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NONIONIC SURFACTANTS

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POLYETHYLENE GLYCOL

KPX Green Chemical Co. Ltd.

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KPX Green Chemical has been a functional chemical products manufacturer since its physical division from KPX Chemical on January 1, 2003, and provides the best solutions to satisfy the customers based on the best professionalism with ethylene oxide derivative products such as EOA(Ethylene Oxide Adducts) and ETA(Ethanolamines).


Starting with the production of EOA in 1978, the company began to produce ETA commercially for the first time in Korea in 1992, and has been producing DMC and MEG since 2008.

We provide our customers with higher value after beginning with the commercial production of AM in 2015.

Based on the technology and trust accumulated over 40 years since the establishment of the mother company, KPX Green Chemical has been endeavoring to deliver more special experiences and higher value to our customers.

From now on, we will prioritize our customers and shareholder value while fulfilling our social responsibility and ethics.

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POLYOXYETHYLENE ALKYL ETHER

Type

KONION OT-Series [C8 iso-alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-----------------------------|-------------------|--------------------------|------|
| OT-3 | Polyoxyethylene Octyl Ether | Liquid | 206 ~ 222 | 10.1 |
| OT-8 | | Liquid | 111 ~ 121 | 14.5 |

KONION LA-Series [C12-14 fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|------------------------------|-------------------|--------------------------|------|
| LA-2N | Polyoxyethylene Lauryl Ether | Liquid | 195 ~ 205 | 6.2 |
| LA-3N | | Liquid | 168 ~ 176 | 8.1 |
| LA-5N | | Liquid | 132 ~ 140 | 10.6 |
| LA-7N | | Liquid | 108 ~ 116 | 12.2 |
| LA-9N | | Paste | 92 ~ 98 | 13.4 |
| LA-20N | | Solid | 50 ~ 55 | 16.4 |
| LA-50NF | | Flake | 21.5 ~ 25.5 | 18.4 |

KONION CA-Series [C16 fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-----------------------------|-------------------|--------------------------|------|
| CA-5 | Polyoxyethylene Cetyl Ether | Liquid | 116 ~ 124 | 9.4 |
| CA-20F | | Flake | 48 ~ 52 | 15.6 |
| CA-50F | | Flake | 21 ~ 25 | 18 |

KONION CSA-Series [C16-18 fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-----------------------|-------------------|--------------------------|------|
| CSA-3 | Polyoxyethylene Cetyl | Liquid | 142 ~ 150 | 6.9 |
| CSA-15 | Stearyl Ether | Solid | 58 ~ 65 | 14.5 |

KONION SA-Series [C18 fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-------------------------------|-------------------|--------------------------|------|
| SA-7 | Polyoxyethylene Stearyl Ether | Paste | 94 ~ 101 | 10.7 |
| SA-50 | | Solid | 21.5 ~ 24 | 17.8 |

KONION EA-Series [C16-18 Unsaturated fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-----------------------------------|-------------------|--------------------------|------|
| EA-5 | Polyoxyethylene Oleyl Cetyl Ether | Liquid | 115 ~ 120 | 9.0 |
| EA-11 | | Liquid | 72.5 ~ 77.5 | 12.9 |
| EA-24 | | Solid | 41 ~ 44 | 16 |

KONION OA-Series [C18 Unsaturated fatty alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB | |
|--------------|-----------------------------|-------------------|--------------------------|-------------|------|
| OA-2 | Polyoxyethylene Oleyl Ether | Liquid | 153 ~ 163 | 4.9 | |
| OA-8 | | Paste | 87 ~ 94 | 11.4 | |
| OA-10 | | Paste | 76 ~ 83 | 12.4 | |
| OA-20 | | Solid | 47 ~ 51 | 15.3 | |
| OA-40F | | Flake | | 25.5 ~ 29.5 | 17.4 |
| | | | | | |

KONION BTA-Series [C13 iso-alcohol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB | |
|--------------|--------------------------------|-------------------|--------------------------|---------------|------|
| BTA-0606 | Polyoxyethylene Tridecyl Ether | Liquid | 163 ~ 170 | 7.8 | |
| BTA-1010 | | Liquid | 129 ~ 135 | 10.4 | |
| BTA-1414 | | Liquid | 106 ~ 112 | 12.0 | |
| BTA-2020 | | Liquid | 85 ~ 89 | 13.6 | |
| BTA-60(S) | | Liquid | | 116.5 ~ 122.5 | 11.3 |
| | | | | | |

Characteristics

The hydrophile level of polyoxyethylene alkyl ether can be freely controlled by adding a number of moles of ethylene oxide, and it is also suitable to use for many purposes as its property can be changed depending on the selection of fatty alcohol.

As it is an ether-type nonionic surfactant, it is not hydrolyzed by acid or alkali, but is used for prescription where acid resistance, alkali resistance and hard water resistance are necessary.

In addition, it can be biodegraded using linear alcohol, and it offers the biggest benefit.

