Safety Data Sheet

Regulation : In accordance with Regulation (EU) 2015/830 (REACH), Annex II, and OSHA 29 CFR 1910.1200

Section I – IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Important Note: As a solid, manufactured article, exposure to hazardous ingredients is not expected with normal use. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication Standard requirement. The information contained in this Safety Data Sheet contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.

1.1 Product identifier

Substance name : MODEL CM0630 (67Ah capacity)

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

Relevant identified uses : Lithium-Ion battery

Uses advised against : Use for recommended use only

Further Information : Not available

1.3 Details of the supplier of the safety data sheet

Supplier : SAMSUNG SDI Co., Ltd.

Street address/P.O. Box : 150-20, Gongse-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea

Country ID/Postcode/Place :

Telephone number : +82-31-288-4415

Responsible Department: Cell development department

e-mail address of competent person responsible for the SDS : Not available

National contact : 1-800-424-9300: US and Canada / 1-703-527-3887: International

1.4 Emergency Telephone

: +82-31-288-4415

Opening hours : Not available

Other comments : Not available

1.5 Further Information

Remark:

The information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. SAMSUNG SDI Co., Ltd. makes no warranty, expressed or implied, with respect to this information and disclaims all liabilities from reliance on it.

Section II – HAZARDS IDENTIFICATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

2.1 Classification of the substance or mixture

2.1.1 Classification according to Regulation (EC) No. 1272/2008 [CLP] and OSHA 29 CFR 1910.1200 :

Not classified

2.1.2 Additional information:

Classification of the substance or mixture.

Preparation Hazards and Classification: The product is a Lithium ion cell or battery and is therefore classified as an article and is not hazardous when used according to the recommendations of the manufacturer. The hazard is associated with the contents of the cell or battery. Under recommended use conditions, the electrode materials and liquid electrolyte are non-reactive provided that the cell or battery integrity remains and the seals remain intact. The potential for exposure should not exist unless the cell or battery leaks, is exposed to high temperatures or is mechanically, electrically or physically abused/damaged. If the cell or battery is compromised and starts to leak, based upon the battery ingredients, the contents are classified as Hazardous.

Hazardous Materials Information Label (HMIS)
Health: Not available
Flammability: Not available
Physical Hazard: Not available

NFPA Hazard Ratings
Health: 0
Flammability: 1
Reactivity: 0

2.2 Label elements

Hazard pictograms : Not applicable

Signal word : Not applicable

Hazard statement : Not applicable

Precautionary statements: Not applicable

Supplemental Hazard information (EU) : Not applicable

2.3 Other hazards :

Appearance, Color and Odor: Solid object with no odor.

Primary Routes(s) of Exposure: These chemicals are contained in a sealed enclosure. Risk of exposure occurs only if the cell or pack is mechanically, thermally, electrically or physically abused to the point of compromising the enclosure.
If this occurs, exposure to the electrolyte solution contained within can occur by inhalation, ingestion, eye contact and skin contact.

Potential Health Effect(s):

Acute (short term): see Section 8 for exposure controls.
In the event that this cell or pack has been ruptured, the electrolyte solution contained within the cell would be corrosive and can cause burns to skin and eyes.
Inhalation: Inhalation of materials from a sealed cell is not an expected route of exposure. Vapors or mists from a ruptured cell may cause respiratory irritation.
Ingestion: Swallowing of materials from a sealed cell is not an expected route of exposure. Swallowing the contents of an open cell can cause serious chemical burns to mouth, esophagus, and gastrointestinal tract.
Skin: Contact between the cell and skin will not cause any harm. Skin contact with the contents of

an open cell can cause severe irritation or burns to the skin.
Eye: Contact between the cell and the eye will not cause any harm. Eye contact with the contents of an open cell can cause severe irritation or burns to the eye.
CHRONIC (long term): see Section 11 for additional toxicological data.

Interactions with other chemicals: Immersion in high conductivity liquids may cause corrosion and breaching of the cell or battery enclosure. The electrolyte solution inside of the cells may react with alkaline (basic) materials and present a flammability hazard.

Potential Environmental Effects: Not Available.

Section III – COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Mixture

CAS No.	EC No.	REACH Registration No.	%[weight]	Name	Common Name (Synonyms)	Classification according to Regulation(EC) No 1278/2008(CLP)
12057-17-9	601-724-5	-	25	Lithium Manganese (III,IV) oxide	$LiMn_2O_4$	Not classified
7429-90-5	231-072-3	-	20	Aluminium	Al	Flam. Sol. 1, H228 Water-react. 2, H261
7782-42-5	231-955-3	-	15	Graphite	Grafito	Not classified
7440-50-8	231-159-6	-	10	Copper	Cu	Not classified
182442-95-1	695-690-9	-	10	Cobalt lithium manganese nickel oxide	Not available	Not classified
177997-13-6	700-042-6	-	5	Lithium Nickel Cobalt Aluminium oxide	LNCA	Not classified
9003-07-0	618-352-4		5	1-Propene, homopolymer	Polypropylene	Not classified
616-38-6	210-478-4	-	5	Dimethyl carbonate	DMC	Flam. Liq. 2, H225
1344-28-1	215-691-6	-	3	Aluminium oxide	Activated Alumina	Not classified
1333-86-4	215-609-9	-	2	Carbon black	Carbon	Not classified

Further Information
Because of the cell structure the dangerous ingredients will not be available if used properly.
During charge process a lithium graphite intercalation phase is formed.

Section IV – FIRST-AID MEASURES

※ General information

The following first aid measures are required only in case of exposure to interior battery components after damage of the external battery casing. Undamaged, closed cells do not represent a danger to the health.

