

MoDRN Module: Oxybenzone versus Zinc Oxide in Sunscreen for Biology Classrooms


Teacher's Notes

This lab is estimated to take 1 to 1.5 hours.

Oxybenzone is used in chemical-based sunscreens as a photoprotective agent against UVB and short-wave UVA rays with an absorption profile from 270 to 350 nm with absorption peaks at 288 and 350 nm. It was allowed for use in 1975, although research shows it to be a possible endocrine disruptor as well as having “high concerns” for biochemical and cellular change impacts due to the production of reactive oxygen species. Some animal studies have also shown development effects at high doses, although studies have been inconsistent in conclusion. A CDC biomonitoring summary indicates that appreciable levels of oxybenzone can be found in urine. The European Commission concluded that there is estrogenicity, although there is no similarity of conclusion from U.S. Agencies. At this time, there is no information on carcinogenicity.

In response to concerns over this molecule found in sunscreens, a substitution of Zinc Oxide was made in many formulas, especially for children as there is a significantly increased potential for harm. Rather than being absorbed, as oxybenzone is (it has been noted to be in potentially 97% of the population as a bioaccumulative), it is relatively inert and does not absorb. There is some difference on opinion whether Zinc Oxide works by reflecting or scattering UV rays or absorbing it and converting it to infrared heat. Zinc Oxide in sunscreen is considered a nanoparticle, and there is some concern in that regard. It is considered non-toxic and a GRAS product (Generally Recognized as Safe), however inhalation of Zinc Oxide should be avoided due to the size of the particle and the negative health impact on the lungs.

This may be approached as a movement across membranes topic. Zinc Oxide has a very low dermal absorption whereas oxybenzone has been shown to be significantly absorbed dermally, although there are some conflicting studies.



The chemistry classroom module aligns to the following Next Generation Science Standard: HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

The biology classroom module aligns to the following Next Generation Science Standard: HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

The environmental science classroom module aligns to the following Next Generation Science Standard: HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. **NOTE: The experiment for the environmental science classroom can be adapted uses other organisms or seeds.**



Supplemental Readings

The following are supplemental readings for you and your students to understand the general principles of green chemistry as well as the role of molecule substitution in toxicity consideration:

CDC. (2013). Oxybenzone: Biomonitoring Summary. Retrieved from http://www.cdc.gov/biomonitoring/Benzophenone-3_BiomonitoringSummary.html

European Commission. (2001). Opinion on the Evaluation of Potentially Estrogenic Effects of UV-filters adopted by the SCCNFP during the 17th Plenary meeting of 12 June 2001. Retrieved from

http://ec.europa.eu/health/scientific_committees/consumer_safety/opinions/sccnfp_opinions_97_04/sccp_out145_en.htm

European Commission. (2006). Opinion on Benzophenone-3. Retrieved from http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_078.pdf

Environmental Working Group. (2014). Oxybenzone. Retrieved from <http://www.ewg.org/skindeep/ingredient/704372/OXYBENZONE/#>

NCBI. (n.d.). PubChem compound: Oxybenzone. Retrieved from <http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=4632>

U.S. Department of Health and Human Services. (2015). Toxicology tutorials. Retrieved from <http://sis.nlm.nih.gov/enviro/toxtutor.html>

Background

What is UV? UV is ultraviolet light, a light wave shorter than violet-color light. UV light is divided into 3 wave-lengths: UV-A, the most common; UV-B, the most dangerous; and UV-C, is dangerous but we're not exposed because it is bounced back to space by the Earth's ozone layer.

THE LIGHT SPECTRUM

Infrared	Visible	UV-A	UV-B	UV-C
1000-700nm*	390-700nm*	400-315nm*	315-280nm*	280-100nm*
Makes our skin feel warm. Can be seen by snakes	Wavelength seen by our eyes. Includes the colors of the visible spectrum	Invisible. Shorter wavelengths, more energy. Causes skin damage, premature aging, melanoma. Passes through car glass	Causes sunburn, skin cancer, photo-aging, cataracts. Needed for Vitamin D synthesis	Dangerous, but completely absorbed by the ozone layer and doesn't reach earth surface

What does Exposure mean?

Exposure happens when UV radiation from the sun reaches your skin. You are exposed to UV when you are outside on sunny or cloudy days. UV intensity varies with time of day, season, and latitude. The equator at noon receives much more UV than at noon in Norway. You can still get sunburned on cloudy days because UV rays can bounce off the clouds. This is known as the broken-cloud effect. In fact, one survey found that UV-B increased by 25% on partly cloudy compared to sunny days.



