Section 1: Product and Company Identification:

1.1 Product Identifier

Product Form:	Mixture
Identification of Substance:	Cesium Tungsten Oxide and Ethylene Glycol
Product Name:	NYACOL® CTO-EG
Synonym:	CTO, doped cesium tungsten oxide
CAS Number:	52350-17-1, 107-21-1
Index Number:	Not available.
EINECS Number:	466-380-9
REACH Registration Number:	Ethylene glycol: Registered. CTO: In accordance with Article 2 (7)(c) of REACH, registration of this substance is not required.
Formula:	$Cs_{0.33}WO_3$

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

Recommended Use:	IR asborber. Polymer additive.
Restrictions on Use:	For industrial use only, not for food, drug or home use.

1.3 Details of the supplier of the safety data sheet

Company Identification:	Nyacol Nano Technologies, Incorporated Megunko Road, P.O. Box 349, Ashland, MA 01721 U.S.A. +1 508-881-2220
Email Contact:	info@nyacol.com
Internet:	www.nyacol.com

1.4 Emergency telephone number

In Case of Emergency:	USA/Canada CHEMTREC: +1 (703) 527-3887 International CHEMTREC: +1 (703) 741-5970 24 Hours/Day: 7 Days/Week

Section 2: Hazard(s) Identification

2.1 GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute Tox. 4 H302 Harmful if swallowed; STOT, RE 2 H373 May cause damage to organs through prolonged or repeated exposure.

2.1.1 Classification according to Regulation (EC) No. 1272/2008 (CLP)

Acute Tox. 4 H302 Harmful if swallowed; STOT, RE 2 H373 May cause damage to organs through prolonged or repeated exposure.

2.2 Label Elements - Labelling according to Regulation (EC) No. 1272/2008

Signal Word: Danger

Hazard determining components of labelling:	Ethylene Glycol (Ethane-1,2-diol)
Hazard Statement(s):	H302 - Harmful if swallowed. H373 - May cause damage to organs (kidneys) through prolonged or repeated exposure.

Precautionary Statement(s):

P260 - Do not breathe dust/fumes/gas/mist/vapors/ spray.
P264 - Wash skin thoroughly after handling.
P270 - Do not eat, drink or smoke when using this product.
P301+P312+P330 - IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P314 - Get medical advice/attention if you feel unwell.
P501 - Dispose of contents/container to an approved waste disposal plant.

2.1 GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Not classified.

2.1.1 Classification according to Regulation (EC) No. 1272/2008 (CLP)

Not classified.

2.2 Label Elements - Labelling according to Regulation (EC) No. 1272/2008

Not labelled.

Signal Word: Not applicable.

Hazard Pictogram: Not applicable.

Hazard Statement(s): Not applicable.

Precautionary Statement(s): Not applicable.

2.3 Other Hazards

Components do not meet the criteria for a PBT or vPvB substance.

2.4 Unknown acute toxicity (GHS US)

No further relevant information available.

Section 3: Composition / Information on Ingredients

3.1 Chemical characterization: Mixtures

Component Name:	Product Identifier	GHS Classification	Percent By Weight
Ethylene Glycol: REACH: 01-2119456816-28-0202	CAS: 107-21-1 EINECS: 203-473-3 Index: 603-027-00-1	Acute Tox. 4, H302 STOT RE 2; H373	70-80
Cesium tungsten oxide:	CAS: 52350-17-1 EINECS: 466-380-9 Index: Not available	Not classified	20-30

Impurities: Present at a level below that to be taken into account for classification.

Stabilizing Additives: Do not effect classification

The supplier currently has no knowledge on additional ingredients that are classified and that contribute to the classification of this substance.

See Section 16 for a list of hazards if identified above.

Section 4: First-Aid Measures

4.1 Description of first aid measures

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes. Hold eyelids apart while flushing to rinse entire surface of the eye and lids with water. Get medical attention.

