LG Chem Yeosu Complex	Material Safety Data Sheet	Identity No.	GHS–EPS–R01
	EPS Resin (Flame Retardant Grade)	Pages	1/11

1. Identification of the product and the supplier

1) Chemical Name : EPS Resin (Flame Retardant Grade)

2) Advisable use and Restriction
- ○ Advisable use :Plastic product
- ○ Restriction of product using :Used for recommended use.

3) Manufacturer/Supplier/Distributor information
- ○ Company : LG Chem, LTD. Yeosu Complex
- ○ Address : 55, Yeosusandan-2-ro, Yeosu-si, Jeollanam-do
- ○ Emergency response number : +82-61-680-1273
- ○ Respondent : EPS Production Team C/R

2. Hazard identification

1) Hazard classification :
- o Acute toxicity (dermal) : Category 5
- o Hazardous to the aquatic environment (acute hazard) : Category 2

2) Allocation label elements

○ Pictogram and symbol	○ Signal word	○ Hazard statement
Not applicable	Warning	H 313 : May be harmful in contact with skin. H 401 : Toxic to aquatic life

○ Precautionary statements

[Prevention]

P273: Avoid release to the environment.

[Response]

P312: Call a poison center or doctor/physician if you feel unwell.

[Storage]

Not applicable

[Disposal]

P501: Dispose of contents/container to in accordance with local/regional/national/international regulations (to be specified).

3) Other hazard information not included in hazard classification
- ○ NFPA Rating system : Health: Not available, Flammability: Not available, Reactivity: Not available

3. Composition/information on ingredients

Chemical Name	Common name Synonyms	CAS No.	Content (%)
Polystyrene	• Benzene, ethenyl-, homopolymer • Toporex • Vestyron • Styron • Esbrite	9003-53-6	93~95 %
Pentane	• Pentane • Amyl hydride • Skellysolve A	109-66-0	5~6 %
Flame Retardant	• 1,1'-(1-Methylethylidene)bis[3,5-dibromo-4-(2,3-dibromo-2-methyl propoxy)benzene]	97416-84-7	<1 %
Butane	• Butane	106-97-8	<1 %

4. First-aid measures

1) Eye contact:
- Call emergency medical service.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.

2) Skin contact:
- Call emergency medical service.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- For minor skin contact, avoid spreading material on unaffected skin.

3) Inhalation:
- Move victim to non-contaminated place in fresh air.
- Keep victim warm and quiet.

4) Ingestion:
- Call emergency medical service.
- Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.

5) Indication of immediate medical attention and notes for physician:
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

5. Fire-fighting measures

1) Suitable (and unsuitable) extinguishing media:
- Suitable extinguishing media: Dry sand, dry chemical, alcohol-resistant foam, water spray, regular foam, CO2
- Unsuitable extinguishing media: High pressure water streams.

2) Specific hazards arising from the chemical (ex: hazardous combustion products):
- May be ignited by heat, sparks or flames
- Containers may explode when heated.
- Some of these materials may burn, but none ignite readily.
- Fire will produce irritating and/or toxic gases.
- If inhaled, may be harmful.

3) Special protective equipment and precautions for fire-fighters:
- Dike fire-control water for later disposal; do not scatter the material.
- Move containers from fire area if you can do it without risk.
- Fire involving Tanks; Cool containers with flooding quantities of water until well after fire is out.
- Fire involving Tanks; Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- Fire involving Tanks; Always stay away from tanks engulfed in fire.

6. Accidental release measures

1) Personal precautions, protective equipment and emergency procedures:
- Eliminate all ignition sources
- Stop leak if you can do it without risk.
- Do not touch or walk through spilled material.
- Cover with plastic sheet to prevent spreading.
- Prevent dust cloud
- Please note that there are materials and conditions to avoid.

2) Environmental precautions and protective procedures:
- Prevent entry into waterways, sewers, basements or confined areas.

