



SAFETY DATA SHEET

Prepared in accordance with the Malaysian Occupational Safety and Health Revision date: 18-Apr-2017
(Classification, Labelling and Safety Data Sheet of Hazardous Chemicals)
Regulations 2013 (CLASS) and Industry Code of Practice on Chemicals
Classification and Hazard Communication 2014 (ICoP)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product name: Cesium Formate Solution
Product code: CESFORMSOL
Synonyms: CsCOOH-H₂O, Cesium Formate Brine
Recommended use: Drilling & completion fluids: Industrial Products
Restrictions on use: Not Applicable.
Supplier:

Cabot Specialty Fluids
The Metropolis Tower 2
Level 08-09
11 North Buona Vista Drive
SINGAPORE
138589
Tel: +65 6808 7870
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Emergency Telephone Number: CHEMTREC Malaysia: 1-800-815-308
International CHEMTREC: +1 703-741-5970 or +1-703-527-3887
US: CHEMTREC: 1-800-424-9300 or 1-703-527-3887

2. HAZARDS IDENTIFICATION

Classification

| | |
|--|----------------------|
| Acute toxicity - Oral | Category 4 - (H302) |
| Serious eye damage/eye irritation: | Category 2 - (H319) |
| Reproductive toxicity | Category 2 - (H361f) |
| Specific target organ toxicity (repeated exposure) | Category 2 - (H373) |



Signal Word:

WARNING

Hazard statements:

H302 - Harmful if swallowed

H319 - Causes serious eye irritation

H361f - Suspected of damaging fertility

H373 - May cause damage to organs (kidneys, adrenals, nervous system, blood) through prolonged or repeated exposure

Precautionary statements:

P201 - Obtain special instructions before use

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

P260 - Do not breathe mist/vapor/spray

P280 - Wear protective gloves/protective clothing/eye protection/face protection

P308 + P313 - IF exposed or concerned: Get medical advice/attention

P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

P337 + P313 - If eye irritation persists: Get medical advice/attention

P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell

P330 - Rinse mouth

P264 - Wash face, hands and any exposed skin thoroughly after handling

P270 - Do not eat, drink or smoke when using this product

P405 - Store locked up

P501 - Dispose of contents/container in accordance with local, regional, national and international regulations

Hazards not otherwise classified(HNOC)Potential health effects

| | |
|-------------------------------|---|
| Principle Routes of Exposure: | Eye contact, Skin Contact, Inhalation |
| Skin Contact: | May cause irritation. Avoid contact with skin. |
| Inhalation: | Due to its liquid state, this material is not expected to be a significant inhalation hazard. Aerosols or dried product may be irritating to respiratory tract. Do not breathe dust, vapors or mist. |
| Ingestion: | Adverse effects on multiple organ systems were observed in animals following repeated oral exposure to cesium formate. However, these effects would not be expected under normal handling conditions. See Section 11. |
| Reproductive Effects: | Male Reproductive System. See Section 11. |
| Carcinogenicity: | Does not contain any substances listed by IARC (International Agency for Research on Cancer), NTP (National Toxicology Program), OSHA (Occupational Safety and Health Administration), ACGIH (American Conference of Governmental Industrial Hygienists) or |

EU (European Union). See also Section 11.

Target Organ Effects: Eyes, Skin, Respiratory system, Kidney, Adrenal gland

Medical Conditions Aggravated by Exposure: Respiratory disorder, Adrenal gland disorders

Potential Environmental Effects: None known. See Section 12.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms: CsCOOH-H₂O, Cesium Formate Brine.

| Chemical name | CAS No | weight-% | Trade secret |
|--|-----------|----------|--------------|
| Cesium Formate | 3495-36-1 | 60-84 | - |
| Water | 7732-18-5 | 16-40 | - |
| Carbonate and bicarbonate salts of sodium and/or potassium | VARIOUS | 0-5 | - |

Other Information:

The hyphen (-) means "not applicable"

Cesium Formate may contain up to 5% of "other alkali formates" as impurities resulting from our production process. Those alkali formates are not intentionally added in our cesium formate brine but are part of our substance "Cesium Formate" (per the definition of a substance in National Chemical Substance Control Law) and cannot be removed from the material. Those impurities have been tested as part of our product.