Risks & Benefits of UV Exposure

UV is an environmental carcinogen, which means that being exposed to UV light can cause cancer. Unprotected UV exposure causes skin damage, speeds aging and increases lifetime risk of skin cancer. Sun exposure also causes wrinkles, brown spots, leathery skin and sagging. There is no such thing as a healthy tan. Any change in your skin color is a sign of skin damage. 1.3 million people are diagnosed with skin cancer in the US each year, mostly from sun exposure. UV is harmful for anyone, but those with fair skin are at higher risk because they burn more quickly and severely. More Americans have skin cancer than all other cancers combined. The only benefit of UV exposure is Vitamin D. Five minutes of unprotected UV 2-3 times a week provides all the Vitamin D the body can make. Some UV reaches the skin even when you wear sunscreen.




What is SPF?

SPF stands for Sun Protection Factor. SPF is the fraction of UV-B rays blocked by the sunscreen. In SPF15, 1/15th of the UV-B rays will reach the skin when sunscreen is applied properly. If you get sunburned in 10 minutes without sunscreen, you will prevent sunburn for 150 minutes by wearing an SPF15 sunscreen. SPF15 sunscreen protects from 93% of UV-B, SPF30 protects from 97%, and SPF50 gives 98% protection. The Food and Drug Administration (FDA), which regulates sunscreens as an over-the-counter drug, does not recommend using sunscreen with SPF higher than 50. FDA says sunscreen higher than SPF50 is misleading because it offers little added protection, gives a false sense of safety, and tempts people to reapply less often or stay in the sun longer.



What about nanoparticles in sunscreen?



Nanoparticles are ultra-fine particles between 1-100 nanometers in diameter. Nano-size titanium dioxide and zinc oxide have been used in some sunscreens since the 1990s. These physical ingredients reflect, scatter and absorb UV rays and don't tend to cause allergic reactions. The nano-size particles are clear, while older sunscreens used larger particles that appeared white on the skin. Nanoparticles do not pass through healthy skin. Sunscreen with nano-particles protects skin as soon as it is applied while conventional sunscreens must be absorbed.



Risks & Benefits of Using Sunscreen

Sunscreens are more protective against UV-B than UV-A. Avobenzone, titanium dioxide and zinc oxide protect against UV-A. New products that protect against UV-A are used in Europe and are under review by the FDA. Spray sunscreen should not be inhaled, especially sunscreen with nanoparticles because the small particles can be harmful to the lungs. Oxybenzone in sunscreen can penetrate the skin and cause an allergic reaction. It can also interfere with normal hormone function. Sunscreen SPF's higher than 50 have higher concentrations of chemicals and are more likely to have these effects. However, any sunscreen is better for you than being exposed to UV radiation.

How Can I Protect Myself?

- 
- Stay out of the sun between 10am-4pm
 - Stay in the shade
 - Wear protective clothing
 - Use a "broad spectrum" sunscreen with SPF30-50 to protect from both UV-A and UV-B
 - Avoid getting sunburned
 - Apply sunscreen thickly, 1 oz. every 2 hours
 - Apply conventional sunscreen 20 min. before going in the sun, giving it time to absorb into your skin
 - Don't use indoor tanning beds. Exposure to tanning beds before age 30 increases the risk of developing melanoma by 75%
 - With less mature skin and higher surface area to body weight, babies should not be exposed to UV or sunscreen. Babies under 6 mo should be covered and kept out of the sun, especially from 10am-4pm
- 

Student Laboratory Experiment: Use of UV Beads to Determine Efficiency of Various Sunscreens

Student Learning Objectives

At the end of this lesson, students will be able to:

- Predict the differences between the various active ingredients in sunscreens
- Understand health differences between zinc oxide and oxybenzone
- Recognize the safety issues associated with UV, tanning, and sun exposure

Materials

- Lotion and 2 sunscreens, SPF XX, Oxybenzone and Zinc Oxide
- Clear, glow-in-the-dark UV beads
- Small clear containers with lids
- Fine point dry erase marker
- Student Worksheet/Recording Sheet
- Safety Gloves
- UV Glasses

Lab Safety

Always remember to follow the posted lab safety and waste disposal instructions. Please visit the American Chemical Society for Safety Guidelines.

<http://www.acs.org/content/acs/en/education/policies/safety.html>

Real World Application

When choosing products such as sunscreen, deodorant, cleaners, hair products, shampoo, etc, it is important to read the label and research a little into the ingredients to learn more about potential impact on your health. As this activity shows, there may be safer alternatives that allow you to be in control of your health by choosing these alternatives.

Pre-Lab Questions

How will you know whether or not the UV beads have been exposed to UV radiation?