3) The methods of purification and removal:
- Prevent entry into waterways, sewers, basements or confined areas.
- Large Spill; Dike far ahead of liquid spill for later disposal.
- With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
- Powder Spill; Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry.
- Small Spill; Take up with sand or other non-combustible absorbent material and place into containers for later disposal.

7. Handling and storage

1) Precautions for safe handling:
- 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.

2) Conditions for safe storage:
- Store in a closed container.
- Store in cool and dry place.

8. Exposure controls/personal protection

1) Occupational Exposure Limits

	Polystyrene	Pentane	HBCD	Butane
Korean Occupation of Safety and Health Regulation	Not available	TWA : 600 ppm (1,800 mg/m^3) STEL : 750 ppm (2,250 mg/m^3)	Not available	Not available
ACGIH	Not available	TWA: 600 ppm	Not available	Not available
OSHA	Not available	TWA : 600 ppm (1,800 mg/m^3)	Not available	Not available
NIOSH	Not available	TWA: 120 ppm (350 mg/m^3)	Not available	Not available
Biological exposure index	Not available	Not available	Not available	Not available
EU Regulation	Not available	TWA: 1,000 ppm (3,000 mg/m^3)	Not available	Not available
Other	-Czech Republic: OEL-TWAs=5.0 mg/m^3 (dust) -Russia: OEL-MACs=10 mg/m^3 (aerosol) -Slovak Republic: OEL-TWAs= 5.0 mg/m^3 (total solid aerosol)	-Australia: OEL-TWAs=1,770mg/m^3, OEL-STEL=2,210 mg/m^3 -Belgium: OEL-TWAs=1,800 mg/m^3, OEL-STEL=3,600 mg/m^3 -Bulgaria: OEL-TWAs=3,000 mg/m^3 -China: OEL-TWAs=500 mg/m^3, OEL-STEL=1,000 mg/m^3 -Czech Republic: OEL-TWAs=2,000 mg/m^3 -Denmark: OEL-TWAs=1,500 mg/m^3 - Finland: OEL-TWAs=1,500 mg/m^3, OEL-STEL=1,900 mg/m^3 -Greece: OEL-TWAs=2,950 mg/m^3, OEL-STEL=2,950 mg/m^3 -Italy: OEL-TWAs=2,000 mg/m^3 -Slovak Republic: OEL-TWAs=3,000mg/m^3	Not available	-Australia: OEL-TWAs=800 ppm, OEL-STEL=1,600 ppm -Belgium: OEL-TWAs=1,000 ppm -Bulgaria: OEL-TWAs=1,900 mg/m3 -Canada: OEL-TWAs=600 ppm OEL-STEL=750 ppm -Denmark: OEL-TWAs=1,200 mg/m3 -Finland: OEL-TWAs=800 ppm OEL-STEL=1,000 ppm -Germany: OEL-TWAs=1,000 ppm -Greece: OEL-TWAs=1,000 ppm -Ireland: OEL-TWAs=1,000 ppm -Slovak Republic: OEL-TWAs=1,000 ppm, OEL-STEL=5,000 ppm -Spain: OEL-TWAs=1,000 ppm

2) Appropriate engineering controls
-Provide local exhaust ventilation system or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.
3) Personal protective equipment**:**
○ Respiratory protection:
- Wear NIOSH or European Standard EN 149 approved full or half face piece (with goggles) respiratory protective equipment when necessary.

- In case exposured to paticulate material, the respiratory protective equipments as follow are recommended. ;facepiece filtering respirator or air-purifying respirator, high-efficiency particulate air(HEPA) filter media or resporator equipped with powered fan, filter media of use(dust, mist, fume)
- In lack of oxygen(< 19.5%), wear the supplied-air respiratior or self-contained breathing apparatus.oxygen

○ Eye 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.

○ Hand protection: Wear chemical resistant gloves to avoid direct contact with chemical substance.
- Wear chemical resistant gloves.
- Wear appropriate protective gloves by considering physical and chemical properties of chemicals.