4. FIRST AID MEASURES

FIRST AID MEASURES

| | |
|--------------|---|
| Skin Contact | Wash thoroughly with soap and water. Remove contaminated clothing and shoes. Seek medical attention if redness, swelling, itching, or burning occurs. |
| Eye contact | Flush eyes immediately with large amounts of water for 15 minutes. Seek medical attention if redness, swelling, itching, burning or visual disturbances occur. |
| Inhalation | If cough, shortness of breath or other breathing problems occur, move to fresh air. Seek medical attention if symptoms persist. If necessary, restore normal breathing through standard first aid measures. |
| Ingestion | Do not induce vomiting. If conscious, give several glasses of water. Never give anything by mouth to an unconscious person. Seek medical attention. |

Most important symptoms and effects, both acute and delayed

Symptoms: The most important known symptoms and effects are described in Section 2 and/or in Section 11.

Indication of any immediate medical attention and special treatment needed

Note to physicians: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media: Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use foam, carbon dioxide (CO₂), dry chemical or water spray. A fog is recommended if water is used.

Unsuitable Extinguishing Media: None known.

Specific hazards arising from the chemical: Burning produces irritant fumes.

Hazardous combustion products: Carbon monoxide (CO). Carbon dioxide (CO₂). Oxides of Cesium.

Protective equipment and precautions for firefighters: In the event of fire, wear self-contained breathing apparatus. Wear suitable protective equipment.

Risk of Dust Explosion: Not Applicable: Cesium Formate Brine is an aqueous solution

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions: Avoid formation of dust and aerosols. Ensure adequate ventilation. Use personal protective equipment. See also Section 8.

Environmental Precautions:

Environmental Precautions: Contain spill if safe to do so. Local authorities should be advised if significant spillages cannot be contained. See also Section 13.

Methods and material for containment and cleaning up

Methods for containment: Prevent further leakage or spillage if safe to do so.

Methods for cleaning up: Soak up with inert absorbent material. Pick up and transfer to properly labelled containers. See Section 13.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling: Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Do not breathe aerosols or dust from dried material. Provide appropriate exhaust ventilation at machinery and at places where dust, aerosol, or mist can be generated. Avoid ingestion. Avoid prolonged or repeated exposure.

General hygiene considerations: Wash the hands and the face carefully after handling. Contaminated clothes have to be changed and washed before reuse

Conditions for safe storage, including any incompatibilities

Storage Conditions: Keep containers tightly closed in a dry, cool and well-ventilated place. Keep in properly

labeled containers. Do not store together with strong oxidizing agents.

Incompatible materials: Strong oxidizing agents, Platinum catalysts. NBR or Viton type elastomers at high temperature and long exposure times.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure guidelines: There are no exposure limits identified for this product.

Engineering Controls: Ensure adequate ventilation to minimize exposures.

Personal protective equipment [PPE]

Respiratory Protection: Approved respirator may be necessary if local exhaust ventilation is not adequate. Respiratory protection in accordance with EN 149 and OSHA 1910.134.

Hand Protection: Wear suitable gloves (in accordance with EN 374 and OSHA 1910.138): Impervious gloves. Nitrile rubber gloves. PVC or rubber gloves. PVC or other plastic material gloves.

Eye/face Protection: Eye / face protection in accordance with EN 166 and OSHA 1910.133: Wear safety glasses with side shields (or goggles). Wear face-shield if splashes are likely to occur.

Skin and Body Protection: Wear chemical impervious protective clothing if skin contact may occur.

Other: Handle in accordance with good industrial hygiene and safety practice. Emergency eyewash and safety shower should be located nearby.

Environmental exposure controls: In accordance with all local legislation and permit requirements.

9. PHYSICAL AND CHEMICAL PROPERTIES

| | | | |
|-----------------|------------------|-----------------|----------------|
| Physical State: | Liquid | Odor: | None. |
| Appearance: | Colorless Liquid | Odor threshold: | Not Applicable |
| Color: | Colorless | | |