Skin Contact: Wash skin with plenty of soap and water for several minutes. Remove contaminated clothing. Wash clothing prior to reuse. Get medical attention if skin irritation develops or persists.

Inhalation: If inhaled, remove to fresh air. If not breathing, clear person's airway and give artificial respiration. If breathing is difficult, qualified medical personnel may administer oxygen. Get medical attention immediately.

Ingestion:	Do NOT induce vomiting. If a person is conscious and can swallow, immediately give two glasses of water (16 oz. or 500 ml.); however, stop if person feels sick as vomiting should be avoided. If vomiting occurs, avoid vomit entering the lungs. Have physician determine if condition of person will permit induction of vomiting or evacuation of stomach. Do not give anything by mouth to an unconscious or convulsing person.
First Aid Facilities:	Eye wash station.
Advice to Physicians:	No further relevant information available.

4.2 Most important symptoms and effects, both acute and delayed

Causes skin irritation, causes serious eye irritation, may cause respiratory irritation. Ethylene glycol poisoning may initially produce behavior changes, drowsiness, vomiting, diarrhea, thirst and convulsions. End-stage signs of poisoning are renal damage/failure with metabolic acidosis. Immediate treatment, supplemented with hemodialysis if indicated, may limit the progression and severity of toxic effects. Contact a POISON CENTER for further treatment information. Aspiration of this product during induced emesis may result in sever lung injury. If evacuation of stomach is necessary, use method least likely to cause aspiration, such as gastric lavage after endotracheal intubation. Contact a POISON CENTER for additional information.

4.3 Indication of any immediate medical attention and special treatment needed.

Treat symptomatically. Fomepizole and ethanol are antidotes against ethylene glycol toxicity. See http://www.cdc.gov/niosh/ershdb/EmergencyResponseCard_29750031.html for more detailed advice.

Section 5: Fire-Fighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Use water spray, dry chemical, foam or carbon dioxide to extinguish flames. Use water spray to cool fire-exposed containers. Water or foam may cause frothing.
Unsuitable extinguishing media:	None known.

5.2 Special hazards arising from the substance or mixture

Flammability of the product:	Material will burn in a fire. Containers can build pressure if exposed to heat or fire.
Special Hazard Arising from the Chemical:	No further relevant information available.
Fire Hazard:	No further relevant information available.
Explosion Hazard	No further relevant information available.
Reactivity:	No further relevant information available.

5.3 Advice for firefighters

Special Protective Equipment for Fire-fighters:	Wear standard full firefighter turn-out gear (full bunker gear) and respiratory protection (SCBA).

Section 6: Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Eye protection and impervious gloves. An approved air-purifying respirator should be worn if vapor or mist is present. Ensure adequate ventilation.

6.1.1 For non-emergency personnel

Wear protective equipment. Keep unprotected persons away. Avoid contact with skin and eyes.

6.2 Environmental precautions

Prevent entry into sewers and waterways.

6.3 Methods and material for containment and cleaning up

Ventilate area. Avoid breathing vapor. Wear appropriate personal protective equipment, including appropriate respiratory protection. Contain spill if possible. Wipe up or absorb on suitable material and shovel up. Prevent entry into sewers and waterways. Avoid contact with skin, eyes or clothing.

If more than 1 pound of product is spilled, then report spill according to SARA 304 and CERCLA 102(A) requirements.

6.4 Reference to other sections

For more information on exposure controls and personal protection or disposal considerations, check section 8 and 13 of this SDS.

Section 7: Handling and Storage

7.1 Precautions for safe handling

Wear appropriate personal protective equipment (PPE). Minimum feasible handling, and temperatures should be maintained. Avoid generating mist or dust during use. Use only in well ventilated area. Thoroughly wash hands after handling.

7.1.1 Protective measures

Use only in well ventilated areas. As a precautionary measure, the wearing of standard work gear is suggested. Keep ignition sources away. Do not smoke. Protect from heat. Protect against electrostatic charges.