It is possible to produce products on demand using natural or synthetic alcohol, which are not included in the brochure.

Purpose

Similar to the purpose of polyoxyethylene alkyl phenyl ether such as KONION NP and OP, it is used as an emulsifier, dispersant, humectant, detergent and solubilizer across a wide range of fields such as a detergent, synthetic resin, textile, cosmetic and medicine. In particular, it can be utilized well in the area where biodegradation is necessary.

As it is made of well-selected materials, it can also be used as an emulsifier, giving it hydrophile and lyophobic properties, and for medical ointments and cosmetic creams. Product with less additional moles of ethylene oxide is used as a pigment dispersant for printing ink and sewing machine oil, and those with more additional moles is used as O/W-type emulsifier or solubilizer for water-soluble ink or paint.

KONION OA prevents many bubbles, has an excellent penetrability, and is used for manufacturing industrial emulsions such as agricultural pesticides and cutting oils.



POLY(OXYETHYLENE, OXYPROPYLENE) BLOCK COPOLYMER

Type

KONION PE-Series [EO-PO-EO Block Copolymer Type]

| Product Name | Chemical Structure | Appear. (at 20°C) | EO Ratio(%) | M/W | Cloud Point (°C) | Viscosity (25°C, CPS) |
|--------------|---|-------------------|-------------|------|------------------|-----------------------|
| PE-15 | | Liquid | 40 | 940 | [3] 59 | 100 |
| PE-52 | | Liquid | 20 | 1700 | [1] 30 | 300 |
| PE-61 | | Liquid | 10 | 2000 | [1] 24 | 300 |
| PE-62 | | Liquid | 25 | 2500 | [1] 27 | 400 |
| PE-64 | | Paste | 40 | 3200 | [1] 59 | - |
| PE-68F | HO-(C ₂ H ₄ O) _a (C ₃ H ₆ O) _b (C ₂ H ₄ O) _c -H [Block] | Flake | 80 | 8600 | - | - |
| PE-71 | | Liquid | 10 | 2100 | [1] 21 | 350 |
| PE-74 | | Paste | 40 | 3100 | [2] 70 | - |
| PE-91 | | Liquid | 15 | 3100 | [2] 36 | 550 |
| PE-92 | | Liquid | 25 | 3200 | [1] 25 | 700 |
| PE-101 | | Liquid | 15 | 3800 | [2] 52 | 700 |
| PE-1020 | | Liquid | 10 | 1300 | [1] 25 | 190 |

KONION RP-Series [PO-EO-PO Block Copolymer Type]

| Product Name | Chemical Structure | Appear. (at 20°C) | EO Ratio(%) | M/W | Cloud Point (°C) | Viscosity (25°C, CPS) |
|--------------|--|-------------------|-------------|------|------------------|-----------------------|
| RP-1050 | | | 55 | 2000 | [1] 68 | 450 |
| RP-1840 | | | 40 | 2600 | [1] 43 | 650 |
| RP-1924 | HO-(C ₃ H ₆ O) _a (C ₂ H ₄ O) _b (C ₃ H ₆ O) _c -H | Liquid | 25 | 2000 | [1] 36 | 400 |
| RP-2420 | | | 25 | 2600 | [1] 27 | 650 |
| RP-2520 | | | 25 | 3000 | [1] 31 | 650 |

Characteristics

KONION PE is a nonionic block copolymer of poly(oxyethylene, oxypropylene) glycol, and it is made by adding and impressing ethylene oxide, the hydrophilic group, on both ends of the hydrophobic group.

KONION PE is widely used as a surfactant and polyether for many industrial uses, and as it has a hydroxyl group(-OH) base, it is also put to use as a manufacturing synthetic resin such as polyurethane(PU) and polyester(PET).

In addition, it is possible to manufacture products with diverse molecular weights and HLB by controlling the degree of polymerization of propylene oxide and ethylene oxide, and this product has excellent properties as a surfactant with low foamability comparing to those which is made by fatty alcohol with high foamability.

KONION RP, on the contrary to KONION PE, is made by adding and impressing propylene oxide, a hydrophobic group, on both ends of a hydrophilic group. Especially, RP-2420 or 2520 with low ethylene oxide content has an excellent performance as an antifoaming agent, and it also has good performance as a humectant.

Most of them are specialized in the metal processing area as they give an excellent performance in metal cutting oil field.

Purpose

① Synthetic resin industry

It is a detergent with low foamability and is used as a cleaning agent and antifoaming agent for clothes, furnitures, automobiles, oil tanks and machineries.

② Textile industry

Due to its an excellent penetrability, it is used as a dyeing auxiliary, a detergent for wool and anti-static agent for synthetic fabrics.

③ Cosmetics

It is used for deodorant, lotion, shampoo and toothpaste according to each respective purpose.

④ Metal cleaner

Due to its an excellent detergency and low corrosiveness on metals, it is used as an acidity detergent, alkaline detergent and spray detergent for metals.