4.1 Description of first aid measures

Following eye contact :

- In case of contact with substance, immediately flush eyes with running water at least 20 minutes.

Following skin contact :

- In case of contact with substance, immediately flush skin with running water at least 20 minutes.
- Remove and isolate contaminated clothing and shoes.
- Wash contaminated clothing and shoes before reuse.
- Get immediate medical advice/attention.

Following inhalation :

- Specific medical treatment is urgent.
- Move victim to fresh air.
- Administer oxygen if breathing is difficult.

Following ingestion :

- Do not let him/her eat anything, if unconscious.
- Get immediate medical advice/attention.

Further Information :

- The following first aid measures are required only in case of exposure to interior battery components after damage of the external battery casing.
- Undamaged, closed cells do not represent a danger to the health.

4.2 Most important symptoms and effects, both acute and delayed

Acute effects : Not available

Delayed effects : Not available

4.3 Indication of immediate medical attention and special treatment needed

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Section V – FIRE-FIGHTING MEASURES

5.1 Extinguishing media

- When the scale of the fire is small, use a HFC (hydrofluorocarbon) clean-agent fire extinguisher or alcohol resistant foam fire extinguishers. (In case of battery overheating, wear protective gear and immerse heated battery in water)
- In case of large fire, use large amount of water to extinguish.

5.2 Special hazards arising from the substance or mixture

- Flammable gas leaks before ignition and then the product ignites.

5.3 Advice for firefighters

- The ignited battery has a high temperature, so there is a risk of additional ignition even if the fire is extinguished at early stage. Sprinkle a large amount of water until the battery temperature drops to normal temperature.
- If the battery is ignited in multi-stacked condition, multi-stack should be disassembled and then extinguished so that heat is not transferred between batteries

- In the event of a battery fire, cool it by spraying water directly on the battery.
- When handling a overheated battery, wear heat-resistant protective equipment.

Section VI – ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Protective equipment : Use personal protective equipment, see Section 8

Emergency procedures :

- Eliminate all ignition sources.
- Stop leak if you can do it without risk.
- Please note that materials and conditions to avoid.
- Ventilate the area.
- Do not touch or walk through spilled material.

For emergency responders

- Eliminate all ignition sources.
- Please note that materials and conditions to avoid.
- Move battery to well ventilated area to prevent gas accumulation.

6.2 Environmental precautions :

- Prevent entry into waterways, sewers, basements or confined areas.

6.3 Methods and material for containment and cleaning up

For containment : Not available

For cleaning up :

- With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.

Other information: Not available

6.4 Reference to other sections

- See also sections 8 and 13 of the Safety Data Sheet.

Section VII – HANDLING AND STORAGE

7.1 Precautions for safe handling

- Avoid short circuiting the cell.
- Avoid mechanical damage of the cell.
- Do not open or disassemble.
- Please note that materials and conditions to avoid.
- Wash thoroughly after handling.
- Please work with reference to engineering controls and personal protective equipment.
- Be careful to high temperature.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures and storage conditions : Not available

Packaging materials : Not available

Requirements for storage rooms and vessels :

- Storage at temperature described in O&M manual which uses this cell, at approx. 20-50% of nominal capacity.
- Store in a closed container.
- Store in cool and dry place.

7.3 Specific end use(s)

Recommendations : Not available

Industrial sector specific solutions : Not available

Section VIII – EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Occupational Exposure limits

Name	ACGIH regulation	Biological exposure index	OSHA regulation	NIOSH regulation	EU regulation
Lithium Manganese (III,IV) oxide	TWA = 0.02 mg/m^3 (respirable particulate matter), TWA = 0.1 mg/m^3 (inhalable particulate matter)(Manganese inorganic compounds)	Not available	C = 5 mg/m^3 (Manganese compounds)	TWA = 1 mg/m^3, STEL = 3 mg/m^3 (Manganese compounds)	Not applicable
Aluminium	TWA = 1 mg/m^3 (respirable particulate matter)(Aluminum, Aluminum insoluble compounds)	Not available	TWA = 15 mg/m3 (Aluminum metal (as Al), Total dust), 5 mg/m3 (Respirable fraction)	TWA = 10 mg/m^3 (total), 5 mg/m^3 (resp)	Not applicable
Graphite	TWA = 2 mg/m^3 (all forms except graphite fibers, respirable particulate matter)	Not available	TWA = 15 mppcf	TWA = 2.5 mg/m^3 (resp)	Not applicable
Copper	TWA = 0.2 mg/m^3 (Copper fume), TWA = 1 mg/m^3 (Copper dust and mist, Copper compounds as Cu)	Not available	TWA = 0.1 mg/m3 (Copper Fume (as Cu)), 1 mg/m3 (Dusts and mists (as Cu), Cotton dust)	TWA = 1 mg/m^3 (Copper (dusts and mists, as Cu), other copper compounds (as Cu) except Copper fume)	Not applicable