○ Body protection:
- Wear appropriate protective chemical resistant clothing.
- Wear appropriate protective clothing by considering physical and chemical properties of chemicals.

9. Physical and chemical properties

1) Appearance	White sphericity bead / Solid
2) Odor	Odorless
3) Threshold of odor	Not applicable
4) pH	Not applicable
5) Melting point/freezing point	240 ℃
6) Initial boiling point and boiling range	Not applicable
7) Flash point	345~360 ℃
8) Evaporation rate	Not applicable
9) Flammability (solid, gas)	Not available
10) Upper/lower flammability or explosive limits.	Not applicable
11) Vapour pressure	Not applicable
12) Solubility(ies)	Insoluble
13) vapour density	Not applicable
14) Specific gravity /Density	1.04~1.111 g/cm^3 (20 ℃)
15) n-octanol/water partition coefficient	Not available
16) Auto ignition temperature	488~496 ℃
17) Degradation temperature	Not available
18) Viscosity	Not applicable
19) Molecular weight	Not available

10. Stability and reactivity

1) Chemical stability and Possibility of hazardous reactions:
- Fire may produce irritating and/or toxic gases.
- If inhaled, may be harmful.

2) Conditions to avoid (e.g., static discharge, shock or vibration):
- Heat, sparks or flames.

3) Incompatible materials: Combustibles

4) Hazardous decomposition products: Irritating and/or toxic gases

11. Toxicological information

Information of Health Hazardous:

○ Acute toxicity:
- oral: Not classified(<94~96 % of this product consist of an ingredient of unknown toxicity)
  - **Pentane:** LD50= 5,000 mg/kg bw (rat)
  - **HBCD:** LD50> 20,000 mg/kg bw (rat)
- dermal: Category 5 (<94~96 % of this product consist of an ingredient of unknown toxicity)
  - **Pentane:** LD50= 3,000 mg/kg bw (rabbit)
  - **HBCD:** LD50> 20,000 mg/kg bw (rabbit)
- Inhalation: Not classified
  ATEmix > 7.1113 mg/L/4hr
  - **Polystyrene(solid):** LC50=56.6 mg/L/30min (unit conversion: 7.075 mg/L/4hr) (rat)
  - **HBCD(solid):** LC50>200 mg/L/4hr (rat)
  - **Pentane(liquid):** LC50=295 mg/l/2hr (unit conversion: 147.5 mg/l/4hr) (mouse)
  - **Butane(gas):** LC50>658 mg/L/4hr(unit conversion: 27,680 ppm/4hr) (rat)

○ Skin Corrosion/ Irritation: Not classified (<94~96 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** In test on skin irritation with rabbits, skin irritation was not observed. (OECD TG 404)
- **HBCD:** In a primary skin irritation study three male and three female New Zealand White rabbits were used. Only a very slight erythema and barely perceptible irritation were noted. The results indicate that the test substance is not a primary skin irritant and minimally irritating to the skin.

○ Serious Eye Damage/Irritation: Not classified (93~95 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** Transient injury to the conjunctiva was observed after ocular exposure to a single installation of 0.1 ml n-pentane, whereas no corneal or iridal responses were observed.
- **HBCD:** Three male and 3 female New Zealand White rabbits were used for an eye irritation study. The group average scores 0.6, 1.0, 1.0, and 0 at the different time points respectively.
- **Butane:** In test with rabbits, eye irritation was not observed.

○ Respiratory sensitizer: Not available

○ Skin Sensitization:Not classified (<95~97% of this product consist of an ingredient of unknown toxicity)
- **Pentane:** In a Guinea Pig Maximisation test n-pentane did not show any sensitisation potential.