⑤ Emulsifier & dispersant

Due to its outstanding emulsifiability and dispersibility, it is used as an emulsion dispersant for various paints and pigments, as an emulsion stabilizer, dispersant of pulp, and emulsifier for agricultural pesticides.

⑥ For synthetic resins

KONION PE in particular is used as a base material for polyurethane and polyester resin, plasticizer for phenol resin, and as an anti-static agent.

[1] 1g sample + 100g distilled water

[2] 1g sample + 10g diethyleneglycol monobutyl ether solution (c=250g/L)

[3] 1g sample + 100g NaCl solution (c=100g/L)

POLYOXYALKYLENE GLYCOL MONOALKYL ETHER / POLY(OXYETHYLENE, OXYPROPYLENE) GLYCOL

Type

KONLUB BR-Series

| Product Name | Chemical Name | Solubility | Viscosity (cst) | | Specific Gravity (20°C) | Pour Point (°C) | Flash Point (°C) |
|--------------|------------------------|---------------|-----------------|-------|-------------------------|-----------------|------------------|
| | | | 40°C | 100°C | | | |
| BR-510 | | | 8 | 2.3 | 0.991 | -65 | 90 |
| BR-520 | | | 19.5 | 4.5 | 1.015 | -51 | 190 |
| BR-550 | | | 49 | 10.5 | 1.038 | -40 | 230 |
| BR-500 | | | 80 | 16 | 1.046 | -37 | 230 |
| BR-501 | | | 100 | 20 | 1.049 | -35 | 230 |
| BR-502 | Polyoxyalkylene Glycol | Water Soluble | 135 | 26 | 1.052 | -34 | 230 |
| BR-503 | Mono Butyl Ether | | 220 | 41 | 1.054 | -33 | 230 |
| BR-504 | | | 380 | 69 | 1.058 | -31 | 230 |
| BR-504-1 | | | 400 | - | 1.058 | -30 | 230 |
| BR-505 | | | 500 | 89 | 1.059 | -30 | 230 |
| BR-508 | | | 850 | 145 | 1.063 | -28 | 230 |
| BR-5110 | | | 1100 | - | 1.070 | -25 | 230 |

KONLUB BP-Series

| Product Name | Chemical Name | Solubility | Viscosity (cst) | | Specific Gravity (20°C) | Pour Point (°C) | Flash Point (°C) |
|--------------|-------------------------|-------------|-----------------|-------|-------------------------|-----------------|------------------|
| | | | 40°C | 100°C | | | |
| BP-100 | | | 8.7 | 2.3 | 0.962 | -55 | 130 |
| BP-130 | | | 32 | 6.8 | 0.983 | -48 | 210 |
| BP-170 | Polyoxypropylene Glycol | Oil Soluble | 80 | 15 | 0.996 | -37 | 220 |
| BP-220 | Mono Butyl Ether | | 120 | 22 | 1.000 | -33 | 230 |
| BP-330 | | | 230 | 35 | 1.001 | -30 | 230 |
| BP-440 | | | 340 | 55 | 1.003 | -30 | 230 |

KONLUB DR-Series [EO/PO Random Copolymer Type]

| Product Name | Chemical Structure | Solubility | Viscosity (cst) | | Specific Gravity (20°C) | Pour Point (°C) | Active Content (%) | Flash Point (°C) |
|--------------|---|---------------|-----------------|-------------|-------------------------|-----------------|--------------------|------------------|
| | | | 37.8°C | 98.9°C | | | | |
| DR-701C | | | 98 | 22 | 1.097 | -15 | 100 | |
| DR-702 | | | 131(40°C) | 23 | 1.096 | -7 | 100 | |
| DR-76 | HO-(C ₂ H ₄ O) _a | Water Soluble | 1600 | 208 | 1.094 | -4 | 100 | > 250 |
| DR-7195T | (C ₃ H ₆ O) _b -H | | 19500 | 2600(100°C) | 1.097 | 4 | 100 | |
| DR-715S | [Random] | | 2700 | - | 1.096 | - | 80 | |
| DR-820S | | | 9000 | - | 1.097 | - | 80 | |
| MQ-7000 | | | 80000 | - | 1.15(40°C) | 4 | 100 | |

Characteristics

KONLUB BP, BR and DR products are polyether-type compounds which are the derivatives of alkylene oxide. KONLUB BP product is oil-soluble, and KONLUB BR and DR are water-soluble.

Using this product, it is possible to manufacture diverse products depending on the demand of the properties, with the number of molecular weight varying from the hundreds to tens of thousands.

- It has an excellent lubricity.
- An excellent viscosity-temperature characteristic (high viscosity index).
- It is possible to select a desired viscosity.
- Very low pour point.
- It does not create sludge.
- It is a very stable non-volatile high-molecular substance.
- It does not damage rubbers or metals.
- It has nearly no toxicity.
- It is possible to select between oil and water solubilities, and can be easily used with other substances or solvents.

Purpose

Diverse purposes are developed and commercialized by using the excellent properties of KONLUB products, and the purposes are classified as follows.