Cobalt lithium manganese nickel oxide	TWA = 0.2 mg/m^3 (inhalable particulate matter, as Ni)(Nickel insoluble inorganic compounds), TWA = 0.1 mg/m^3 (inhalable particulate matter, as Ni)(Nickel soluble inorganic compounds), TWA = 0.02 mg/m^3 (as Co)(Cobalt inorganic compounds), TWA = 0.02 mg/m^3 (respirable particulate matter, as Mn); 0.1 mg/m^3 (inhalable particulate matter, as Mn)(Manganese inorganic compounds)	Not available	TWA = 1 mg/m^3 (Nickel compounds), C = 5 mg/m^3 (Manganese compounds)	TWA = 0.015 mg/m³ (Nickel metal and other compounds, as Ni), TWA = 1 mg/m³, STEL = 3 mg/m³ (Manganese compounds)	Not applicable
Lithium Nickel Cobalt Aluminium oxide	TWA = 0.2 mg/m^3 (inhalable particulate matter, as Ni)(Nickel insoluble inorganic compounds), TWA = 0.1 mg/m^3 (inhalable particulate matter, as Ni)(Nickel soluble inorganic compounds), TWA = 0.02 mg/m^3 (as Co)(Cobalt inorganic compounds), TWA = 1 mg/m³ (respirable particulate matter)(Aluminum insoluble compounds)	Not available	TWA = 1 mg/m^3 (Nickel compounds)	TWA = 0.015 mg/m³ (Nickel metal and other compounds, as Ni)	Not applicable
1-Propene, homopolymer	Not applicable	Not available	Not applicable	Not applicable	Not applicable
Dimethyl carbonate	Not applicable	Not available	Not applicable	Not applicable	Not applicable
Aluminium oxide	TWA = 1 mg/m^3 (respirable particulate matter)(Aluminum, Aluminum insoluble compounds)	Not available	TWA = 15 mg/m^3 (Total dust), 5 mg/m^3 (Respirable fraction)	Not applicable	Not applicable
Carbon black	TWA = 3 mg/m^3 (inhalable particulate matter)	Not available	TWA = 3.5 mg/m³	TWA = 3.5 mg/m^3	Not applicable

8.2 Exposure controls

8.2.1 Appropriate engineering controls :

Substance/mixture related measures to prevent exposure during identified uses:

- Avoid charging batteries in areas where hydrogen gas accumulate.
- Use local exhaust ventilation to maintain concentrations of hydrogen below the Lower Explosive collect and transport flammable gases in ventilation systems.
- Insure proper ventilation is present and electrolyte mist and vapours.

Structural measures to prevent exposure:

- Avoid charging batteries in areas where hydrogen gas accumulate.
- Use local exhaust ventilation to maintain concentrations of hydrogen below the Lower Explosive collect and transport flammable gases in ventilation systems.
- Insure proper ventilation is present and electrolyte mist and vapours.

Organisational measures to prevent exposure: Not available

Technical measures to prevent exposure:

- Insure proper ventilation is present and electrolyte mist and vapours.

8.2.2 Individual protection measures, such as personal protective equipment :

Eye and face protection

- Wear facepiece with goggles to protect.
- An eye wash unit and safety shower station should be available nearby work place.
- Wear breathable safety goggles to protect from particulate material causing eye irritation or other disorder.
- An eye wash unit and safety shower station should be available nearby work place.

Skin protection

Hand protection

- Wear chemical resistant gloves.
- Wear appropriate protective gloves by considering physical and chemical properties of chemicals.

Other skin protection

- Wear appropriate protective chemical resistant clothing.
- Wear appropriate protective clothing by considering physical and chemical properties of chemicals.

Respiratory protection :

- Wear NIOSH or European Standard EN 149 approved full or half face piece (with goggles) respiratory protective equipment when necessary.
- In case exposed to particulate material, the respiratory protective equipment as follow are recommended.

; facepiece filtering respirator or air-purifying respirator, high-efficiency particulate air(HEPA) filter media or respirator equipped with powered fan, filter media of use(dust, mist, fume)

- In lack of oxygen(< 19.5%), wear the supplied-air respirator or self-contained oxygen breathing apparatus.

8.2.3 Environmental exposure controls

Substance/mixture related measures to prevent exposure: Not available

Instruction measures to prevent exposure: Not available

Organisational measures to prevent exposure: Not available

Technical measures to prevent exposure: Not available

Section IX – PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance

Description : Solid

Color : Various

Odor : Odorless

Odor threshold : Not available

pH : Not available

Melting point/freezing point : Not available

Initial boiling point and boiling range : Not available

Flash point : Not available

Evaporation rate : Not available

Flammability (solid, gas) : Not available

Upper/lower flammability or explosive limits : Not available

Vapor pressure : Not available

Solubility (ies) : Insoluble.

Vapor density : Not available

Relative density : Not available

Partition coefficient: n-octanol/water : Not available

Auto ignition temperature : Not available

Decomposition temperature : Not available

Viscosity : Not available

Explosive properties : Not available

Oxidizing properties : Not available

Molecular weight : Not available

9.2 Other information

Not available

Section X – STABILITY AND REACTIVITY

10.1 Reactivity

- Stable at ambient temperature.

10.2 Chemical stability

- Stable in general.

10.3 Possibility of hazardous reactions

- In case of open cells, there is the possibility of hydrofluoric acid and carbon monoxide release.
- Fire may produce irritating and/or toxic gases.

- Inhalation of material may be harmful.

10.4 Conditions to avoid

- Ignition sources (heat, sparks or flames).

10.5 Incompatible materials

- Combustibles.

