, M. L. Sukhaida University, Udaipur, India.

Bengtsson G., Gunnarsson T. and Rundgren S. (1986). Effects of metal pollution on the earthworm *Dendrobaena Rubida* (Sav.) in Acidified soils. *Water, Air and Soil Pollution* 28 (1986) 361-383. Testing laboratory: University of Lund. Ecology Building, Helgonavagen, Sweden.

Besser JM, Brumbaugh WG, Brunson EL and Ingersoll CG (2005). Acute and chronic toxicity of lead in water and diet to the amphipod *Hyalella azteca*. *Environmental Toxicology and Chemistry*, Vol. 24, No. 7, pp. 1807-1815, 2005.

Chang F-H and Broadbent F E (1981). Influence of trace metals on carbon dioxide evolution from a yolo soil. *Soil Science*, vol 132 No 6, december 1981.

Farrar JD, Bridges TS. (2003). Effects of lead on *Leptocheirus plumulosus*, *Neanthes arenaceodentata*, *Chironomus tentans* and *Hyalella azteca* following long-term sediment exposures. Report for the International Lead Zinc Research Organization. US Army Engineer Research and Development Center, Vicksburg, Mississippi.

Madoni P, Davoli D, Gorbi G, Vescovi L (1996). Toxic effect of heavy metals on the activated sludge protozoan community. *Water Research*, 30 (1), 135-141. Testing laboratory: Istituto di Ecologica, Università di Parma, Italy.

Madoni P, Davoli D, Guglielmi L (1999). Response to SOUR and AUR to heavy metal contamination in activated sludge. *Water Research*, 33 (10), 2459-2464. Testing laboratory: Dipartimento di Scienze Ambientali, Università di Parma, Italy.

Nguyen LTH, Roman Y, Zoetardt H, Janssen CR. (2003). Ecotoxicity of lead to the tubificid oligochaete *Tubifex tubifex* tested in natural freshwater sediments. Draft final report to the International Lead Zinc Research Organization. Laboratory of Environmental Toxicology and Aquatic Ecology, Ghent University, Belgium.

Wood C. M. & Nadella S. (2010). Effects of salinity and DOC on Pb Toxicity to Marine Organisms. Testing laboratory: Dept. of Biology, McMaster University, Hamilton, Canada L8S 4K1. Report date: 2010-01-01.