7.1.2 Advice on general occupational hygiene

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating, drinking and smoking at the workplace and wearing standard working clothes and shoes unless otherwise stated. Wash hands after use. Remove contaminated clothing and protective equipment before entering eating areas. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home.

7.2 Conditions for safe storage, including any incompatibilities

Periods of exposure to high temperatures should be minimized. Water contamination should be avoided. Provide sufficient ventilation in storage and workrooms. Keep container tightly closed. Store in cool, dry area. Do not freeze. Store locked up.

7.3 Specific end use(s)

No additional information available. Refer to Section 1.2 of this SDS.

Section 8: Exposure Controls / Personal Protection

8.1 Control Parameters

Tungsten and compounds (insoluble):

USA OSHA	OSHA PEL Ceiling (mg/m^3)	5 mg/m^3 as W Short term exposure: 10 mg/m3 as W 15-minute reference period.

Ethylene Glycol, CAS #107-21-1

USA OSHA	OSHA PEL Ceiling (mg/m^3)	Not established
USA ACGIH	TLV Ceiling (aerosol only)	100 mg/m3

8.1.2 DNELs and PNECs

Ethylene Glycol (107-21-1)

DNEL (Derived No Effect Level)		
Exposure Route	**Exposure Pattern**	**DNEL**

Inhalation	Long term systemic	As no long term systemic toxicity hazard has been identified, there is no requirement to derive long term DNELs
	Acute systemic	As no acute toxicity hazard has been identified, there is no requirement to derive acute DNELs
	Long term local	35 mg/m^3 (workers) 7 mg/m^3 (general population)
Dermal	Long term systemic	106 mg/kg bw/day (workers) 53/mg/kg bw/day (general population)
	Acute systemic	As no acute toxicity hazard has been identified, there is no requirement to derive acute DNELs
	Local	As no local toxicity hazard has been identified, there is no requirement to derive local DNELs

PNEC (Predicted No Effect Concentration)

PNEC	Value
Aqua (freshwater)	10 mg/L
Aqua (marine water)	1 mg/L
STP	199.5 mg/L
Sediment (freshwater)	37 mg/kg sediment dw
Sediment (marine water)	3.7 mg/kg sediment dw
Soil	1.53 mg/kg soil dw
Secondary poisoning	No potential for bioaccumulation

8.2 Exposure Controls

Engineering Controls: Use local exhaust ventilation or adequate respiratory protective equipment to maintain exposure below workplace exposure limits. Wear protective gloves, protective clothing and eye protection.

Hygiene Measures: Workers should wash exposed skin several times daily with soap and water. Soiled work clothing should be laundered or dry-cleaned. Clean up spills immediately.

Respiratory: Airborne concentrations should be kept to lowest levels possible. If vapor, mist or dust is generated and the occupational exposure limit of the product, or any component of the product, is exceeded, use appropriate NIOSH or MSHA approved air purifying or air supplied respirator after determining the airborne concentration of the contaminant. Air-supplied respirators should always be worn when airborne concentrations of the contaminant or oxygen content is unknown.

Hands: Wear impervious gloves such as neoprene.

Eyes:	Safety glasses, chemical type goggles, or face shield recommended to prevent eye contact.
Skin:	Wear clean body-covering clothing; impervious gloves such as neoprene. Workers should wash exposed skin several times daily with soap and water. Soiled work clothing should be laundered or dry-cleaned.

8.2.3 Environmental Exposure Controls

Adverse effects of this material on the environment have not been evaluated. Proper disposal techniques to isolate and recover material should be implemented.