10.6 Hazardous decomposition products

- No decomposition if stored and applied as directed.
- Irritating and/or toxic gases

Section XI – TOXICOLOGICAL INFORMATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

11.1 Information on toxicological effects

Acute toxicity

Oral : Not classified (ATEmix = 640 ~ 2,558 mg/kg bw)

- Aluminium : Rat LD_{50} > 15,900 mg/kg(Read-across)(OECD Guideline 401)
- Graphite : Rat LD_{50} > 2,000 mg/kg(OECD Guideline 423, GLP)
- Copper : Rat LD_{50} = 481 mg/kg(OECD Guideline 401, GLP)
- Cobalt lithium manganese nickel oxide : Rat LD_{50} > 2,000 mg/kg(NCIS)
- Lithium Nickel Cobalt Aluminium oxide : Rat LD_{50} > 2,000 mg/kg(OECD Guideline 420, GLP)
- Dimethyl carbonate : Rat LD_{50} > 5,000 mg/kg(male/female)(OECD Guideline 401, GLP)
- Aluminium oxide : Rat LD_{50} > 10,000 mg/kg(OECD Guideline 401, GLP, ECHA)
- Carbon black : Rat LD_{50} > 10,000 mg/kg(OECD Guideline 401, GLP, ECHA)

Dermal : Not classified (ATEmix = 3,400 ~ 58,000 mg/kg bw)

- Copper : Rat LD_{50} > 2,000 mg/kg(OECD Guideline 402, GLP)
- Dimethyl carbonate : Rabbit LD_{50} > 2,000 mg/kg(male/female)(GLP)
- Carbon black : Rat LD_{50} > 3,000 mg/kg(ChemIDplus)

Inhalation : Not classified (ATEmix = > 0.888 mg/L / 4 hr)

- Aluminium : Rat LC_{50} > 0.888 mg/L / 4 hr(OECD Guideline 403)
- Graphite : Rat LC_{50} > 2,000 mg/m³ / 4 hr(OECD Guideline 403, GLP)
- Copper : Rat LC_{50} > 5.11 mg/L / 4 hr(OECD Guideline 436, GLP)
- Dimethyl carbonate : Rat LC_{50} > 5.36 mg/L / 4 hr(male/female)(OECD Guideline 403, GLP)
- Aluminium oxide : Rat LC_{50} > 2.3 mg/L / 4 hr(OECD Guideline 403, GLP, ECHA)
- Carbon black : Rat LC_0 = 4.6 mg/m³ / 4 hr(OECD Guideline 403, ECHA)

Skin corrosion/ irritation : Not classified

- Aluminium : In the skin irritation test using rabbits, the test material was not irritating. (Read-across)(OECD Guideline 404)
- Graphite : In the skin irritation test with rabbits, the test material was not irritating. (OECD Guideline 404, GLP)
- Copper : In the skin irritation test using rabbits, the test material was not irritating. (OECD Guideline 404, GLP)

- Cobalt lithium manganese nickel oxide : the test material was not irritating.
- Lithium Nickel Cobalt Aluminium oxide : In the skin irritation test using rabbits, the test material was corrosive. (an exposure period of 1-hour)(OECD Guideline 404, GLP)
- 1-Propene, homopolymer : Processes involved in production&processing of polyolefins are usually totally enclosed & type of accidents that may occur will be burns to skin or eyes, or asphyxiation or intoxication dueto inhalation of vapors escaping from leaks.
- Dimethyl carbonate : In the skin irritation test using rabbits, the test material was not irritating. (OECD Guideline 404)
- Aluminium oxide : In the skin irritation test using rabbits, very slight erythema was observed. it would not lead to classification.(2/12)(OECD Guideline 404)
- Carbon black : In the skin irritation test using rabbits, the test material was not classified. (OECD Guideline 404)

Serious eye damage/ irritation : Not classified
- Aluminium : In the eye irritation test using rabbits, the test material was not irritating. (Read-across)
- Graphite : In the eyes irritation test with rabbits, the test material was slightly irritating. it was fully reversible within 7 days. (OECD Guideline 405, GLP)
- Copper : In the eyes irritation test with rabbits, the test material was irritating. but it was fully reversible within 7 days. (OECD Guideline 405, GLP)
- Cobalt lithium manganese nickel oxide : the test material was not irritating.
- Lithium Nickel Cobalt Aluminium oxide : In the eye irritation test using The SkinEthic RHC model consists of transformed human keratinocytes, the test material was Iirritating.
- Dimethyl carbonate : In the eye irritation test using rabbits, the test material was not irritating. (GLP)
- Aluminium oxide : In the eyes irritation test using rabbits, slight erythema was observed. it would not lead to classification.(OECD Guideline 405)
- Carbon black : In the eye irritation test using rabbits, the test material was not irritating. (OECD Guideline 405)

Respiratory sensitization : Not classified
- Aluminium : In the respiratory sensitization test using mice, the test material was not respiratory sensitization. (Read-across)
- Aluminium oxide : In the respiratory sensitization test using rats, this material was not respiratory sensitizing.(Effects of Asian Sand Dust, Arizona Sand Dust, Amorphous Silica and Aluminium Oxide on Allergic Inflammation in the Murine Lung, 2008)
- Carbon black : This material has not been tested in animals for sensitisation effects on the respiratory tract. In humans, no cases of allergies were reported to the responsible occupational physicians.

