To Our Customers:

The attached Safety Data Sheet (SDS) was prepared by the vendor of the product you purchased through one of our divisions. We used the manufacturer's electronic document directly or scanned a paper copy and generated a file for our automated SDS delivery system.

All statements, technical information, and recommendations contained therein are solely that of the manufacturer of the product. We at Zep Inc. did not verify the accuracy and completeness of the statements and do not warrantee or guarantee the information. We provide vendor SDSs to assist our customers in their compliance efforts. The attached document is in compliance with one of the respective country regulatory requirements noted below:

The OSHA Hazard Communication Standard (in the United States)
The Hazardous Products Regulations (in Canada)

We made every effort to deliver all of the information prepared by the manufacturer. We cannot anticipate all conditions under which this information will be used. If you have any questions about the statements on the SDS, please contact the company shown on the document.

Zep Inc. assumes no liability or responsibility for loss or damage resulting from the improper use or handling of this product, from incompatible product combinations, or from the failure to follow instructions, warnings, and advisories in the manufacturer's product label and Safety Data Sheet.

Sincerely,

Product Stewardship Team
Zep Inc.

물질안전보건자료
(Material Safety Data Sheet)

SECTION 1: Identification

1.1 Identification

Product Name : TGF-NT300NL-90DM12-B

1.2 Recommended use and restrictions on use

Relevant identified used : Thermal material
Uses advised against : Do not use except for purpose

1.3 Supplier

Manufacturer/Supplier : NanoTIM Co., Ltd.
Address : 9-14, Techno 2-ro, Yuseong-gu, Deajeon, Korea
Telephone : +82 42 719 3088
Fax : +82 42 719 3089
Email : holliskim@nanotim.co.kr

SECTION 2: Hazard(s) Identification

2.1 Hazard Classification

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

Skin corrosion/irritation : Category 2
Serious eye damage/eye irritation : Category 2
Germ cell mutagenicity : Category 2
Chronic aquatic toxicity : Category 2

2.2 Label elements

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

GHS Symbols

Signal words : Warning

Hazard statement
H315 Causes skin irritation
H319 Causes serious eye irritation
H341 Suspected of causing genetic defects
H411 Toxic to aquatic life with long lasting effects

Precautionary statement
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P264 Wash hands, forearms and face thoroughly after handling.
P273 Avoid release to the environment
P280 Wear protective gloves, eye protection and face protection

Response
P302+P352 If on skin: Wash with plenty of water
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P308+P313 If exposed or concerned : Get medical advice/attention.
P321 Specific treatment (see supplemental first aid instruction on this label)
P332+P313 If skin irritation occurs: Get medical advice/attention.
P337+P313 If eye irritation persists: Get medical advice/attention.
P362+P364 Take off contaminated clothing and wash it before reuse.
P391 Collect spillage.

Storage
P405 Store locked up.

Disposal
P501 Dispose of contents/container to hazardous or special waste collection point, in accordance with local, regional, national and/or international regulation

SECTION 3: Composition/Information on Ingredients

Material Name	CAS No.	Wt. %
Aluminum oxide	1344-28-1	5 ~ 15 %
Aluminium hydroxide	21645-51-2	60 ~ 80 %
Vinyl/STPD Polydimethyl Siloxane	68083-19-2	5 ~ 15 %
Confidential		0 ~ 5 %

SECTION 4: First-Aid Measures

Eye contact	Get emergency medical attention. Wash skin and eyes under running water for at least 20 minutes immediately upon contact with the substance. If it gets on your eyes, wash it carefully with water for a few minutes. Remove contact lenses if possible. Keep washing. If irritation persists, seek medical measures and advice.
Skin contact	For hot substances, soak affected area in large amounts of cold water or wash it off to remove heat. Get emergency medical attention. Remove contaminated clothing and shoes and isolate contaminated areas. Wash skin and eyes under running water for at least 20 minutes immediately upon contact with the substance. Prevent the spread of contaminated areas in case of minor skin contact. If you feel uncomfortable, consult a medical(doctor) institution. If skin irritation occurs, seek medical measures and advice. Take off contaminated clothing and wash it before using it again.
Inhalation	Remove excess dust or fume with clean air and take medical measures if you have cough or other symptoms. Move to a place with fresh air. If you don't breathe, perform an artificial respiration. When eating or inhaling substances, do not use mouth-to-mouth ventilation and use appropriate breathing apparatus. If breathing is difficult, provide oxygen. Keep him warm and stable. If you are exposed or are concerned about exposure, seek medical measures and advice.
Ingestion	Get emergency medical attention. When eating or inhaling substances, do not use mouth-to-mouth ventilation and use appropriate breathing apparatus. If you are exposed or are concerned about exposure, seek medical measures and advice.
Notes to physician	Contact the medical staff and take special emergency measures such as follow-up investigation when exposing. Let medical personnel be aware of the substance and take protective measures.