Section 9: Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Physical State	Liquid
Color:	Dark blue
Odor:	Slightly sweet
Metling point/freezing point:	-13 °C (ethylene glycol)
Boiling point:	197 °C (ethylene glycol)
Flammability:	Combustible; Material will burn in a fire.
Lower and upper explosion limit:	3.2 vol% and 15.3 vol% (ethylene glycol)
Flash point:	111 °C (ethylene glycol)
Auto-ignition temperature:	398 °C (ethylene glycol)
Decomposition temperature:	Not determined
pH:	Not applicable
Kinematic viscosity, mm^2/s	<50
Solubility:	Fully miscible with water. CTO practically insoluble.
Partition coefficient, n-octanol/water (log value)	-1.36 (ethylene glycol)
Vapor pressure	0.1 hPa at 25°C (ethylene glycol)
Relative density (specific gravity)	1.3
Relative vapor density	Not detrmined

9.2 Other information

No further relevant information available.

Section 10: Stability and Reactivity

10.1 Reactivity

Reaction with strong acids and strong oxidizing agents.

10.2 Chemical Stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Hazardous polymerization will not occur.

10.4 Conditions to avoid

No recommendation.

10.5 Incompatible materials

Not determined.

10.6 Hazardous decomposition products

Toxic levels of carbon monoxide, carbon dioxide, irritating aldehydes and ketones may be formed on burning. Heating in air may produce irritating aldehydes, acids and ketones.

Section 11: Toxicological Information

11.1 Information on toxicological effects

Cesium Tungsten Oxide:

Acute toxicity: LD50: >2000 mg/kg (oral, rat)

Ethylene Glycol, CAS 107-21-1

Acute toxicity, oral (human)	Harmful if swallowed. LD50: 1400-1600 mg/kg
Acute toxicity, oral (rat)	LD50: >4000 mg/kg
Acute toxicity, dermal (rabbit)	LD50: >6000 mg/kg
Skin corrosion/irritation	Causes skin irritation
Serious eye damage/irritation	Not irritating
Respiratory or skin sensitization	Not sensitizing
Germ cell mutagenicity	Not considered to be mutagenic (weight of evidence approach)
Carcinogenicity	Not considered to be carcinogenic (weight of evidence approach)
Reproductive toxicity	Not considered to be reproductive or developmental toxicant (weight of evidence approach). May have reproductive toxicity at high oral doses.
STOT-single exposure	Causes damage to organs if swallowed. Target organs: Central nervous system, kidneys
STOT-repeated exposure	NOEL 150 mg/kg bw/day - kidneys found to be the target organ at high doses (oral)
Aspiration hazard	Not considered to cause an aspiration hazard
Inhalation:	Not classified as inhalation hazard. Use breathing protection when aerosol or mist is formed.
Ingestion:	Systemic toxicity can occur through ethylene glycol ingestion. Symptoms include headache, weakness, confusion, dizziness, staggering, slurred speech, loss of coordination, faintness, nausea and vomiting, increased heart rate, decreased blood pressure, difficulty breathing and seeing, pulmonary edema, unconsciousness, convulsions, collapse, and coma. Symptoms may be delayed. Decreased urine output and kidney failure may also occur. Severe poisoning may cause death.

Section 12: Ecological Information

12.1 Ecological Toxicity

Ethylene Glycol, CAS 107-21-1

Toxicological endpoint	**Value**	**Species, Method**
Acute (short-term toxicity):		
Fish	LC50 (96h) > 72860 mg/L	Pimephales promelas, EPA 600/4-90/027
Crustacea	EC50 (48h) > 100 mg/L	Daphnia magna, OECD 202
Algae/aquatic plants	EC10 (96h) > 100 mg/L	Weight of evidence approach
Activated sludge respiration	EC20 > 1995 mg/L	Read across approach from supporting substance, ISO 8192
Chronic (long-term toxicity):		
Fish	NOEC (7d) 15380 mg/L	Weight of evidence approach
Crustacea	NOEC (7d) 8590 mg/L	Weight of evidence approach

12.2 Persistence and degradability

Ethylene glycol in this product is reported to have a moderate rate of biodegradation; greater than or equal to 30% degradation over a test period of 28 days or less.