Skin sensitization : Not classified
- Aluminium : In the skin sensitization test using guinea pigs, the test material was not skin sensitizing.
- Graphite : In the skin sensitization test using mice, the test material was not skin sensitizing. (OECD Guideline 429, GLP)
- Copper : In the skin sensitization test using guinea pigs, the test material was not skin sensitizing. (OECD Guideline 406, GLP)
- Cobalt lithium manganese nickel oxide : this material was not skin sensitizing. (Mouse)
- Lithium Nickel Cobalt Aluminium oxide : In the skin sensitization test using mouse, the test material was not skin sensitizing. (OECD Guideline 429, GLP)
- Dimethyl carbonate : In the skin sensitization test using guinea pigs, the test material was not skin sensitizing. (OECD Guideline 406, GLP)
- Aluminium oxide : In the skin sensitization test using guinea pigs, this material was not skin sensitizing.(Landsteiner / Draize method)

- Carbon black : In the skin sensitization test using guinea pigs, the test material was not skin sensitizing. (OECD Guideline 406, GLP)

Carcinogenicity : Not classified

IARC

- Cobalt lithium manganese nickel oxide : Group 1 (Nickel compounds), Group 2B (Cobalt and cobalt compounds)
- Lithium Nickel Cobalt Aluminium oxide : Group 1 (Nickel compounds), Group 2B (Cobalt and cobalt compounds)
- 1-Propene, homopolymer : Group 3
- Carbon black : Group 2B

OSHA

- Cobalt lithium manganese nickel oxide : Present (Nickel compounds, Cobalt compounds)
- Lithium Nickel Cobalt Aluminium oxide : Present (Nickel compounds, Cobalt compounds)
- Carbon black : Present

NTP

- Cobalt lithium manganese nickel oxide : K (Nickel compounds), R (Cobalt compounds)
- Lithium Nickel Cobalt Aluminium oxide : K (Nickel compounds), R (Cobalt compounds)

ACGIH

- Lithium Manganese (III,IV) oxide : A4 (Manganese inorganic compounds)
- Aluminium : A4 (Aluminum, Aluminum insoluble compounds)
- Cobalt lithium manganese nickel oxide : A1 (Nickel insoluble inorganic compounds), A3 (Cobalt inorganic compounds), A4 (Nickel soluble inorganic compounds, Manganese inorganic compounds)
- Lithium Nickel Cobalt Aluminium oxide : A1 (Nickel insoluble inorganic compounds), A3 (Cobalt inorganic compounds), A4 (Nickel soluble inorganic compounds, Aluminum insoluble compounds)
- Carbon black : A3

EU : Not classified

Mutagenicity : Not classified

- Aluminium : Negative reactions were observed in both in vivo (Mammalian Erythrocyte Micronucleus Test(OECD Guideline 474, GLP)) and in vitro (Mammalian cell gene mutation test(OECD Guideline 476, GLP)).
- Graphite : Negative reactions were observed in in vitro test(Bacterial Reverse Mutation Assay(OECD Guideline 471, GLP)).
- Copper : Negative reactions were observed in in vivo test(mammalian somatic cell study: cytogenicity/erythrocyte micronucleus(EU Method B.12, GLP)).
- Cobalt lithium manganese nickel oxide : Nagative : in vitro test ((Ames test, S. typhimurium, E. Coli)(Chromosome aberration test, human lymphocyte)
- Lithium Nickel Cobalt Aluminium oxide : Negative reactions were observed in in vitro test(Bacterial Reverse Mutation Assay(OECD Guideline 471, GLP))
- Dimethyl carbonate : Negative reactions were observed in in vivo (Mammalian Spermatogonial Chromosome Aberration Test (OECD Guideline 483, GLP))
- Aluminium oxide : In in vivo test (Mammalian Bone Marrow Chromosome Aberration Test (OECD Guideline 475)), a positive reation was observed.
- Carbon black : Positive reactions were observed in both in vitro (Chromosomal aberrations test (OECD Guideline 476, GLP)) and in vivo (ypoxanthine-guanine phosphoribosyl transferase gene (hprt) mutations in alveolar epithelial cells).

Reproductive toxicity : Not classified

- Aluminium : In the reproductive toxicity and developmental toxicity test using rats, adverse effects were not observed, respectively. (OECD Guideline 422, GLP)(OECD Guideline 414)
- Graphite : In the reproductive toxicity with rats, there were no significant adverse effects on reproductive parameters. (OECD Guideline 422, GLP)

- Copper : In the reproductive toxicity and developmental toxicity test with rats, there were no significant adverse effects on reproductive parameters and no evidence of malformations at any doses. (OECD Guideline 416, 414, GLP)
In the developmental toxicity test using rabbits, adverse effects were not observed, respectively. (GLP)
- Lithium Nickel Cobalt Aluminium oxide : In the reproductive toxicity and developmental toxicity test with rats, as the 500 mg/kg/day treatment group was terminated early due to excessive dose level no definitive reproductive effect could be established. and no effect of treatment was detected on reproduction or offspring development, at a treatment level up to 150 mg/kg/day. (OECD Guideline 422, GLP)
- Dimethyl carbonate : In the reproductive toxicity test using rats, adverse effects were not observed, respectively. (OECD Guideline 415, GLP)
In the developmental toxicity test using rabbits, adverse effects were not observed, respectively. (OECD Guideline 414, GLP)
- Aluminium oxide : In the reproductive toxicity test using rats, no toxicologically significant effects were noted. (OECD Guideline 422, GLP)(Read across: Al(OH)13Cl17(in aqueous solution))
- Carbon black : In the reproductive toxicity and developmental toxicity test using mice, adverse effects were not observed, respectively. (OECD Guideline 414, GLP)