What do you expect to see in each box after you place it under the black light or in the sun?
Fill in the grid below with your predictions:

Box #	Box 1	Box 2	Box 3	Box 4
Lotion or sunscreen type:				
Prediction:				

Explain your predictions



Method and Instructions

1. Gather your materials to begin the experiment: UV beads in plastic boxes, dry erase marker, and a UV light (or experiment can be done near a window or outside).
2. The beads in the boxes change color in UV light. The objective is to see whether and how effectively lotion and various active ingredient sunscreens prevent the UV beads from being exposed to UV light.
3. Apply lotion and the various sunscreens to the lid of the boxes, to simulate sunscreen on the skin. Use as much as you would when applying on your own skin. Each lid should have an equal amount of lotion.
4. Use the marker to label the boxes, to keep track of what substance you apply to each box:
 - Control (nothing is applied to the control box).
 - Lotion
 - SPF XX Oxybenzone Active Material Sunscreen
 - SPF XX Zinc Oxide Active Ingredient Sunscreen
5. Place the 4 plastic boxes under the UV light for approximately 10-15 seconds, one at a time. Notice how the beads change colors by quickly turning the boxes over to view the beads through the clear surface (no lotion or sunscreen on that surface). Observe the color variation through the bottom of the box. Do it quickly as the color fades in a few seconds. Make note of the colors in your lab notebook or on a piece of paper.
7. Clean up your station, rinse the lotion and sunscreen from the lids of the boxes and dry, and return all materials to the front of the class where you got them.

8. Record your observations on this grid:

Box #	Box 1	Box 2	Box 3	Box 4
Lotion type:				
Prediction:				



Laboratory Questions

Does the sunscreen active ingredient make a difference for how much UV radiation exposure the beads receive?

What does this exercise with UV beads teach us about our skin's exposure to UV radiation?

Since sunburn is associated with skin cancer, how could you lower your risk of cancer caused by UV exposure from excessive sun?

How will this activity/unit impact your choices and behaviors in regard to your health?

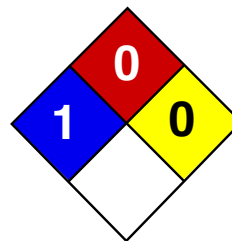
Will you make a conscious decision to alter your purchases? Why or why not?



Optional SDS Activity:

1. Obtain the SDS for zinc oxide and oxybenzone, provided by your teacher.
2. In your lab group, analyze the SDS against each other. Consider the following questions as you analyze the chemicals:
 - A. Does the chemical have a human health impact, an ecological impact or both?
 - B. Is there an acute or chronic effect? Which do you think makes the chemical more dangerous?
 - C. What are the routes of exposure and how does that impact whether the chemical is harmful or not? For example if it's only harmful if swallowed, does that make it less harmful because you're not eating sunscreen? Or not?
 - D. What pictograms do you see on the SDS? Pictograms tell you about the hazards without using words.
3. Compare the zinc oxide product with the oxybenzone product and note any differences, such as thickness, color, ease of application, absorption rate, etc.
4. Using criteria established by your group, rank the two active chemicals from safest to most hazardous. Be sure to record the reasoning you used to justify your ranking.
5. Compare your rankings with other groups. Discuss why you ranked them as you did and consider how others ranked them, along with their justifications, too. Which sections contributed most to your conclusion and why? Did you analyze the toxicological data just as it relates to humans or how it relates to animals or the ecosystem?
6. Discuss the ranking as individual groups or as a class with your teacher. Which sunscreen would you use, based off this activity, and why? Did everyone agree? What were some of the main sections groups used to classify safety? What are some things you learned from this activity?

Background Information originally created by participants in The Academy for Teaching about Health and Environment Interactions (ATHENA), a program of the University of Washington Center for Ecogenetics and Environmental Health. Funding from the National Institute of Environmental Health Sciences (NIEHS), Grant #ES007033.



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Zinc oxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc oxide

Catalog Codes: SLZ1009, SLZ1114, SLZ1222, SLZ1057

CAS#: 1314-13-2

RTECS: ZH4810000

TSCA: TSCA 8(b) inventory: Zinc oxide

CI#: Not available.

Synonym: Calamine; Zinc white

Chemical Name: Zinc Oxide

Chemical Formula: ZnO

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc oxide	1314-13-2	100

Toxicological Data on Ingredients: Zinc oxide: ORAL (LD50): Acute: 7950 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Slow addition of zinc oxide to cover linseed oil varnish causes generation of heat and ignition.