12.3 Bioaccumulative potential

Ethylene Glycol is not considered to be bioaccumulative.

12.4 Mobility in soil

Ethylene Glycol: Based upon a calculated log Koc (=0), adsorption to solid soil phase is not expected.

12.5 Results of PBT and vPvB Assessment

No further relevant information available.

12.6 Other adverse effects

No further relevant information available.

Section 13: Disposal Considerations

This information presented only applies to the materials as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. Disposal should be in accordance with applicable regional, national and local laws and regulations.

Disposal Considerations:	The product should be disposed through an authorized waste contractor.
United States:	The product is not a RCRA regulated waste.

Section 14: Transport Information

The product is not restricted for transportation.

Sections 14.1 - 14.4

Regulations

U.S. D.O.T.: Not regulated.

ICAO/IATA: Not regulated.

IMO/IMDG: Not regulated in non-bulk quantities (<5000 lbs.).

ADR: Not regulated.

14.5 Environmental hazards:

No further relevant information available.

14.6 Special precautions for users:

No further relevant information available.

14.7 Transport bulk according to Annex II of MARPOL73/78 and the IBC Code

Not applicable, the product is not sold in bulk quantities.

Section 15: Regulatory Information

15. 1 Safety, health and environmental regulations/legislation specific for substance or mixture:

Water hazard class: Ethylene Glycol:	Water hazard class 1: Slightly hazardous for water
EPA TSCA Inventory:	All ingredients listed.
State Right-to-Know Laws:	Section 3 of this SDS lists all components of the product
SARA 311/312 Hazards:	Acute Toxicity. Specific target organ toxicity, repeated exposure.
California Proposition 65:	No ingredients listed.

SARA 313, 304 and CERCLA 102 (A): This product contains the following toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40 CFR 372:

Chemical Name	CAS #	Percent By Weight
Ethylene Glycol	107-21-1	70-80

If more than one (1) pound of Ethylene Glycol (1.2 pounds of CTO- EG) is spilled, then report the spill according to SARA 304 CERCLA 102 requirements.

Canadian Regulations:

Domestic Substance List: All ingredients listed.

WHMIS: Class D, Division 1, Division 2, material causing other toxic effects and teratogenic effects.

Controlled Products Regulations: This SDS contains all the information items specified in Schedule 1, Column 3 of the Controlled Products Regulations in a 16-heading format.

15. 2 Chemical safety assessment:

A Chemical Safety Assessment has not been carried out.

Section 16: Other Information

List of hazard phrases:
H302 - Harmful if swallowed.
H373 - May cause damage to organs (kidneys) through prolonged or repeated exposure.

National Fire Protection Association (U.S.A.) 704: Health-2, Flammability-1, Reactivity-0, Special-None

HMIS® Hazard Rating: Health-2, Flammability-1, Reactivity-0, Protective Equipment - I; safety glasses, gloves, combination respirator.

Recommended Use: CTO-EG is recommended for use as a polymer additive and transparent conductive coatings. Other uses have not been investigated and may have other hazards. For industrial use only, not for food, drug or home use.

Work Alert: Workers using the product should read and understand this SDS and be trained in the proper use of this material.

Other Special Considerations: None known.

SDS Prepared By: Andrew A. Guzelian
Technical Services Manager
Nyacol Nano Technologies, Incorporated
Telephone: 508-881-2220 U.S.A.

Revision Date: December 19, 2023

Supersedes: None.

This SDS has been prepared with data from Nyacol Nano Technologies, Inc.'s laboratories, raw material suppliers, and government publications. Information herein is accurate to the best of our knowledge. Suggestions are made without warranty or guarantee of results. Before using, the user should determine the suitability of the products for the intended use, and the user assumes the risk and liability in connection therewith. We do not suggest violation of any existing patents or give permission to practice any patented invention without license.