- Uses for lubrication properties
It can be used as a metal-working fluid, hydraulic fluid, ingredient for various lubricants, ingredient for brake fluid, a smoothing oil for the textile industry, and lubricant and parting agent for rubbers and plastics.
- Uses for interfacial properties
Especially, KONLUB BP has an excellent performance as an antifoaming and demulsifying agent, it is widely used as an industrial antifoaming agent.
- Uses for other physical and chemical properties
As the low molecular product of the KONLUB DRs has low toxicity, it is widely used as an ingredient for cosmetics and medical supplies, as well as a synthetic material of diverse organic compounds.
In particular the high molecular products can be used as a water-soluble mechanical hydraulic fluid, heat treating oil for metals or and a heat transfer medium.

Type

KONION NP-Series [Nonylphenol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | Cloud Point (°C) | HLB |
|--------------|-----------------------------------|-------------------|--------------------------|------------------|------|
| NP-2 | | | 176 ~ 188 | - | 5.7 |
| NP-3 | | | 154 ~ 164 | - | 7.5 |
| NP-4 | | | 138 ~ 146 | - | 8.9 |
| NP-5 | | | 124 ~ 131 | - | 10.0 |
| NP-6 | | Liquid | 113 ~ 119 | - | 10.9 |
| NP-8 | | | 95 ~ 101 | 24 ~ 33 | 12.3 |
| NP-8.5 | | | 91.5 ~ 97.5 | 39 ~ 43 | 12.6 |
| NP-9 | Polyoxyethylene Nonylphenol Ether | | 88 ~ 94 | 48 ~ 54 | 12.8 |
| NP-9.5 | | | 86.5 ~ 89.5 | 54 ~ 58 | 13.1 |
| NP-10 | | | 83 ~ 89 | 60 ~ 66 | 13.3 |
| NP-12 | | Paste | 72 ~ 78 | 80.5 ~ 85.5 | 14.1 |
| NP-15 | | | 60.5 ~ 66.5 | - | 15.0 |
| NP-30 | | Solid | 34.5 ~ 38.5 | - | 17.1 |
| NP-40F | | Flake | 26.5 ~ 30.5 | - | 17.8 |
| NP-50F | | | 21.5 ~ 25 | - | 18.2 |

KONION OP-Series [Octylphenol ethoxylates]

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | HLB |
|--------------|-----------------------------------|-------------------|--------------------------|------|
| OP-10 | Polyoxyethylene Octylphenol Ether | Liquid | 84 ~ 90 | 13.6 |
| OP-40F | | Flake | 26.5 ~ 30.5 | 17.9 |

Characteristics

KONION NP and OP are nonionic surfactants, and have the following characteristics.

① Solubility

Solubility in water increases as polyoxyethylene ether chains become longer. When diluting the KONION NP and OP with water, the viscosity tends to rise at the initial stage. It becomes a gel-type solution that cannot be diluted with cold water, it should be diluted by placing it in warm or hot water, alternately.

It is also possible to prevent solidification as a gel-type by adding alcohols, glycols, other solvents or salts. The solubility of KONION NP and OP in organic solvents and oils also differs depending on the level of added ethylene oxide, and the solubility of aliphatic hydrocarbon rapidly decreases if the number of additional moles of ethylene oxide increases. Products with a small number of additional moles of ethylene oxide are dissolved with mineral oil or paraffinic hydrocarbon, and all the KONION NP and OP products are melted with aromatic hydrocarbons such as benzene, toluene and ketone, alcohol or chlorinated hydrocarbon.

② Cloud Point

The solubility of KONION NP and OP in water decreases as the temperature rises. When heating the water solution, which is transparent at room temperature, it changes into the opaque liquid at the certain temperature. The temperature at this point defines as a cloud point. Cloud point becomes higher as the length of polyoxyethylene ether increases. In particular, in case of the product with the high degree of ethylene oxide polymerization (e.g. 30 mole added product), the cloud point of water solution will not be created until it reaches the boiling point, however, the cloud point may be lowered when salts such as sodium chloride are added. As the cloud point is both physical and reversible phenomenon, the water solution becomes transparent or opaque as it is cooled or heated, and in most cases, it is possible to be used at temperatures above the cloud point.

③ Safety

As it is a nonionic compound, it is greatly resistant to acid, alkali, reducing agents and peroxide oxidizers.

④ Compatibility

As it has an excellent compatibility with all nonionic, anionic and cationic surfactants, it is possible to realize a synergy effect when using them together.

⑤ Solubility

The detergency changes depending on the degree of ethylene oxide added. Surface tension is the lowest when there are 6 moles of ethylene oxide, and it increases as the number of additional moles increases. The dispersion force of KONION NP and OP differs depending on the dispersive medium, however, their dispersibility is excellent in general. The wetting force of KONION NP and OP differs depending on the degree of adding ethylene oxides, and in particular KONION NP-8.5 and KONION NP-10 is excellent. The foaming force of KONION NP and OP maintains a medium level of various surfactants.