SECTION 5: Fire-Fighting Measures

Suitable Extinguishing media	Small fire: dry sand, dry chemical, end alcohol foam, water spray, general foam, CO2(carbon dioxide) Large fire: water spray/fog, general foam
Unsuitable extinguishing media	high-pressure water
Specific hazards from Chemical material	It can decompose at high temperatures and produce toxic gases. During burning, pyrolysis or combustion can produce irritating and highly toxic gases. Containers can explode when heated. Some can burn but do not ignite easily. Nonflammability, the material itself does not burn, but may decompose during heating, resulting in corrosive/toxic fume. Fire may produce irritable, corrosive and toxic gases.
Protective equipment and preventive method at fire-fighting	Rescuers should wear appropriate protective gear. Keep a safe distance away from the area and digest it. It may be molten and transported, so be careful. Some of them may be transported at high temperatures, so be careful. Dig a ditch to dispose of the fire hydrant, lock it up, and keep the matter from scattering. If it's not dangerous, move the containers from the fire area. In the event of a tank fire, fire it at maximum distance or use unmanned fire extinguishing equipment. In the event of a tank fire, cool the container with plenty of water even after extinguishing the fire. In case of a tank fire, withdraw immediately if there is a high-pitched sound or if the tank discolors. In the event of a tank fire, get out of the tank in flames. In the event of a tank fire, use unmanned fire extinguishing equipment for large-scale fires, and if it's impossible, let it burn.

SECTION 6: Accidental Release Measures

Personal precautions, protective	Wipe off any spills immediately and follow the precautions in the protective gear.

equipment and emergency procedures	
	Remove all sources of ignition. Stop the leak if it's not dangerous. Do not touch damaged containers or leaks without proper protective clothing. Cover it with plastic sheets to stop the spread. Prevent dust formation. Pay attention to substances and conditions to avoid Avoid inhalation of dust, fume, gas, mist, steam, spray.
Precautions need for Environmental protective	Prevent entry into waterways, sewers, basements, and confined spaces. Do not discharge into the environment.
Methods and material for containment and cleaning up	Absorb spills with inert material (e.g., dry sand or soil) and place in chemical waste container. Remove air dust and wet it with water to prevent it from scattering. Absorb liquids and wash contaminated areas with detergent and water. In the event of a large leak, keep it away from the liquid leak and create a ditch. Place the leak in a clean, dry container with a clean shovel, loosely close it, and move the container away from the leak area. In case of powder leakage, cover with a plastic sheet to prevent spread and keep it dry. In the event of a small leak, absorb sand, non-flammable substances, and place them in a container. Collect the leak.

SECTION 7: Handling and Storage

A. Safety handling tips	Follow all MSDS/label precautions as the product may remain after the container has been emptied. Handle/Save carefully. Carefully open the cap before opening. Avoid prolonged or continuous skin contact. Do not breathe steam from heated substances. Don't enter the storage area unless there is adequate ventilation. Pay attention to substances and conditions to avoid Refer to engineering management and personal protective equipment. Be careful of high temperatures. Don't handle all safety precautions until you have read and understood them. Avoid inhalation of dust, fume, gas, mist, steam, spray. Wash the handling area thoroughly after handling. Handle only outdoors or in well ventilated areas.
B. Safety storage method	Drain and properly seal the empty drum barrel and immediately return it to the drum regulator or place it properly. Store in a locked storage area.

SECTION 8: Exposure Controls/Personal Protection

A. Exposure standards of chemicals and biological exposure standards, etc	
- Domestic regulation	
Aluminum oxide	TWA - 10 /㎥ In case of exposed to metal dust TWA - 5 ㎎/㎥ In case of exposed to welding fume TWA - 5 ㎎/㎥ In case of exposed to fatigue powder
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data
- ACGIH regulation	
Aluminum oxide	TWA 1 ㎎/㎥
Aluminum hydroxide	TWA 1 ㎎/㎥
Vinyl/STPD Polydimethyl Siloxane	No data
- Biological exposure standard	
Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data
- Other exposure standard	
Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data
B. Properties engineering management	Use process isolation, local exhaust, or other engineering management to adjust the air level below the exposure standard.