○ Carcinogenecity: Not classified (< 6 % of this product consist of an ingredient of unknown toxicity)
- **Polystyrene:** IARC: 3
- **HBCD:** Data from one lifetime bioassay with oral exposure for 18 months in mice is available. Responses associated with tumors were not observed.
- **Butane:** Butadiene is classified as carcinogenic 1A (containing ≥ 0,1% butadiene)

○ Mutagenicity: Not classified (93~95 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** Negative reations were observed in vitro(Ames test, Reverse mutation assay) and in vivo (Dominant lethal assay)
- **HBCD:** HBCD was negative in both an in vitro chromosome aberration test and an in vivo micronucleus test.
- **Butane:** Butadiene is classified as mutagenicity 1B (containing ≥ 0,1% butadiene)

○ Reproductive toxicity: Not classified (<95~97 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** In a 13-week subchronic inhalation toxicity study with male and female rats, no signs of toxicity were observed on the reproductive system by macroscopic or microscopic evaluation after exposure to n-pentane up to 20,000 mg/m^3 (6,660 ppm).

○ Specific target organ toxicity (single exposure): Not classified (<94~96 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** It has caused narcotic effects in mice after 5 min exposure at a concentration of 96mg/l .
- **HBCD:** In an acute oral toxicity study of HBCDD, 5 male and 5 female rats (Charles River CD strain) were used. Females: diarrhea in 1 out of 5, hypoactivity in 1 out of 5. Males: hypoactivity in 3 out of 5, corneal opacity in 3 out of 5 and ptosis in 3 out of 5. None of the animals died.

○ Specific target organ toxicity (repeat exposure): Not classified (93~95 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** In a recent 13-week sub-chronic inhalation toxicity study with rats, no systemic toxicity was observed following n-pentane exposure up to 20,000 mg/m^3 (6,660 ppm).
- **HBCD:** In 90-day oral toxicity with rats, liver weights increased at the lowest dose (100 mg/kg/day) in both sexes. Thyroid weights were increased at a mid dose in females. (300 mg/kg/day)
- **Butane:** In 90-day inhalation toxicity with rats, there were no deaths and no other significant toxicological effects were found. (NOAEL=4489 ppm)

○ Aspiration Hazard: Not classified (<95~97 % of this product consist of an ingredient of unknown toxicity)
- **Pentane:** Based on the value of the kinematic viscosity for n-pentane (3.58 · 10-7 m2/s), n- pentane has the potential to cause chemical pneumonia.

12. Ecological information

1) Ecological toxicity:
○ Acute toxicity: Category 2
○ Chronic toxicity: Not classified
• Fish:
- **Polystyrene:** 48hr-LC50(*Oryzias latipes*)> 500 mg/l
- **Pentane:** 96hr-LC50(*Ozyrias latipes*)= 9.6 mg/l
- **HBCD:** 96hr-LC50(*Lepomis macrochirus*)>100 mg/l
- **Butane:** 96hr-LC50>1,000 mg/l

• Crustacea:
- **Pentane:** 96hr-EC50(*Daphnia magna*)= 9.74 mg/l
- **HBCD:** 48hr-EC50(*Daphnia magna*)> 0.0032 mg/l (OECD TG 202)

• Algae:
- **Pentane:** 96hr-EC50(*Scenedesmus subspicatus*)= 1.1 mg/l
- **HBCD:** 96hr-EC50(*Selenastrum capricornutum*)> 0.0025 mg/l (OECD TG 201)

2) Persistence and degradability:
○ Persistence:
- **Pentane:** Low persistency (log Kow is less than 4 estimated. (log Kow=3.45)
- **HBCD:** High persistency (log Kow is more than 4 estimated. (log Kow=7.74 (estimated))
- **Butane:** Low persistency (log Kow is less than 4 estimated. (log Kow=2.89)

○ Degradability: Not available

3) Bioaccumulative potential:
○ Bioaccumulation:
-**Pentane:** Bioaccumulation is expected to be low according to the value of logKow<4 (log Kow=3.45) and BCF<500(BCF=171)
- **HBCD:** Bioaccumulation is expected to be high according to the value of logKow>4 (log Kow=7.74(estimated)) and BCF<500(BCF=181,000)

○ Biodegradation:
- **Polystyrene:** In biodegradation test with activated sludge(30 mg/l), 2% biodegradation was observed after 28 days(OECD TG 302C)
- **Pentane:** In biodegradation test, 70% biodegradation was observed after 192 hours.
- **HBCD:** Not biodegradation **(**OECD TG 301D)
- **Butane:** In biodegradation test, 72.6 % biodegradation was observed after 35 day.