The foaming force increases depending on the degree of ethoxylation, however, it does not reach that of anion compounds such as alkyl sulfate.

As KONION NP and OP have an excellent emulsification process, they can create stable emulsions. As the characteristics of emulsification can differ depending on the types of oil or organic solvents, and other components emulsified by solvents, we have to decide whether KONION NP or OP are suitable for emulsification. Especially, as KONION OP is a surfactant with an excellent penetration force comparing to others, the product with a large number of added ethylene oxides has an excellent performance in emulsion polymerization.

The most suitable KONION NP products for various oils or organic solvents are as follows.

| | |
|----------------------------------|--------------------------------|
| KONION NP - 4 ~ KONION NP - 7 | Mineral based oil hydrocarbons |
| KONION NP - 8.5 ~ KONION NP - 12 | Aromatic hydrocarbons |
| KONION NP - 10 ~ KONION NP - 15 | Chlorinated hydrocarbons |
| KONION NP - 20 ~ KONION NP - 40 | Fatty acid, WAX |

The water solution of KONION NP and OP has an excellent detergency, and KONION NP-6 and NP-8 especially are used as a detergent removing oily pollutants at a low temperature. If there are a lot of electrolytes, it is desirable to use the product with high degree of added ethylene oxides (more than 20 moles), and if having a lot of alkali, silicate or phosphorus compounds, it is effective to clean by heating with KONION NP-9 ~ NP-15.

It is more effective to use KONION NP with anionic surfactants.

Purpose

KONION NP and OP are classified as follows depending on the degree of added ethylene oxide.

| Number of additional moles of ethylene oxide | Uses |
|--|---|
| 2 Mole - 4 Mole | - Antifoaming agent of surfactant solutions - Detergent and dispersant contained in oil products - Sulfated middle products |
| 4 Mole - 8 Mole | - Oil-soluble detergents - Emulsifier for insecticides and herbicides - Dispersants - Sulfated middle products |
| 8 Mole - 12 Mole | - Fabric detergent - Penetrant for leather working - Detergent for family and industrial uses - Emulsifier for insecticides and herbicides |
| 12 Mole - 20 Mole | - Emulsifier for fats, oils and waxes - Stabilizers for synthetic resins - Detergent and humectants used at a high temperature and a concentration of electrolytes |
| More than 20 moles | - Dyeing auxiliaries - Soap dispersants - Emulsifier and stabilizer for the emulsion polymerization process |

POLYOXYALKYLENE STYRENATED PHENYL ETHER

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Hydroxyl Value (mgKOH/g) | Cloud Point (°C) | HLB |
|------------------|--|-------------------|--------------------------|-------------------|------|
| KONION SP-126 | | | 51.5 ~ 55.5 | ^[1] 58 | 12.6 |
| KONION SP-135 | | | 44 ~ 49.5 | ^[3] 49 | 13.5 |
| KONION SP-145 | | | 37 ~ 42 | ^[3] 63 | 14.5 |
| KONION TSP-80 | Polyoxyethylene Stylenated Phenyl Ether | | 77 ~ 85 | ^[2] 57 | 8.9 |
| KONION TSP-100 | | | 69 ~ 77 | ^[2] 63 | 10.0 |
| KONION TSP-150 | | Liquid | 56 ~ 64 | ^[2] 74 | 12.0 |
| KONION TSP-200 | | | 46 ~ 52 | ^[2] 79 | 13.0 |
| KONION TSP-1008R | | | 50 ~ 57 | ^[1] 47 | - |
| KONION TSP-1012R | Polyoxyalkylene | | 43 ~ 50 | ^[3] 44 | - |
| KONION TSP-1015R | Tristylenated Phenyl Ether | | 40 ~ 45 | ^[3] 52 | - |
| KONION TSP-1520R | | | 32 ~ 37 | ^[3] 61 | - |

Characteristics

KONION SP and TSP are polyaromatic polyether products made by adopting the styrene monomers in molecules, and they have an excellent performance for emulsification dispersion.

Nonionic surfactants, made by using the general linear alcohol as a base, are specialized for emulsifying, dispersing and cleaning various oily pollutants, however, KONION SP and TSP have an excellent performance for their emulsification dispersion of substances composed of aromatics in the emulsified materials such as pigments, paints and pesticides.

As they have an excellent wetting properties and penetrability, they are suitable for cleaning hard surfaces such as glass and metal, and highly refined products can be used as a wet cleaner or reattachment inhibitor for electronic materials.