| <u>Property</u> | <u>Values</u> | <u>Remarks • Method</u> |
|--|-----------------------------|--|
| pH: | 9 - 11 | (measured in 1:10 dilution with water) |
| Melting point/freezing point: | 0 - 5.1 °C | According to OECD 102/EU Method A.1 |
| Boiling point / boiling range: | 112 °C - 145 °C | See Cabot Specialty Fluid's Formate Technical Manual |
| Evaporation Rate: | < 0 | @ 20 °C |
| Vapor pressure: | 400 - 2250 Pa | acc. to OECD 104 |
| Vapor Density: | | No information available |
| Density: | 1.05-2.40 g/cm ³ | |
| Bulk Density: | | No information available |
| Specific Gravity at 20°C: | 1.05-2.40 | @ 15.6 °C See Cabot Specialty Fluid's Formate Technical Manual |
| Water solubility: | 84.6 - 86.6% | @ 20+/- 0,5 °C |
| Solubility(ies): | | See Cabot Specialty Fluid's Formate Technical Manual |
| Partition Coefficient (n-octanol/water): | < -2.20 | No potential to bioconcentrate |
| Decomposition temperature: | > 200 °C | See Cabot Specialty Fluid's Formate Technical Manual |
| Viscosity: | 1.7 - 10 cP | @ 20 °C |

| | | |
|--|--|--|
| Kinematic viscosity: | | No information available |
| Dynamic viscosity: | | No information available |
| Oxidizing Properties: | Mild reducing agent, which when in contact with oxidants, can react vigorously | |
| Softening point: | | Not Applicable |
| VOC content (%): | | Not Applicable |
| % Volatile (by Volume): | | No information available |
| % Volatile (by Weight): | | No information available |
| Surface Tension: | 72.4 mN/m | at 21.0 ± 0.5°C for a 1.04 g/l solution. |
| Explosive properties: | | Not Applicable. Aqueous solution with low vapour pressure No chemical groups associated with flammable or explosive properties |
| Flash Point: | | Not Applicable. |
| Flammability (solid, gas): | | Not Applicable |
| Flammability Limit in Air: | | Not flammable |
| Explosion Limits in Air - Upper (g/m ³): | | Not Applicable |
| Explosion Limits in Air - Lower (g/m ³): | | Not Applicable |
| Autoignition Temperature: | | Not Applicable. |
| Minimum Ignition Temperature: | | Not Applicable |
| Minimum Ignition Energy: | | Not Applicable |
| Ignition Energy: | | No information available |
| Maximum Absolute Explosion Pressure: | | Not Applicable |
| Maximum Rate of Pressure Rise: | | Not Applicable |
| Burn Velocity: | | Not Applicable |
| Kst Value: | | Not Applicable |
| Dust Explosion Classification: | | Not Applicable |

"No information available" indicates testing has not been performed. Endpoint is listed "Not Applicable" due to the nature of the product: Aqueous solution with low vapour pressure

10. STABILITY AND REACTIVITY

| | |
|-------------------------------------|--|
| Reactivity: | Reacts with strong oxidizers. |
| Stability: | Stable under recommended handling and storage conditions. |
| Possibility of hazardous reactions: | None under normal processing. |
| Hazardous polymerization: | Hazardous polymerization does not occur. |
| Conditions to avoid: | Avoid contact with strong oxidizing agents. During long exposures to high temperatures, and in contact with certain catalysts, some liberation of gasses (H ₂ and CO) might occur. The greatest risk exists when dry formate powder is contacted by a platinum catalyst. Users are advised to obtain the Cabot Specialty Fluid's (CSF) Formate Technical Manual, Section A13 from a CSF representative for more detailed information on conditions to avoid. CSF does not recommend retorting formate solutions to determine solids content as temperatures may exceed 500 °C. The use of rupture disks is recommended as a precautionary measure when conducting heat aging of formate solutions at temperatures above 150 °C. |

Incompatible materials: Strong oxidizing agents, Platinum catalysts. NBR or Viton type elastomers at high temperature and long exposure times.

Explosion data See also Section 9.

Sensitivity to Mechanical Impact: None.

Sensitivity to Static Discharge: None.

Hazardous decomposition products: Carbon dioxide (CO₂). Carbon monoxide (CO). Oxides of Cesium.

11. TOXICOLOGICAL INFORMATION

Information given is based on data obtained from this substance or from similar substances.

Acute toxicity

Oral LD50: LD50/oral/rat > 300 mg/kg and < 2000 mg/kg. (OECD 401 and OECD 420).

Inhalation LC50: No data are available on the product itself

Dermal LD50: LD50/dermal/rat = >2000 mg/kg. (OECD 402).

Skin corrosion/irritation: Skin irritation test, rabbit (OECD 404): Not irritating

Serious eye damage/eye irritation: Primary eye irritation test in rabbit (OECD 405): Irritating to eyes.

Sensitization: Not sensitizing based on Local Lymph Node Assay (OECD 429).