4) Mobility in soil:
- **Pentane:** Low potency of mobility to soil. (Koc values = 80 (estimated) L/kg)

13. Disposal considerations

1) Disposal method:
- Incinerate the waste
- Bury the specified waste in the management-typed burial facility after crushing, cutting, or melting in less than the maximum diameter of 15 cm in size, if incineration is not available.

2) Disposal precaution:
- Consider the required attentions in accordance with waste treatment management regulation.

14. Transport information

1) UN Number:UN2211
2) UN Proper shipping name: POLYMERIC BEADS, EXPANDABLE evolving flammable vapour
3) Transport Hazard class: 9
4) Packing group: III
5) Marine pollutant: Not applicable
6) Special precautions:
   ○ in case of fire: F-A
   ○ in case of leakage: S-I

15. Regulatory information

Korea:
○ Occupational Safety and Health Regulation:
- **Pentane:** Occupational exposure limits listed
- **Butane:** Occupational exposure limits listed

○ Toxic Chemical Control Act:
- **Polystyrene:** KE-13257 (Existing Chemical Substance)
- **Pentane:** KE-27968 (Existing Chemical Substance)
- **HBCD:** KE-18398 (Existing Chemical Substance), 2002-2-11 (Observational Chemicals)
- **Butane:** KE-03751(Existing Chemical Substance)

○ Dangerous Material Safety Management Regulation:
- **Pentane:** Special inflammable, class 4 (50ℓ)

○ Wastes Control Act:
- **Polystyrene:** Public Controlled Waste (waste synthetic polymer compound)
- **Pentane:** Public Controlled Waste

EU classification:
- **Pentane:**
  • Classification: F+; R12 Xn; R65 R66 R67 N; R51-53
  • Risk phrases: R12, R51/53, R65, R66, R67
  • Safety phrases: S2, S9, S16, S29, S33, S61, S62
  • EU Regulation 1272/2008: Flam. Liq. 2, Asp. Tox. 1, STOT SE 3, Aquatic Chronic 2
- **HBCD:** Candidate list of SVHC (Date of publication: Oct. 28, 2008)
- **Butane:**
  • Classification: F+; R12, Carc. Cat. 1; R45, Muta. Cat. 2; R46
  • Risk phrases: R: 45-46-12
  • Safety phrases: S: 53-45
  • EU Regulation 1272/2008: Flam. Gas 1, Press. Gas, Carc. 1A, Muta. 1B

U.S.A management information:
• OSHA (29CFR1910.119) : Not regulated
• CERCLA 103 (40CFR302.4): Not regulated
• EPCRA 302 (40CFR355.3): Not regulated
• EPCRA 304 (40CFR355.4): Not regulated
• EPCRA 313 (40CFR372.65): Not regulated
- **Polystyrene:** Inventory - United States - Section 8(b) Inventory (TSCA): XU

- **Pentane:** Inventory - United States - Section 8(b) Inventory (TSCA): T
- **HBCD:** Inventory - United States - Section 8(b) Inventory (TSCA): T
- **Butane:** Inventory - United States - Section 8(b) Inventory (TSCA): Butane

○ Japan management information:
- **Polystyrene:** Inventory-Existing and New Chemical Substances (ENCS): (6)-120
- **Pentane:** Inventory-Existing and New Chemical Substances (ENCS): (2)-5
- **HBCD:** Inventory-Existing and New Chemical Substances (ENCS): (3)-2254
- **Butane:** Inventory-Existing and New Chemical Substances (ENCS): (2)-4