Purpose

- ⊙ Emulsification disperser for pesticides
- ⊙ Emulsification disperser for textiles
- ⊙ Wet cleaner for electronic materials
- ⊙ Wet cleaner for electronic anti-adhesion agent

^[1] 1g sample + 100g distilled water

^[2] 1g sample + 10g diethyleneglycol monobutyl ether solution (c=250g/L)

^[3] 1g sample + 100g NaCl solution (c=100g/L)

POLYOXYETHYLENE ALKYL AMINE ETHER

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Total amine Value (mgKOH/g) | HLB |
|---------------|-------------------------------------|-------------------|-----------------------------|------|
| KONION LM-2 | Polyoxyethylene Lauryl Amine Ether | Liquid | 192 ~ 202 | 6.1 |
| KONION LM-10 | | | 85 ~ 90 | 13.8 |
| KONION SM-2H | Polyoxyethylene Stearyl Amine Ether | Liquid | 156 ~ 160 | 4.6 |
| KONION SM-10 | | | 76.5 ~ 81.5 | 12.3 |
| KONION SM-15 | | | 58 ~ 63 | 14.1 |
| KONION SM-20 | | | 47 ~ 51 | 15.3 |
| KONION SM-30 | | Solid | 34 ~ 37 | 16.6 |
| KONION TAM-5 | Polyoxyethylene Tallow Amine Ether | Liquid | 114 ~ 119 | 9.2 |
| KONION TAM-20 | | | 48 ~ 51 | 15.5 |

Characteristics

KONION LM, SM and TAM products are polyoxyethylene alkyl amine ether-type nonionic surfactants.

It has the property of a weak cationic surfactant in the water solution, and it will never be precipitated or separated even when used together with anionic surfactants, which differs from general cationic surfactants.

Products with a small number of additional moles of ethylene oxide tend to have the property of a weak anionic surfactant in the water solution, and they become closer to the property of normal nonionic surfactants as the number of additional moles of ethylene oxide increases.

Purpose

KONION LM, SM and TAM products are used for diverse purposes due to the weak cationic properties.

In particular, they are used as a paint disperser in the fabric, paint and ink industries, an emulsifier and disperser for anti-static agents or pesticide in the rubber and plastic industries, and as a conditioner, leveling agent, smoothing agent and anti-static agent in the textile industry.

In addition, some of the products may be applied for the purposes of removing pollutants, polishing the surface, and preventing corrosion, in the metalworking industry.



POLYOXYETHYLENE GLYCOL FATTY ACID ETHER

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Saponification value (mgKOH/g) | HLB |
|---------------|------------------------------|-------------------|--------------------------------|---------|
| KONION ML-10 | Polyoxyethylene Monolaurate | Liquid | 85 ~ 90 | 13.8 |
| KONION ML-14 | | | 66.5 ~ 70.5 | 15.2 |
| KONION MS-9 | 79.5 ~ 85.5 | | 11.6 | |
| KONION MS-14 | Polyoxyethylene Monostearate | | 60 ~ 65 | 13.7 |
| KONION MO-5 | | | 107 ~ 117 | 8.8 |
| KONION MO-9 | Polyoxyethylene Monooleate | | 80 ~ 86 | 11.7 |
| KONION MO-14 | | | 59.5 ~ 65.5 | 13.8 |
| KONION CO-12 | Polyoxyethylene Castor Oil | | 110 ~ 119 | 7.2 |
| KONION CO-25 | | | 80 ~ 86 | 10.8 |
| KONION CAW-30 | | | Polyoxyethylene Castor Wax | 69 ~ 76 |

Characteristics

KONION ML, MS, MO, CO and CAW products include the fatty acid polyoxyethylene glycol ester-type nonionic surfactants. As they have a low toxicity and do not stimulate the skin or eyes, they are suitable as an emulsion stabilizer for cosmetics and medical supplies. It is possible to select between oil-soluble and water-soluble products depending on the number of added moles of ethylene oxide. As they are nonionic, they can be used together with nonionic, anionic and cationic surfactants. As they have excellent properties as emulsifiers, dispersers, antifoaming agents, smoothing agents and oiliness improvers. So they can be used in diverse industries of agricultural pesticide, metalworking, paper, pulp, textile, medical supply and cosmetic.

Purpose

- ① Cosmetics & medical supplies
As they have excellent emulsion dispersing properties and low toxicity for the human body, they are used as emulsifiers in the cosmetics and medical supplies area. And some of them may be used as materials for ointments or hair greases in a gel state with 30~50% of water solution.
- ② Pesticide industry
As they have excellent emulsification properties, they are suitable as an emulsifier for machine oils or various pesticide emulsifiers by using them together with the proper anionic or nonionic surfactants.
- ③ Metalworking industry
As they have low metal corrosion properties, they can be used as a detecting detergent for metals, or an emulsion improver and emulsifier for metal-working fluids.
- ④ Textile industry
As they have an excellent emulsifying and smoothing properties for mineral and vegetable oils, they can be used as a mixing material of emulsions for textile such as weaving and spinning oils.
- ⑤ Paper and pulp industry
As they have an excellent emulsibility and dispersibility for various materials, they can be applied to diverse purposes such as sizing and coating agents.
- ⑥ Synthetic resin industry
They have an excellent emulsibility and dispersibility of monomers as an emulsifier for emulsion polymerization, manufacture a high concentration of emulsion products.
- ⑦ Others
Using the excellent emulsifying capacity for mineral oils, neutral oils and resin materials, they are widely used in other industries.