Specific target organ toxicity (single exposure) : Not classified

- Aluminium : In the acute oral toxicity test using rats, adverse effects were not observed, respectively. (Read-across)(OECD Guideline 401) In the acute inhalation toxicity test using rats, adverse effects were not observed, respectively. (OECD Guideline 403)
- Graphite : In the acute oral toxicity test with rats, no signs of discomfort or toxicity effects. (OECD Guideline 423, GLP)
- Copper : In the acute oral toxicity test with rats, clinical signs observed included lethargy, prostrate posture, green coloured diarrhoea, voiding few faeces and moribundity. (OECD Guideline 401, GLP)
In the acute inhalation toxicity test with rats, slight to moderate ataxia, slight to moderate tremor and slight to moderate dyspnoea were observed. (OECD Guideline 436, GLP)
- Lithium Nickel Cobalt Aluminium oxide : In the repeated oral toxicity test with rats, no signs of systemic tocicity were noted during the observation period. (OECD Guideline 420, GLP)
- Dimethyl carbonate : In the acute oral toxicity test using rats, hypoactivity, ataxia and loss of the righting reflex were observed. (OECD Guideline 401, GLP)
In the acute dermal toxicity test using rabbits, adverse effects were not observed, respectively. (GLP)
In the acute inhalation toxicity test using rats, adverse effects were not observed, respectively. (OECD Guideline 403, GLP)
- Aluminium oxide : In the acute oral/inhalation toxicity test using rats, no abnormal clinical signs were recorded.(OECD Guideline 401/403, GLP)
- Carbon black : In the acute oral toxicity and acute inhalation toxicity test with rats, adverse effects were not observed, respectively. (OECD Guideline 401, GLP)(OECD Guideline 403)

Specific target organ toxicity (repeat exposure) : Not classified

- Aluminium : In the repeated oral toxicity toxicity tests using rats, toxicity to organs was not observed. (Read-across)(OECD Guideline 422, GLP) In the repeated inhalation toxicity toxicity tests using rats, toxicity to organs was not observed. (OECD Guideline 413)
- Graphite : In the repeated oral toxicity test with rats, no signs of discomfort or toxicity effects. (OECD Guideline 422, GLP) In the repeated inhalation toxicity test with rats, in the Graphite high-dose group, clearly adverse effects such as markedly increased incidence of interstitial fibrosis, were seen in the lung. (OECD Guideline 412, GLP)
- Copper : In the repeated oral toxicity and inhalation toxicity test using rats, toxicity to organs was not observed. (EU Method B.26, GLP)(OECD Guideline 412, GLP)
- Cobalt lithium manganese nickel oxide : In surviving animals in 50 mg / ㎥ (3 weeks recovery group), the minimum degradation / regeneration in lung was observed. NAOEC (no adverse effect observation) was not decided.(Rat, 6 hr/day, 2 times exposure, 28 days observation, 2, 10, 50mg / m3, inhalation test, short term - lung toxicity test)

- Lithium Nickel Cobalt Aluminium oxide : In the repeated oral toxicity test with rats, microscopic changes in the spleen and kidneys seen for animals of either sex at 500 and 150 mg/kg/day and males only at 50 mg/kg/day. The changes identified in the kidneys of male rats are specific for male rats only and are considered not to represent “serious damage” to health. (OECD Guideline 422, GLP)
- Dimethyl carbonate : In the repeated oral toxicity tests using rats, toxicity to organs was not observed. (OECD Guideline 408, GLP)
- Aluminium oxide : In the repeated oral toxicity test using rats, no toxicologically significant effects were noted. (OECD Guideline 422, GLP)(Read across: Aluminium chloride basic)
In the repeated inhalation toxicity test using rats, Intratracheal injection of aluminium powder caused nodular pulmonary fibrosis in the lungs of the rats only at the highest dose administered (100 mg). but Progressive fibrosis was not observed in rats on inhalation exposure to the powders indicating that the intratracheal instillation mode of test compound delivery may lead to artifacts not representative of actual inhalation exposures. (OECD Guideline 413)
- Carbon black : In the sub-chronic inhalation toxicity test using rats, there was clear evidence of inflammation and some alveolar epithelial cell hyperplasia and fibrosis at the high exposure group. In the mid-exposure group there was evidence of inflammation characterised by accumulation of neutrophils and macrophages within the alveolar spaces.

Aspiration Hazard : Not available

Section XII – ECOLOGICAL INFORMATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

12.1 Ecological toxicity

Acute toxicity : Not classified ($L(E)C_{50}$ = 0.11~0.44 mg/L)

Fish

- Aluminium : 96hr-LC_{50}(*Pimephales promelas*) = 1.16 mg/L (GLP)
- Graphite : 96hr-LC_{50}(*Danio rerio*) > 100 mg/L (OECD Guideline 203, GLP)
- Copper : 96hr-LC_{50}(*Oncorhynchus mykiss*) = 0.164 mg/L
- Dimethyl carbonate : 96hr-LC_{50}(*Danio rerio*) ≥ 100 mg/L (OECD Guideline 203, GLP)
- Aluminium oxide : 96hr-LC_{50}(*Pimephales promelas*) = 1.16 m/L (Read across : aluminum chloride hexahydrate)(PA/600/4-85/013, GLP, ECHA)
- Carbon black : 96hr-LC_{0}(*Danio rerio*) = 1,000 mg/L (OECD Guideline 203, GLP, ECHA)

Crustacean

- Aluminium : 48hr-LC_{50}(*Ceriodaphnia dubia*) = 0.72 mg/L (GLP)
- Graphite : 48hr-EC_{50}(*Daphnia magna*) > 100 mg/L (OECD Guideline 202, GLP)
- Copper : 48hr-LC_{50}(*Ceriodaphnia dubia*) = 0.014 mg/L
- Dimethyl carbonate : 48hr-EC_{50}(*Daphnia magna*) > 100 mg/L (OECD Guideline 202, GLP)
- Aluminium oxide : 48hr-LC_{50}(*Ceriodaphnia dubia*) = 0.72 mg/L (Read across : aluminum chloride hexahydrate)(EPA/600/4-85/013, GLP, ECHA)
- Carbon black : 24hr-EC_{50}(*Daphnia magna*) > 5,600 mg/L (OECD Guideline 202, GLP, ECHA)