○ China management information:
- **Polystyrene:** Inventory of Existing Chemical Substances (IECSC): Present
- **Pentane:** Inventory of Existing Chemical Substances (IECSC): Present
- **HBCD:** Inventory of Existing Chemical Substances (IECSC): Present
- **Butane:** Inventory of Existing Chemical Substances (IECSC): Present

○ Canada management information:
- **Polystyrene:** Inventory-Domestic Substances List (DSL): Present
- **Pentane:** Inventory-Domestic Substances List (DSL): Present
- **HBCD:** Inventory-Domestic Substances List (DSL): Present
- **Butane:** Inventory-Domestic Substances List (DSL): Present

○ Australia management information**:**
- **Polystyrene:** Inventory-Australia Inventory of Chemical Substances (AICS): Present
- **Pentane:** Inventory-Australia Inventory of Chemical Substances (AICS): Present
- **HBCD:** Inventory-Australia Inventory of Chemical Substances (AICS): Present
- **Butane:** Inventory-Australia Inventory of Chemical Substances (AICS): Present

○ New Zealand management information:
- **Polystyrene:** Inventory-New Zealand - Inventory of Chemicals (NZIoC): Present
- **Pentane:** Inventory-New Zealand - Inventory of Chemicals (NZIoC): Present
- **HBCD:** Inventory-New Zealand - Inventory of Chemicals (NZIoC): Present
- **Butane:** Inventory-New Zealand - Inventory of Chemicals (NZIoC): Present

○ Substance of Roterdame Protocol: Not regulated

○ Substance of Stockholme Protocol: Not regulated

○ Substance of Montreal Protocol: Not regulated

1) Information source and references:
- ECB:ESIS (European chemical Substances Information System) (http://ecb.jrc.it/esis)
- International Uniform Chemical Information Database (IUCLID) (http://ecb.jrc.it/esis)
- RAR: http://ecb.jrc.ec.europa.eu/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/SUMMARY/n-pentanesum043.pdf
- U.S. National library of Medicine (NLM) Hazardous Substances Data Bank (HSDB): http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+PENTANE

- IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT (Multivolume work)., p. S7 216 (1987)
- INCHEM: http://www.inchem.org/documents/icsc/icsc/eics1043.htm
- CHRIP: http://www.safe.nite.go.jp/data/hazkizon/pk_e_kizon_disp.html?k_no=0535
- RTECS: http://csi.micromedex.com/DATA/RT/RTRZ9450000.HTM?Top=Yes
- Envichem: http://wwwp.ymparisto.fi/scripts/Kemrek/Kemrek_uk.asp?Method=MAKECHEMdetails form& txtChemId=2477
- AKRON: http://ull.chemistry.uakron.edu/erd/
- ECHA SVHC support document
- THOMSON;LOLI: http://csi.micromedex.com/fraMain.asp?Mnu=0
- Korea Occupational Health & Safety Agency: http://www.kosha.net
- National chemicals information systems (http://ncis.nier.go.kr)

2) Issue date : 1996. 06. 01

3) Revision number and date : 2017. 5. 15 (10^{th})

4) Other material safety data sheet information:
- The contents of this MSDS documented and the information based on current knowledge and information. Some of the information contained in the information provided by the Korea Occupational Safety & Health Agency
- This MSDS were made of the informational purposes for the safe handling when education or use of the production department workers. Therefore we make no guarantee for result obtained, and assume no responsibility for damages incurred by use of this product. But the material used for the purpose of the data requested is available for further information.

<Record management>

Revision	Revision categories	Revision content	Revision date	Personnel
5th	Overall	Written in the form of GHS	2009.04.01.	Dae Gyeong Kim
6th	Overall	Written in the form of GHS	2011.03.30.	Dae Gyeong Kim
7th	Overall	Additional toxic information	2012.06.25.	Jae Pil Kim
8th	Name	Mark as Flame Retardant Grade Following company CI rules	2013.10.21.	Jae Pil Kim
9th	Address	A change of address	2016.02.29.	Seung Hyun Song
10th	Chemical ingredients	HBCD → NON HBCD	2017.5.15	Dongmin Park