LOW FOAMING AGENT

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Cloud Point (°C) | Viscosity (25°C, cps) | Specific Gravity (20°C) |
|---------------|-----------------------------|-------------------|-------------------|-----------------------|-------------------------|
| KONION LF-209 | Polyoxyalkylene Alkyl Ether | Liquid | ^[2] 48 | 26 | 0.97 |
| KONION LF-222 | | | ^[1] 28 | 56 | 0.98 |
| KONION LF-230 | | | ^[2] 50 | 50 | 0.97 |
| KONION LF-236 | | | ^[1] 25 | 186 | 1.03 |

Characteristics

The nonionic surfactant made of general linear and branching alcohols has excellent cleaning, emulsifying and dispersing properties, however, it often creates trouble in the manufacturing process as it has high foamability. So KONION LF is a specially designed product to solve this problem by lowering foamability and reducing foam durability and it can be applied to the cleaning process which demands low foamability.

As it is a product without the loss of cleaning, emulsifying and dispersing capacities, it can reduce water waste during rinsing.

Purpose

- ⦿ Detergent for low-foamability textiles
- ⦿ Emulsifier and disperser for textiles
- ⦿ Disperser for paints and pigments

^[1] 1g sample + 100g distilled water

^[2] 1g sample + 10g diethyleneglycol monobutyl ether solution (c=250g/L)

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Cloud Point (°C) | Viscosity (25°C, cps) | Specific Gravity (20°C) |
|--------------|-----------------------------|-------------------|-------------------|-----------------------|-------------------------|
| NEORIN-310 | Polyoxyalkylene Alkyl Ether | Liquid | ^[2] 28 | 121 | 0.97 |
| NEORIN-390 | Polyoxyalkylene Glycol | | ^[2] 30 | 500 | 1.02 |
| NEORIN-400 | Polyoxyalkylene Alkyl Ether | | ^[2] 29 | 320 | 1.00 |
| NEORIN-415 | Polyoxyalkylene Alkyl Ether | | ^[2] 33 | 270 | 0.99 |
| NEORIN-420 | Polyoxyalkylene Alkyl Ether | | ^[2] 33 | 240 | 0.99 |
| NEORIN-430 | Polyoxyalkylene Alkyl Ether | | ^[2] 43 | 230 | 0.99 |

Characteristics

NEORIN is a poly (oxypropylene, oxyethylene) copolymerized product which has excellent anti-foaming properties compared to natural materials.

Soybean oil, liquid paraffin and silicon emulsion were used as anti-foaming agents before, however, these agents have anti-germ properties and low anti-foaming durability, and can contaminate the equipments. In contrast, NEORIN is an anti-foaming agent designed to prevent these problems.

Purpose

- For industrial fermentation

NEORIN-400 is an anti-foaming agent that was specially developed for industrial fermentation, and it is used for removing foam created in the process.

In particular, it is easy to use because it has an excellent foam durability and is easily dispersed in water.

- Others

NEORIN-310, 390, 415, 420 and 430 are the universal industrial anti-foaming agents, and they may replace silicon anti-foaming agents across diverse areas including the paper manufacture industry, construction with concrete materials, and civil engineering.

Type

| Product Name | Chemical Name | Appear. (at 20°C) | Cloud Point (°C) | Viscosity (25°C, cps) | Specific Gravity (20°C) | HLB |
|----------------|--------------------------|-------------------|-------------------|-----------------------|-------------------------|------|
| KONION NF-10 | Polyalkylene Alkyl Ether | Liquid | - | 48 | 0.94 | 3.3 |
| KONION NF-60 | | | - | 45 | 0.97 | 10.5 |
| KONION NF-80 | | | ^[1] 32 | 60 | 0.99 | 12.0 |
| KONION NF-100 | | ^[1] 64 | 83 | 1.01 | 13.3 | |
| KONION NF-120 | | Paste | ^[1] 83 | 82 (at 30°C) | 1.02 (at 30°C) | 14.2 |
| KONION NF-140 | | | ^[1] 93 | 65 (at 40°C) | 1.02 (at 40°C) | 15.2 |
| KONION NF-400F | Flake | - | - | 130.5 (at 50°C) | 1.06 (at 40°C) | 17.8 |

Characteristics

- Nonionic surfactants with an excellent biodegradability
- Surface tension is lower than nonyl phenol ethoxylate
- Defoaming property is better than that of nonyl phenol ethoxylate
- An excellent water solubility together with low viscosity

KONION NF is a product developed to replace KONION NP and OP, which are environmentally hazardous materials.

As it has an excellent biodegradability and absorptive capacity, it can be replaced to KONION NP and OP series in diverse areas.