If dust, fume, or mist is generated during operation, ventilate so that air pollution is kept below the exposure standard.

Install eyewash and safe shower facilities for storing or using this material.

C. Personal protective gear

- Respiratory protection

Aluminum oxide	In case of exposed to metal dust Wear respirators certified by the Korea Occupational Safety and Health Agency to suit the physical and chemical characteristics of the particulate matter exposed If the exposure concentration is lower than 100 /㎥, the wear a respirator with an appropriate type of filter If the exposure concentration is lower than 250 ㎎/㎥ (loose-fitting) Wear a hood/helmet-type electric respirator or continuous-flow dust mask. If the exposure concentration is lower than 500 ㎎/㎥, wear full-face or powered half-way ,air-supplied continuous flow/pressure-demand espiratory protection with appropriate filters If the exposure concentration is lower than 10000 ㎎/㎥, the wear a full-face or helmet/ hood type and pressure demand type mask with appropriate filters If the exposure concentration is lower than 100000 ㎎/㎥, the wear a self-air supply (SCBA) or pressure-demand self-air supply (SCBA) respirator with appropriate filters In case of exposed to welding fume Wear respirators certified by the Korea Occupational Safety and Health Agency to suit the physical and chemical characteristics of the particulate matter exposed If the exposure concentration is lower than 50 ㎎/㎥, the wear a breathing apparatus with an appropriate type of filter If the exposure concentration is lower than 125 ㎎/㎥, the wear a nose-fitting hood/helmet electric breathing protection or continuous flow-proof mask with appropriate type of filter If the exposure concentration is lower than 250 ㎎/㎥, the wear a full-face or powered half-way or air-supplied continuous flow/pressure-demanding half-way breathing apparatus with appropriate filters. If the exposure concentration is lower than 5000 ㎎/㎥, the wear a full-face or helmet/ hood type and pressure demand type mask with appropriate filter If the exposure concentration is lower than 50000 ㎎/㎥, the wear a self-air supply (SCBA) or pressure-demand self-air supply (SCBA) respirator with appropriate filters In case of exposed to fatigue powder Wear respirators certified by the Korea Occupational Safety and Health Agency to suit the physical and chemical characteristics of the particulate matter exposed If the exposure concentration is lower than 50 ㎎/㎥, the wear a breathing apparatus with an appropriate type of filter If the exposure concentration is lower than 125 ㎎/㎥, the wear a nose-fitting hood/heelmet electric breathing protection or continuous flow-proof mask with appropriate type of filter If the exposure concentration is lower than 250 ㎎/㎥, the wear a full-face or powered half-way or air-supplied continuous flow/pressure-demanding half-way breathing apparatus with appropriate filters If the exposure concentration is lower than 5000 ㎎/㎥, the wear a full-face or helmet/ hood type and pressure demand type mask with appropriate filter If the exposure concentration is lower than 50000 ㎎/㎥, the wear a self-air supply (SCBA) or pressure-demand self-air supply (SCBA) respirator with appropriate filters
Aluminum hydroxide	Wear respirators certified by the Korea Occupational Safety and Health Agency to suit the physical and chemical characteristics of the particulate matter exposed For particulate matter, the following respiratory protections are recommended: - Filterable dust mask on the face or air filter mask (high-efficiency particulate filter) or electric fan-attached dust mask (filter for dust, mist, and fume)
Vinyl/STPD Polydimethyl Siloxane	Wear respirators certified by the Korea Occupational Safety and Health Agency to suit the physical and chemical characteristics of the particulate matter exposed - Filterable dust mask on the face or air filter mask (high-efficiency particulate filter) or electric fan-attached dust mask (filter for dust, mist, and fume) In case of gaseous/liquid substances, the following respiratory protections are recommended: - Isolated front-type gas mask (for organic compounds (for acidic gases) or isolation-type gas mask (for organic compounds) or directly connected front gas mask (for acid gases) or other gas-borne mask (for acidic gases) or gas-borne mask (for acidic gases) or gas-to-gas-to-oil (for organic gases). If the oxygen is deficient (<19.6%), wear an air mask or self-contained respirator
Eye protection	Wear breathable eye protection to protect your eyes against particulate matter that may irritate your eyes or cause other health problems Install emergency cleaning facilities (shower type) and washing facilities in a location easily accessible to workers Wear the following eye protection glasses that may cause eye irritation or other health problems. - Enclosed safety glasses for gas-conditioned organic materials - In case of vapor-conditioned organic matter, safety glasses or breathable safety glasses - Breathable goggles for particulate matter
	Wear proper protective gloves considering the physical and chemical properties of the chemical.
Body protection	Wear proper protective clothing considering the physical and chemical properties of the chemical.