Mutagenicity: Not mutagenic in Ames test. (OECD 471). Negative in chromosome aberration test in human lymphocytes. (OECD 473). Negative in mouse lymphoma assay. (OECD 476).

Carcinogenicity: Does not contain any substances listed by IARC (International Agency for Research on Cancer), NTP (National Toxicology Program), OSHA (Occupational Safety and Health Administration), ACGIH (American Conference of Governmental Industrial Hygienists) or EU (European Union).

Reproductive Toxicity: Effects observed in ovaries and testes at 500 mg/kg/d in a 28-day oral repeated dose study in rats. No effects were observed on reproductive organs at the two lower doses (150 and 15 mg/kg/d).

Based on a 90-day oral repeated dose toxicity study (OECD 408) on a similar substance (cesium chloride), this product is classified as Reproductive Toxicity Category 2 - suspected of damaging fertility. Male and female rats were used in the study. Effects on reproductive organs and reproductive cycles were seen only in males. The reproductive effects were generally secondary to other toxic effects on adrenals and kidneys. The No Observed Adverse Effect Level (NOAEL) for reproductive effects is equivalent to 10 mg Cs/kg bodyweight/day.

Developmental toxicity: Based on the results of a Prenatal Developmental Toxicity Study (OECD 414) on a similar substance (cesium hydroxide), this product is not considered a developmental toxicant.

STOT - single exposure: Effects on the central nervous system were observed in rats following a single oral exposure to 1250 mg/kg and higher.

STOT - repeated exposure: In a 28-day oral study in rats, effects were observed in multiple organ systems at the high dose (500 mg/kg/d). Signs of neurotoxicity were also observed. Elevated reticulocyte count and effects on the heart, liver, spleen and serum biochemistry were observed at the middle dose (150 mg/kg/d). Elevated reticulocyte count was the only effect observed at the low dose (15 mg/kg/d). (OECD 407).

Based on a 90-day oral repeated dose toxicity study (OECD 408) on a similar substance (cesium chloride), this product is classified as STOT-RE Category 2 - may cause damage to multiple organs (kidneys and adrenals) through prolonged or repeated exposure. The No Observed Adverse Effect Level (NOAEL) for kidney and adrenal effects is equivalent to 10 mg Cs/kg bodyweight/day.

Aspiration Hazard: Based on industrial experience and available data, no aspiration hazard is expected.

12. ECOLOGICAL INFORMATION

Aquatic Toxicity:

MARINE

Pacific oyster (*Crassostrea gigas*) EC50 (24 hr) = 1200 mg/l
 Marine copepod (*Acartia tonsa*) EC50 (48 hr) = 340 mg/l
 Marine algae (*Skeletonema costatum*) EbC50 (72 hr) = 710 mg/l; ErC50 (0-72hr) = 1600 mg/l; NOEC = 320mg/l
 Brown shrimp (*Crangon crangon*) LC50 (96 hr) = 875 mg/l
 Juvenile turbot (*Scophthalmus maximus*) LC50 (96 hr) = 260 mg/l
 Ctenogobius gymnauchen LC50 (96 hr) = 861.5 mg/l
 Amphipod (*Corophium volutator*) LC50 (10 day) = 6653 mg/kg
 Mysid shrimp (*Mysidopsis bahia*) LC50 (48 hr) = 521 mg/l
 Mysid shrimp (*Mysidopsis bahia*) IC25 growth (7 day) = 260 mg/l, NOEC growth = 252 mg/l; IC25 survival (7 day) = 359 mg/l, NOEC survival = 420 mg/l
 Inland Silverside (*Menidia beryllina*) LC50 (96 hr) = 787 mg/l
 Inland Silverside (*Menidia beryllina*) IC25 growth (7 day) = 440 mg/l, NOEC growth = 252 mg/l; IC25 survival (7 day) = 471 mg/l, NOEC survival = 420 mg/l

FRESHWATER

Zebra fish (*Brachydanio rerio*) LC50 (96 hr) >100 mg/l
 Rainbow trout (*Oncorhynchus mykiss*) LC50 (96 hr) = 2100 mg/l
 Water flea (*Daphnia magna*) EC50 (48 hr) > 100 mg/l
 Freshwater algae (*Desmodesmus subspicatus*, formerly *Scenedesmus subspicatus*) ErC50 (0-72 hr) = 110 mg/l; NOEC = 56 mg/l
 Freshwater algae (*Pseudokirchneriella subcapitata*, formerly *Selenastrum capricornutum*) ErC50 (0-72 hr) = 110 mg/l; NOEC = 18 mg/l