Algae

- Aluminium : 72hr-EC_{50}(*Pseudokirchneriella subcapitata*) = 0.2 mg/L (OECD Guideline 201, GLP)
- Graphite : 72hr-EC_{50}(*Pseudokirchneriella subcapitata*) > 100 mg/L (OECD Guideline 201, GLP)

- Copper : 96hr-EC_{50}(*Chlamydomonas reinhardtii*) = 0.047 mg/L
- Dimethyl carbonate : 72hr-EC_{50}(*Pseudokirchneriella subcapitata*) > 100 mg/L (OECD Guideline 201, GLP)
- Aluminium oxide : 72hr-EC_{50}(*Selenastrum capricornutum*) = 1.05 mg/L (Read across : Aluminium powder)(OECD Guideline 201, GLP, ECHA)
- Carbon black : 72hr-EC_{50}(*Desmodesmus subspicatus*) > 10,000 mg/L (OECD Guideline 201, GLP), ECHA)

Chronic toxicity : Not classified

Fish

- Aluminium : 33day-NOEC(*Danio rerio*) = 0.0715 mg/L (OECD Guideline 210, GLP)
- Copper : 30day-NOEC(*Perca fluviatilis*) = 0.188 mg/L (OECD Guideline 204)
- Aluminium oxide : 33day-NOEC(*Brachydanio rerio*) = 0.0715 mg/L (OECD Guideline 210, GLP)(Read across : reagent grade aluminum nitrate nonahydrate, ECHA)

Crustacean

- Aluminium : 28day-NOEC(*Hyalella azteca*) = 0.0531 mg/L (GLP)
- Copper : 14day-NOEC(*Penaeus mergulensis and Penaeus monodon* (prawns) = 0.033 mg/L
- Dimethyl carbonate : 21day-NOEC(*Daphnia magna*) = 25 mg/L (OECD Guideline 211, GLP)
- Aluminium oxide : 17day-NOEC(*Aeolosoma sp.*) = 0.9625 mg/L (GLP)(Read across: Aluminum nitrate nonahydrate, ECHA)

Algae

- Graphite : 72hr-NOEC(*Pseudokirchneriella subcapitata*) ≥ 100 mg/L (OECD Guideline 201, GLP)
- Copper : 19day-NOEC(*giant kelp Macrocystis pyrifera*) = 0.0102 mg/L
- Aluminium oxide : 72hr-NOEC(*Selenastrum capricornutum*) = 0.28 mg/L (Read across : Aluminium powder) (OECD Guideline 201, GLP, ECHA)
- Carbon black : 72hr-NOEC(*Desmodesmus subspicatus*) > 10,000 mg/L (OECD Guideline 201, GLP, ECHA)

12.2. Degradability

Degradability :

- Cobalt lithium manganese nickel oxide : Because it is an inorganic substance, it is not decomposed.

12.3. Bioaccumulative potential

Bioaccumulation

- Dimethyl carbonate : Bioaccumulation is expected to be low according to the BCF < 500 (BCF < 3.2)

Biodegradation

- Dimethyl carbonate : As well-biodegraded, it is expected to have low accumulation potential in living organisms(86% biodegradation was observed after 28 days) (OECD Guideline 301C)

12.4 Mobility in soil

- Dimethyl carbonate : No potency of mobility to soil. (K_{oc} = 2.9 ~ 6.65) (25 °C)

12.5 Results of PBT and vPvB assessment : Not available

12.6 Other adverse effects : Not available

Section XIII – DISPOSAL CONSIDERATION

13.1 Waste treatment methods

Product/Packaging disposal

- Consider the required attentions in accordance with waste treatment management regulation.

Waste codes / Waste designation according to LoW(2015) : 16-06-05

Waste treatment-relevant information

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

Sewage disposal-relevant information: Not available

Other disposal recommendations: Not available

Section XIV – TRANSPORTATION INFORMATION

※ If those lithium-ion batteries are packed with or contained in an equipment, then it is the responsibility of the shipper to ensure that the consignment are packed in compliance to the latest edition of the IATA Dangerous Goods Regulations section Ⅱ of either Packing Instruction 966 or 967 in order for that consignment to be declared as NOT RESTRICTED (non-hazardous/non-Dangerous). If those lithium-ion batteries are packed with or contained in an equipment, UN No. is UN3481.

14.1 UN Number : 3480

14.2 UN Proper shipping name : LITHIUM ION BATTERIES (including lithium ion polymer ba tteries)

14.3 Transport Hazard class : 9

14.4 Packing group : I

14.5 Special provisions : 188

14.6 Packing instructions : P903

14.7 Environmental hazards : No

14.8 Special precautions for user

in case of fire : F-A

in case of leakage : S-I

14.9 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not Available

14.10 IATA Transport : PI 965-Section IA

14.11 Package labels

Section XV – REGULATORY INFORMATION

15.1 Safety, health and environmental regulation/legislation specific for the substance or mixture

EU regulations

Harmonized classification – Annex VI of Regulation (EC) No 1272/2008 (CLP Regulation):

- Aluminium : Flam. Sol. 1, H228, Water-react. 2, H261
- Dimethyl carbonate : Flam. Liq. 2, H225

Authorisations and/or restrictions on use: ~~Not regulated~~

Authorisations: Not regulated

Restrictions on use: Not regulated

Other EU regulations:

Candidate List of substances of very high concern for Authorisation : Not regulated