SECTION 9: Physical and Chemical Properties

9.1 Product Properties

A. Appearance	
Appearance	Liquid, Paste at 20℃
Color	White
B. Odor	Slight
C. Odor threshold	Not available
D. pH	Not available
E. Melting point/Freezing point	Not available
F. Initial boiling point and boiling point range	Not available
G. Flash point	Not Ignition Below 110 Degrees.
H. Evaporating rate	Not available
I. Flammability(Solid, Gas)	Not available
J. Upper/lower limit of inflammation and explosion range	Not available
K. Vapor pressure	Not available
L. Solubility	Not available
M. Vapor density	Not available
N. Specific gravity	2.0
O. n-octanol/water partition coefficient (Kow))	Not available
P. Spontaneous ignition point	Not available
Q. Decomposition temperature	Not available
R. Viscosity	150,000cP
S. Molecular weight	Not available

9.2 Material Properties

Aluminium oxide

A. Appearance	
Appearance	Solid (Powder)
Color	White
B. Odor	Unscented
C. Odor threshold	Not available
D. pH	Not available
E. Melting point/Freezing point	2054 ℃
F. Initial boiling point and boiling point range	3000 ℃
G. Flash point	Not Ignition Below 110 Degrees.
H. Evaporating rate	Not available
I. Flammability(Solid, Gas)	Not available
J. Upper/lower limit of inflammation and explosion range	Not available
K. Vapor pressure	1 Hg (2158℃)
L. Solubility	<0.1 ㎎/ℓ (Insolubility)
M. Vapor density	Not available
N. Specific gravity	3.97
O. n-octanol/water partition coefficient (Kow))	Not available
P. Spontaneous ignition point	Not available
Q. Decomposition temperature	Not available
R. Viscosity	Not available
S. Molecular weight	101.9

Aluminium hydroxide

A. Appearance	
Appearance	Solid (Powder)
Color	White
B. Odor	Unscented
C. Odor threshold	Not available
D. pH	About 8 ~ 9 (100 g/ℓ, 20℃, Slurry)
E. Melting point/Freezing point	About 200 ℃ (Decomposition)
F. Initial boiling point and boiling point range	> 2900 ℃
G. Flash point	Not Ignition Below 110 Degrees.
H. Evaporating rate	Not available
I. Flammability(Solid, Gas)	Non flammability
J. Upper/lower limit of inflammation and explosion range	Not available
K. Vapor pressure	(at 20℃)
L. Solubility	≤ 0 g/ℓ (20℃, pH: About 6 ~ 7)
M. Vapor density	2.42 g/㎤ (Density)
N. Specific gravity	2.4 ((Water=1))

O. n-octanol/water partition coefficient (Kow))	Not available
P. Spontaneous ignition point	(Non-flammability)
Q. Decomposition temperature	About 200 ℃ (0, Resolvability: OK)
R. Viscosity	Not available
S Molecular weight	78.004

Vinyl/STPD Polydimethyl Siloxane

A. Appearance	
Appearance	Not available
Color	Not available
B. Odor	Not available
C. Odor threshold	Not available
D. pH	Not available
E. Melting point/Freezing point	Not available
F. Initial boiling point and boiling point range	Not available
G. Flash point	Not Ignition Below 110 Degrees.
H. Evaporating rate	Not available
I. Flammability(Solid, Gas)	Not available
J. Upper/lower limit of inflammation and explosion range	- / -
K. Vapor pressure	Not available
L. Solubility	0.0004379 g/100
M. Vapor density	Not available
N. Specific gravity	Not available
O. n-octanol/water partition coefficient (Kow))	6.64
P. Spontaneous ignition point	Not available
Q. Decomposition temperature	Not available
R. Viscosity	Not available
S. Molecular weight	334.71

SECTION 10: Stability and Reactivity

A. Chemical stability and possibility of adverse reaction

Aluminum oxide	It can decompose at high temperature and produce toxic gases
	As the temperature increases, the container explodes.
	Some of them can burn, but it doesn't ignite easily.
	Non-inflammable, the material itself doesn't burn, but it can decompose during heating and produce corrosive / toxic fume
Aluminum hydroxide	As the temperature increases, the container explodes.
	Some of them can burn, but it doesn't ignite easily.
	Non-inflammable, the material itself doesn't burn, but it can decompose during heating and produce corrosive / toxic fume
	In case of fire, irritability, corrosivity and toxic gases can be generated.
Vinyl/STPD Polydimethyl Siloxane	As the temperature increases, the container explodes.
	Some of them can burn, but it doesn't ignite easily.
	Non-inflammable, the material itself doesn't burn, but it can decompose during heating and produce corrosive / toxic fume
	In case of fire, irritability, corrosivity and toxic gases can be generated.