Other Information:

In the majority of marine species, this material has not demonstrated toxicity and has received a rating of GOLD/SILVER/SILVER for drilling products and GOLD for Completion/Workover products under the PARCOM Harmonized Offshore and Chemical Notification Format (HOCNF)

ENVIRONMENTAL FATE

Persistence and degradability

READILY BIODEGRADABLE

Ready Biodegradability in Sea Water - Closed Bottle Test (OECD Method 306) = 79%

degradation after 28 days
 Ready Biodegradability in Sea Water - Closed Bottle Test (OECD Method 306) = 66%
 degradation after 28 days
 Ready Biodegradability in Freshwater - Closed Bottle Test (OECD Method 301D) = 83%
 degradation after 28 days
 Ready Biodegradability in Freshwater - Closed Bottle Test (OECD Method 301D) = 79%
 degradation after 28 days

Bioaccumulation Log Pow = < - 2,20 (no potential to bioconcentrate). See also Section 9.

Mobility: No information available.

Distribution to Environmental Compartments: No information available.

Other adverse effects: No other data are available.

13. DISPOSAL CONSIDERATIONS

Disclaimer: Information in this section pertains to the product as shipped in its intended composition as described in Section 3 of this SDS. Contamination or processing may change waste characteristics and requirements. Regulations may also apply to empty containers, liners or rinsate. State/provincial and local regulations may be different from federal regulations. The person generating waste must determine its proper classification

Unused and Uncontaminated Product: Waste codes should be assigned by the user based on the application for which the product was used. The unused material would be considered a hazardous waste.

Disposal considerations: Product, as supplied, should be disposed of in accordance with the regulations issued by the appropriate federal, state and local authorities. Same consideration should be given to containers and packaging.

14. TRANSPORT INFORMATION

DOT

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |
| Packing group | Not regulated |

ICAO (air)

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |
| Packing group | Not regulated |

IATA

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |

| | |
|---------------|---------------|
| Packing group | Not regulated |
|---------------|---------------|

IMDG

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |
| Packing group | Not regulated |

RID

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |
| Packing group | Not regulated |

ADR

| | |
|----------------------|---------------|
| UN/ID no | Not regulated |
| Proper Shipping Name | Not regulated |
| Hazard Class | Not regulated |
| Packing group | Not regulated |

IMO IBC Code: Cesium Formate - Provisionally assessed as: Pollution Category Z, Ship Type 3, with additional requirement 15.19.6.

| |
|-----------------------------------|
| 15. REGULATORY INFORMATION |
|-----------------------------------|

International Inventories

| | |
|--|-----------------|
| TSCA - United States Toxic Substances Control Act Section 8(b) Inventory | Complies |
| DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List | Complies |
| EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances | Complies |
| ENCS - Japan Existing and New Chemical Substances | Does not comply |
| IECSC - China Inventory of Existing Chemical Substances | Does not comply |
| KECL - Korean Existing and Evaluated Chemical Substances | Does not comply |
| PICCS - Philippines Inventory of Chemicals and Chemical Substances | Does not comply |
| AICS - Australian Inventory of Chemical Substances | Complies |
| NZIoC - New Zealand Inventory of Chemicals | Does not comply |
| TCSI - Taiwan Chemical Substance Inventory | Complies |

Note: Cabot Corporation holds a low volume notification certificate from China and is allowed to import Cesium Formate substance up to 10 tonnes per year.

Product has been notified as required per CLASS Regulation. Cesium Formate: Hazardous substance has been notified in accordance with CLASS law requirement.

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|------------------------------|
| 16. OTHER INFORMATION |
|------------------------------|

References:

MARPOL 73/78, Latest edition of Marine Environment Protection Committee (MEPC) Circulars MEPC.2/Circular, IBC Code, IMO

Resolution A.673(16) Guidelines for the Transport and Handling of Limited Amounts of Hazardous and Noxious Liquid Substances in bulk on Offshore Support Vessels.

Contacts: See Section 1

Tantalum Mining Corporation
of Canada, Ltd.

Bernic Lake

Box 2000

Lac du Bonnet, MB R0E 1A0

CANADA

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Disclaimer:

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Prepared by: Cabot Corporation - Safety, Health and Environmental Affairs
Revision date: 18-Apr-2017

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End of Safety Data Sheet