U.S.A regulations

U.S.A Inventory (TSCA):

- Lithium Manganese (III,IV) oxide : Present [PMN; S; 5E] (ACTIVE)
- Aluminium : Present (ACTIVE)
- Graphite : Present (ACTIVE)
- Copper : Present (ACTIVE)
- Cobalt lithium manganese nickel oxide : Present [PMN; S; 5E] (ACTIVE)
- Lithium Nickel Cobalt Aluminium oxide : Present [PMN] (ACTIVE)
- 1-Propene, homopolymer : Present [XU] (ACTIVE)
- Dimethyl carbonate : Present (ACTIVE)
- Aluminium oxide : Present (ACTIVE)
- Carbon black : Present (ACTIVE)

U.S.A management information (OSHA Regulation) : Not regulated

U.S.A management information (CERCLA Regulation) :

- Copper : 5,000 lb

U.S.A management information (EPCRA 302 Regulation) : Not regulated

U.S.A management information (EPCRA 304 Regulation) : Not regulated

U.S.A management information (EPCRA 313 Regulation) :

- Lithium Manganese (III,IV) oxide : Regulated (Manganese compounds)
- Aluminium : Regulated (fume or dust)
- Copper : Regulated
- Cobalt lithium manganese nickel oxide : Regulated (Nickel, Cobalt, Manganese compounds)
- Lithium Nickel Cobalt Aluminium oxide : Regulated (Nickel Compounds, Cobalt Compounds)
- Aluminium oxide : Regulated (fibrous forms)

Substance of Rotterdam Protocol : Not regulated

Substance of Stockholme Protocol : Not regulated

Substance of Montreal Protocol : Not regulated

15.2 Chemical safety assessment :

- No chemical safety assessment has been carried out for this product by the supplier.

Section XVI – OTHER INFORMATION EU

Product safety data sheet for PA0001N0006A/PA0001N0007A/PA001N0008A prepared in accordance with Regulation (EU) 2015/830 (REACH), Annex II, and OSHA 29 CFR 1910.1200

16.1 Indication of changes

Date Updated : 13 Oct. 2021

Version : Rev. 04

16.2 Abbreviations and acronyms

ACGIH = American Conference of Government Industrial Hygienists

CLP = Classification Labelling Packaging Regulation ; Regulation (EC) No 1272/2008

CAS No. = Chemical Abstracts Service number

DMEL = Derived Minimal Effect Levels

DNEL = Derived No Effect Level

EC Number = EINECS and ELINCS Number (see also EINECS and ELINCS)

EU = European Union

IARC = International Agency for Research on Cancer

ISHL = Industrial Safety & Health Law

NIOSH = National Institute for Occupational Safety & Health

NTP = National Toxicology Program

OSHA = European Agency for Safety and Health at work

PBT = Persistent, Bioaccumulative and Toxic substance

PNEC(s) = Predicted No Effect Concentration(s)

REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 453/2010

STP = Sewage Treatment Plant

SVHC = Substances of Very High Concern

vPvB = Very Persistent and Very Bioaccumulative

UN = United Nations

MARPOL = International Convention for the Prevention of Pollution from Ships (IMO)

IBC = Intermediate Bulk Container

CERCLA = Comprehensive Environmental Response, Compensation & Liability Act (US)

EPCRA = Emergency Planning and Community Right-to-Know Act (US)

EINECS = European Inventory of Existing Commercial chemical Substances

ELINCS = European List of Notified Chemical Substances

16.3 Key literature reference and sources for data :

U.S. National library of Medicine (NLM) Hazardous Substances Data Bank (HSDB)

LookChem; http://www.lookchem.com/

IUCLID: http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/7631905.pdf

CHRIP(Chemical Risk Information Platform)

EPISUITE v4.11; http://www.epa.gov/opt/exposure/pubs/episuitedl.html

The Chemical Database -The Department of Chemistry at the University of Akron;
http://ull.chemistry.uakron.edu/erd/
ECOTOX: http://cfpub.epa.gov/ecotox/
International Chemical Safety Cards (ICSC): http://www.nihs.go.jp/ICSC/
National Chemical Information System (http://ncis.nier.go.kr)
Korea Dangerous Material Inventory Management System (http://hazmat.nema.go.kr)
REACH information on registered substances; https://echa.europa.eu/information-on-chemicals/registered-substances
EU CLP; https://echa.europa.eu/information-on-chemicals/cl-inventory-database
NIOSH Pocket Guide; http://www.cdc.gov/niosh/npg/npgdcas.html
IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; http://monographs.iarc.fr
National Toxicology Program; http://ntp.niehs.nih.gov/results/dbsearch/
TOMES-LOLI®; http://www.rightanswerknowledge.com/loginRA.asp
UN Recommendations on the transport of dangerous goods 17th
American Conference of Governmental Industrial Hygienists TLVs and BEIs.

16.4 Classification and procedure used to derive the classification for mixtures according to Regulation(EC) 1272/2008(CLP) : Not classified

16.5 Relevant H-statements : Not applicable

16.6 Training advice :

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

16.7 Further information :

Data of sections 4 to 8, as well as 10 to 12, do not necessarily refer to the use and the regular handling of the product (in this sense consult package leaflet and expert information), but to release of major amounts in case of accidents and irregularities. The information describes exclusively the safety requirements for the product (s) and is based on the present level of our knowledge. This data does not constitute a guarantee for the characteristics of the product(s) as defined by the legal warranty regulations. "(n.a. = not applicable; n.d. = not determined)"

The data for the hazardous ingredients were taken respectively from the last version of the sub-contractor’s safety data sheet.