B. Avoiding condition

Aluminum oxide	Heat, Spark, Flame etc. ignition source
Aluminum hydroxide	Heat, Spark, Flame etc. ignition source
Vinyl/STPD Polydimethyl Siloxane	Heat, Spark, Flame etc. ignition source

C. Avoiding material

Aluminum oxide	Supporter of combustion, Reducing agents
Aluminum hydroxide	Supporter of combustion, Reducing agents
Vinyl/STPD Polydimethyl Siloxane	Supporter of combustion, Reducing agents

D. Harmful material after decomposition

Aluminum oxide	Corrosive / toxic fume
	Irritant, Corrosive, toxic gas
Aluminum hydroxide	Corrosive / toxic fume
	Irritant, toxic gas
	Irritant, Corrosive, toxic gas
Vinyl/STPD Polydimethyl Siloxane	During burning, the irritating and highly toxic gases can be caused by pyrolysis and combustion.
	Corrosive / toxic fume
	Irritant, toxic gas

SECTION 11: Toxicological Information

A. Information about path of exposure at high probability

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

B. Information about health hazards

- Acute toxicity

Oral

Aluminum oxide	LD50 > 10000 /kg Rat (No death during observasion period (OECD Guideline 401))
Aluminum hydroxide	LD50 > 2000 ㎎/㎏ Rat
Vinyl/STPD Polydimethyl Siloxane	LD50 16000 ㎎/㎏ Rat

Dermal

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	LD50 16000 ㎎/㎏ Rabbit

Inhalation

Aluminum oxide	Dust LC50> 2.3 ㎎/ℓ 4 hr Rat (No death, EPA 40 CFR 158, OECD Guideline 403, GLP)
Aluminum hydroxide	Mist LC50 7.6 ㎎/ℓ 1 hr Rat
Vinyl/STPD Polydimethyl Siloxane	No data

Skin corrosion/irritation

Aluminum oxide	It observed a mount of 0.5g in rabbits at time of 72 hours after 4 hours of exposure , Unstimulate , OECD Guideline 404, GLP
Aluminum hydroxide	Point of edema : 0/4, No irritant, Rabbit, OECD TG 404
Vinyl/STPD Polydimethyl Siloxane	Probability of MOD/SEV = 1.000

Serious eye damage/irritation

Aluminum oxide	Eye irritation test results for 72 hours on rabbits, Unstimulate. (OECD Guideline 405, GLP)
Aluminum hydroxide	No irritant, Rabbit, Corneal opacity(0), Iris(0), Conjunctival injection(0.2), Chemosis(0), Completely reversivle in 48 hours, OECD TG 405 No hypersensitivity, Mouse, in vivo, male
Vinyl/STPD Polydimethyl Siloxane	Prob. of SEV Ocular Irritancy = 0.000(TOPKAT:Ocular Irritancy SEV vs MOD), Prob. of MLD Ocular Irritancy = 0.005(TOPKAT:Ocular Irritancy MLD vs NON)

Respiratory hypersensitivity

Aluminum oxide	Results of respiratory hypersensitivity tests on rats
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

Dermal hypersensitivity

Aluminum oxide	Results of dermal hypersensitivity on guinea pig, Non-senstivity, OECD Guideline 406, EPA OPPTS 870.2600, GLP)
Aluminum hydroxide	No senstivity, Guinea pig, GLP, male, Guinea pig maximization test (GMPT): Level of capacity : 50 and 75%, reaction: 0/10, OECD TG 406
Vinyl/STPD Polydimethyl Siloxane	No data