Special Remarks on Explosion Hazards:

May explode when mixed with chlorinated rubber. Zinc Oxide and Magnesium can react explosively when heated.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 5 STEL: 10 (mg/m³) from ACGIH (TLV) [United States] Inhalation TWA: 15 (mg/m³) from OSHA (PEL) [United States] Inhalation Total. TWA: 5 STEL: 10 CEIL: 25 (mg/m³) from NIOSH Inhalation TWA: 5 STEL: 10 (mg/m³) from OSHA (PEL) [United States] Inhalation Respirable. Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Odorless.

Taste: Bitter.

Molecular Weight: 81.38 g/mole

Color: White to yellowish-white

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: 1975°C (3587°F)

Critical Temperature: Not available.

Specific Gravity: 5.607 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Is not dispersed in cold water, hot water.

Solubility:

Insoluble in cold water, hot water Soluble in dilute acetic acid, or mineral acids, ammonia, ammonium carbonate, fixed alkali hydroxide solution..

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Reacts violently with magnesium, linseed oil. Reacts with hydrochloric acid to produce zinc chloride. Reacts with sulfuric acid to produce zinc sulfate. Reacts with hydrogen fluoride to produce zinc fluoride tetrahydrate. Gradually absorbs CO₂ on exposure to air. Sublimes at normal pressure. Zinc Oxide reacts with Carbon Monoxide or hydrogen to produce elemental zinc.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 7950 mg/kg [Mouse].

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.

Other Toxic Effects on Humans:

Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects based on animal data. No human data found at this time. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: May cause mild skin irritation. Eyes: May cause mechanical eye irritation and conjunctivitis. Inhalation: May cause mechanical irritation of the respiratory tract. A few sources claim that finely divided zinc oxide dust can cause "metal fume fever." Zinc oxide dust is generally considered a nuisance dust; adverse effects are unlikely when exposures are kept under reasonable control. Inhalation of high concentrations of Zinc Oxide fume or dust may cause "Metal Fume Fever." Symptoms of metal fume fever may include a flu-like condition involving headache, chills, fever, sweats, nausea, vomiting, cough, muscle aches and pains, and difficulty breathing, pulmonary edema. May also affect the liver. Ingestion: May cause digestive tract irritation although Zinc oxide has a low toxicity by oral exposure route. Chronic Potential Health Effects: Ingestion: Prolonged or repeated ingestion of zinc oxide may affect blood, metabolism, and the thyroid.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

Illinois toxic substances disclosure to employee act: Zinc oxide Rhode Island RTK hazardous substances: Zinc oxide
Pennsylvania RTK: Zinc oxide Minnesota: Zinc oxide Massachusetts RTK: Zinc oxide New Jersey: Zinc oxide California
Director's List of Hazardous Substances: Zinc oxide TSCA 8(b) inventory: Zinc oxide

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

R40- Possible risks of irreversible effects. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves.

HMS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

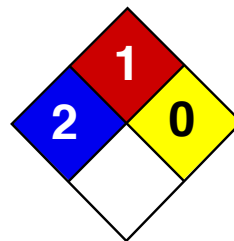
Other Special Considerations: Not available.

Created: 10/10/2005 08:34 PM

Last Updated: 05/21/2013 12:00 PM

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Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Dioxybenzone MSDS

Section 1: Chemical Product and Company Identification

Product Name: Dioxybenzone

Catalog Codes: SLD4360, SLD2230

CAS#: 131-53-3

RTECS: DJ1049500

TSCA: TSCA 8(b) inventory: Dioxybenzone

CI#: Not available.

Synonym: Benzophenone-8; UV24; UF2; Cyasorb UV 24; 2,2'-Dihydroxy-4-methoxybenzophenone; Benzophenone, 2,2'-dihydroxy-4-methoxy-; Dioxybenzon;

Chemical Name: Dioxybenzone

Chemical Formula: C14-H12-O4

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Dioxybenzone	131-53-3	100

Toxicological Data on Ingredients: Dioxybenzone LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances:

Slightly flammable to flammable in presence of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:

Sensitive to light. Store in light-resistant containers. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 244.24 g/mole

Color: Yellow.

pH (1% soln/water): Not available.

Boiling Point: 172.5°C (342.5°F)

Melting Point: 74°C (165.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Not available.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not available.

Special Remarks on Reactivity: Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation (lung irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: May cause skin, eye, mucous membrane, respiratory tract, and gastrointestinal tract irritation. The toxicological properties of this substance have not been fully investigated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Dioxybenzone

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

R36/37/38- Irritating to eyes, respiratory system and skin. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:14 PM

Last Updated: 05/21/2013 12:00 PM

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