- Carcinogenicity

Industrial Safety and Health Act

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

Ministry of Employment and Labor Notice

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

IARC

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

OSHA

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

ACGIH

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

NTP

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

EU CLP

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

- Germ cell mutagenicity

Aluminum oxide	1) In oral administration bone marrow chromosomal aberrations test using rat(mammalian somatic cells), in vivo mammalian somatic cell study: bone marrow chromosome aberration), indeterminate results for aluminum oxide in size of 50-200μm (ambiguous); positive results for 30nm particles; positive results for 40nm particles; 2) Oral infusion red blood cell small nucleitide test on rat (mammalian somatic cells, in vivo mammalian somatic cell study: erythrocyte micronucleus) an aluminum oxide in size of 50-200μm negative results; positive results for 30nm particles; positive results for 40nm particles; 3) Oral administration DNA damage and recovery test on rat (mammalian somatic cells, in vivo mammalian cell study: DNA damage and/or repair) an aluminum oxide in size of 50-200μm negative results; positive results for 30nm particles; positive results for 40nm particles; => Based on the above results, aluminum oxide of nanoscale was determined to be mutant
Aluminum hydroxide	in vitro - Chromosome aberration test using mammalian cells : Positive (lymphocytes:, no metabolic activator), OECD TG 473
Vinyl/STPD Polydimethyl Siloxane	Computed Probability of Mutagenicy = 0.547

- Reproductive toxicity

Aluminum oxide	Dosing toxicity study with regeneration / occurrence toxicity screening tests for rats (female/male) with no observation of side effect results as a result of repeated binding experiments (OECD Guideline 422, GLP)
Aluminum hydroxide	Benefits to high capacity aluminum (30 mg Al/kg bw/day, 100 mg Al/kg bw/day, 300 mg Al/kg bw/day) for fetal development of rats, development from chronic postpartum exposure and neurotoxicity effects It's one piece of information. Since the F1 generation was administered for the entire period after the reason, it is difficult to distinguish between developmental toxicity and direct toxicity, and the 364-day cohort result is a high-capacity al-citrate group of babies. Obstructed clear and consistent effects on body weight after reason in the , Na-citrate effects observed in female offspring, urinary lesions were observed in high doses, urinary tract lesions more frequently observed in males, no evidence of effects on memory, learning, critical effects, and front and back leg grip strength observed in 100 mg Al/kg bw/day group, urinary tract, and urinary tracte Because effects were observed in both high-capacity and NA-citrate groups, Al-based LOAEL / NOAEL cannot be proposed based on the results of sexual maturity in this study, the weight difference at the end of the reason relative to the control group is high Although it occurs in the Al-citrate group of capacity and is considered to be related to administration, the role of Al is unclear, relative differences between the high-capacity Al-citrate group and Na-citrate group may be related to differences in liquid consumption Guideline: OECD TG 426 and OECD TG 452, GLP
Vinyl/STPD Polydimethyl Siloxane	No data

- Specific target organ toxicity (single exposure)

Aluminum oxide	Acute toxicity (alert) test results for rats (cancer), no therapeutic effect, LD50 >2000 mg/kg bw (OECD TG 423, GLP)
Aluminum hydroxide	Oral: There were no clinical signs of associated addiction after treatment or during the 14-day observation period. Soft feces appear in all individuals on the day of administration only. No similar clinical signs after the first day of the observation period / no pathological treatment effects (rat / female / OECD TG 423 / GLP) Inhalation: The observed clinical symptoms were consistent with breathing difficulties. Survivors were described as showing "somewhat" toxic effects and good recovery until the end of the 14-day observation period. More discoloration was observed on the lung surface of treated animals compared to control animals. A "slight" increase in the number of lung lesions in test animals was also reported, but no individual data or additional details were provided. The dead animals were found to have white gel in their organs and stomachs. (Rats / Male / Equivalent or similar to Guideline: OECD TG 403).
Vinyl/STPD Polydimethyl Siloxane	No data

- Specific target organ toxicity (repetitive exposure)

Aluminum oxide	Test results for repeated oral toxicity (28 days) using rat (water), LOAEL: 141 or 302 mg/kg important One effect is not observed (OECD TG 407)
Aluminum hydroxide	Oral (chronic): As a result of oral exposure through rats, LOAEL for aluminium toxicity is designated as 1075 mg AlCitrate/kg bw/day (100 mg Al/kg bw/day) (fatal effects, fairly consistent results for front and back leg grip strength), Rat, OECD TG 426 and OECD TG 45LP2, GLP2. inhalation (single-based clothing): Study results provide clear evidence of widespread inflammatory reactions in positive control (arbor treatment) animals, Rat
Vinyl/STPD Polydimethyl Siloxane	No data

- Aspiration harmful elements

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

- Influence of other harmful elements

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

SECTION 12: Ecological Information (non-mandatory)

A. Ecological toxicity

- Fish

Aluminum oxide	LC50 0.078 ~ 0.108 ㎎/ℓ 96 hr Pimephales promelas
Aluminum hydroxide	NOEC > 50 ㎎/ℓ 96 hr Ictalurus punctatus (Running water, Fresh water, GLP)
Vinyl/STPD Polydimethyl Siloxane	LC50 0.021 ㎎/ℓ 96 hr (Unclassified because water solubility is less than 1 ㎎/ℓ)

- Crustacean

Aluminum oxide	LC50 > 3.69 ㎎/ℓ 48 hr Ceriodaphnia dubia
Aluminum hydroxide	NOEC > 22.6 ㎎/ℓ 96 hr Acronuria sp. (Still water, Fresh water)
Vinyl/STPD Polydimethyl Siloxane	LC50 0.024 ㎎/ℓ 48 hr Unclassified because water solubility is less than 1 ㎎/ℓ)

- Birds

Aluminum oxide	EC50 > 0.024 ㎎/ℓ 96 hr Scenedesmus subspicatus
Aluminum hydroxide	EC10 0.153 ㎎/ℓ 72 hr Pseudokirchneriella subcapitata (OECD TG 201 , Half still water, Fresh water)
Vinyl/STPD Polydimethyl Siloxane	EC50 0.085 ㎎/ℓ 96 hr Unclassified because water solubility is less than 1 ㎎/ℓ)

B. Residuality and Degradability

- Residuality

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	log Kow 6.64

- Degradability

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

C. Bioaccumulation

- Accumulation

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	BCF 11200

- Biodegradability

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	(Cut-off value=-0.2432 : degradable material(BIOWIN 5))

D. Soil roving

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

E. Other harmful effect

Aluminum oxide	Fish:Pimephales promelas, NOEC 28d 7.1 ㎎/ℓ, ECHA, Crustacean:Daphnia magna, NOEC 28d 1.89 ㎎/ℓ, ECHA, Birds:Pseudokirchneriella subcapitata, 96hr NOEC ≥0.004 ㎎/ℓ, OECD Guideline 201, Alga, Growth Inhibition Test,GLP , Refractory material, Not classified as acute toxicity because the water solubility is less than 1 ㎎/ℓ
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

SECTION 13: Disposal Considerations (non-mandatory)

A. Disposal method

Aluminum oxide	Process in one of the following ways. 1. Please solidification process. 2. Please land the specified waste in a managed landfill where it can be reclaimed. 3. Please incinerate waste catalysts including combustible materials. 4. If waste catalysts including a substance equivalent to halogen groups are incinerated, please incinerate them at high temperatures.
Aluminum hydroxide	If specified in the Waste Management Act, dispose of the contents and containers according to the regulations.
Vinyl/STPD Polydimethyl Siloxane	If specified in the Waste Management Act, dispose of the contents and containers according to the regulations.

B. Caution for disposal

Aluminum oxide	Dispose of the contents container (according to the contents specified in the relevant laws and regulations).
Aluminum hydroxide	Dispose of the contents container (according to the contents specified in the relevant laws and regulations).
Vinyl/STPD Polydimethyl Siloxane	Dispose of the contents container (according to the contents specified in the relevant laws and regulations).

SECTION 14: Transport Information (non-mandatory)

A. UN number (UN No.)

Aluminum oxide	n/a
Aluminum hydroxide	UN 3077
Vinyl/STPD Polydimethyl Siloxane	n/a

B. Appropriate shipment name

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

C. Class of risk in transport

- International Maritime Dangerous Goods(IMDG) CODE

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

- International Air Transport Association(IATA) Dangerous Goods Regulations

: Not Restricted IATA

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

D. Container grade

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

E. Marine pollutant

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

F. Special safety measures that users need or need to know about transportation or means of transport

- Emergency action case of fire

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

- Emergency action case of spillage

Aluminum oxide	n/a
Aluminum hydroxide	n/a
Vinyl/STPD Polydimethyl Siloxane	n/a

SECTION 15: Regulatory Information (non-mandatory)

A. Regulations under Industrial Safety and Health Act

Aluminum oxide	Hazardous Substances target material
	Working environment measurement target material (Measurement cycle : 6 months)
	Special health check target material (Diagnosis cycle : 12 months)
	Exposure Standard Setting Material
Aluminum hydroxide	Hazardous Substances target material
	Working environment measurement target material (Measurement cycle : 6 months)
	Special health check target material (Diagnosis cycle : 12 months)
Vinyl/STPD Polydimethyl Siloxane	No data

B. Regulations under Chemicals Control Act

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

C. Regulations under Safety Control of Dangerous Substance Act

Aluminum oxide	No data
Aluminum hydroxide	No data
Vinyl/STPD Polydimethyl Siloxane	No data

D. Regulations under Wastes Control Act

Aluminum oxide	Designated and Normal (Combustion) waste
Aluminum hydroxide	Designated and Normal (Combustion) waste
Vinyl/STPD Polydimethyl Siloxane	No data

E. Other domestic and regulation by foreign law

- Domestic regulation

Other Domestic regulation

Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

- Overseas regulation

United States Management Information(OSHA regulations)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(CERCLA regulations)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(EPCRA 302 regulations)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(EPCRA 304 regulations)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(EPCRA 313 regulations)
Aluminum oxide Applicable
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(Rotterdam Convention Material)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information (Stockholm Convention Material)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

United States Management Information(Montreal Protocol Material)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

EU Classical information(Final classification results)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

EU Classical information(Dangerous Statements)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

EU Classical information(Safety statements)
Aluminum oxide n/a
Aluminum hydroxide n/a
Vinyl/STPD Polydimethyl Siloxane n/a

SECTION 16: Other Information

A. Data Source

Aluminium oxide
ICSC 0351(Appearance)
ICSC 0351(Color)
ICSC 0351, ECHA(E. Melting point/Freezing point)
ICSC 0351(F. Inital boiling point and boiling point range)
ECHA(K. Vapor pressure)
ECHA(L. Solubility)
ICSC 0351(N. Specific gravity)
ICSC 0351(S. Molecular weight)
ECHA(Oral)
ECHA(Inhalation)

ECHA(Skin corrosion/irritation)
ECHA(Serious eye damage/irritation)
ECHA(Respiratory hypersensitivity)
ECHA(Dermal hypersensitivity)
ECHA(Germ cell mutagenicity)
ECHA(Reproductive toxicity)
ECHA(A specific target organs toxic (Once exposure))
ECHA(A specific target organs toxic(Repeated exposure))
ECHA(Fish)
ECHA(Crustacean)
ECHA(Birds)
ECHA(E. Other harmful effect)

Aluminium hydroxide

ECHA(Appearance)
ECHA(Color)
ECHA(B. Odor)
GESTIS(D. pH)
ECHA(E. Melting point/Freezing point)
ECHA(F. Initial boiling point and boiling point range)
ECHA(H. Inflammability(Solid, Gas))
ICSC(J. Vapor pressure)
ECHA(K. Solubility)
ECHA(L. Vapor density)
ICSC(P. Spontaneous ignition temperature)
ECHA(Q. Decomposition temperature)
ECHA(Oral)
ECHA(Inhalation)
ECHA(Skin corrosion/irritation)
ECHA(Serious eye damage/irritation)
ECHA(Dermal hypersensitivity)
ECHA(Germ cell mutagenicity)
ECHA(Reproductive toxicity)
ECHA(A specific target organs toxic (Once exposure))
ECHA(A specific target organs toxic(Repeated exposure))
ECHA(Fish)
ECHA(Crustacean)
ECHA(Birds)
Molbase(Persisent)
Chemical book(Melting point/Freezing point)|ICSC(Flammability(Solid, Gas))|ICSC(Vapor pressure)|ICSC(Spontaneous ignition temperature)|ECHA(Oral)|ECHA(Inhalation)|IUCLID(Skin corrosivity or acridity)|ECHA(Severe eye injury or acridity)|ECHA(Dermal hypersensitivity)|ECHA(Fish)|ECHA(Crustacean)|ECHA(Birds)|Molbase(Persistent)|ECHA(Other harmful effect)

Vinyl/STPD Polydimethyl siloxane

Quantitative Structure Activity Relation(QSAR)(L. Solubility)
Quantitative Structure Activity Relation(QSAR)(Aa. n-octanol/water partition coefficient (Kow))
Quantitative Structure Activity Relation(QSAR)(S. Molecular weight)
National Library of Medicine(http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?CHEM)(Oral)
Registry of Toxic Effects of Chemical Substances(Oral)
National Library of Medicine(http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?CHEM)(Percutaneous)
Registry of Toxic Effects of Chemical Substances(Percutaneous)
TOPKAT:Skin Irritation(Skin corrosion/irritation)
TOPKAT(Serious eye damage/irritation)
TOPKAT:Ames Mutagenicity(Germ cell mutagenicity)

B. Date of initial preparation 2020-03-03

C. Revision number and Final revision date

Revision number 5 number
Final revision date 2022-01-18

D. Etc.

○ The prepared material safety data sheet (MSDS) is the data that has been edited and partially modified by referring to the MSDS provided by the Korea Occupational Safety and Health Agency.