Purpose

- Textile: emulsification dispersion agent, detergent
- Pesticide: emulsifier
- Pigments & paints: disperser
- Emulsifier for oils and waxes
- Emulsifier for emulsion polymerization
- Similar application and purpose to NP-Series

^[1] 1g sample + 100g distilled water

^[2] 1g sample + 10g diethyleneglycol monobutyl ether solution (c=250g/L)

^[3] 1g sample + 100g NaCl solution (c=100g/L)

POLYOXYETHYLENE GLYCOL

Type

I KONION PEG-Series $\text{HO}-(\text{CH}_2\text{CH}_2\text{O})_n-\text{CH}_2\text{CH}_2\text{OH}$

| Product Name | Appear. (at 20°C) | Molecular Weight(g/mol) | Hydroxyl Value (mgKOH/g) | Freezing Point (°C) | Specific Gravity | Viscosity (100°C, cps) |
|--------------|-------------------|-------------------------|--------------------------|---------------------|------------------|------------------------|
| PEG-200 | Liquid | 190 ~ 210 | 535 ~ 590 | - | 1.124 (20°C) | 4.4 |
| PEG-300 | | 285 ~ 315 | 356 ~ 393 | -15 ~ -8 | 1.124 (20°C) | 5.6 |
| PEG-400 | | 380 ~ 420 | 267 ~ 295 | 4 ~ 8 | 1.125 (20°C) | 7.2 |
| PEG-600 | | 570 ~ 630 | 178 ~ 196 | 17 ~ 22 | 1.126 (20°C) | 11 |
| PEG-1000 | | 950 ~ 1050 | 107 ~ 118 | 35 ~ 39 | 1.093 (60°C) | 18 |
| PEG-1540 | Solid | 1375 ~ 1525 | 73.5 ~ 81.6 | 42 ~ 45 | 1.092 (60°C) | 22 |
| PEG-2000 | | 1900 ~ 2100 | 53.0 ~ 59.0 | 51 ~ 54 | 1.092 (60°C) | 42 |
| PEG-4000F | Flake | 3180 ~ 3520 | 31.9 ~ 35.3 | 55 ~ 60 | 1.092 (60°C) | 90 |
| PEG-4000P | | 3800 ~ 4200 | 26.7 ~ 29.5 | 56 ~ 61 | 1.092 (60°C) | 140 |
| PEG-6000P | | 5800 ~ 6600 | 17.5 ~ 19.3 | 56 ~ 61 | 1.092 (60°C) | 320 |
| PEG-6000F | | 7980 ~ 8820 | 12.7 ~ 14.0 | 56 ~ 63 | 1.069 (90°C) | 880 |
| PEG-10000F | | 9300 ~ 10700 | 10.5 ~ 12.0 | 58 ~ 65 | 1.069 (90°C) | 950 |
| PEG-15000F | | 14000 ~ 16000 | 7.0 ~ 8.0 | 58 ~ 65 | 1.069 (90°C) | - |
| PEG-20000F | | 16000 ~ 25000 | 4.5 ~ 7.0 | 58 ~ 65 | 1.069 (90°C) | - |

Characteristics

① Exterior

As the average molecular weight is increased, the exterior changes from a fluid to a paste or wax-type solid, it is possible to manufacture white flake-type products in high molecular weight from 3,000.

② Solubility & compatibility

As all the liquid, semi-solid and flake products are soluble in water. So it is possible to use water as the cheapest solvent option.

In addition, it can be dissolved by most of the organic solvents except hydrocarbon. The compatibility of these organic solvents will be lowered as the molecular weight increases, however, it has a high compatibility with most medicines.

③ Hygroscopic property

The liquid-type KONION PEG has hygroscopic properties, however, in most cases, hygroscopic properties decrease as molecular weight increases, and hygroscopic properties of products with more than 1,000 of molecular weight are largely decreased.

④ Toxicity & stimulation

It has little toxicity or stimulation. So it can be used for cosmetics or medical supplies.

⑤ Other chemical properties

As 2 -OH bases at the end of KONION PEG have the properties of class 1 alcohol, it can be made into ester or ether. As the combination of Ether of KONION PEG is stable, it will never hydrolyze.

It is possible to be stored for a long time as it does not oxidize and prevents the reproduction of fungi or bacteria.

Its water solubility is not influenced by electrolytes, hard water or other salts.

It can be used together with class 4 ammonium salts without reducing its disinfectant properties.

Purpose

As KONION PEG has excellent chemical and physical properties, it is widely used in diverse industries as an intermediary material for manufacturing surfactants, plasticizers and lubricants.

① Medical supplies

It has good solubility in water and has excellent compatibility with other organic materials, and as it is not toxic nor stimulates skin, it is possible to use KONION PEG-300, 400, 1000 and 1540 for the base material of ointments, suppositories, injections, solvents and tablet binding agents.

② Cosmetics

As it is neutral, odorless, water soluble and not stimulus, it is used as an intermediary material in the cosmetics industry.

KONION PEG-400~PEG-6000 are used depending on purposes such as creams, lotions, toothpastes, beauty soaps and cosmetics.

③ Rubber

It is used as a parting agent for rubber foam or latex foam products. It is also used as AIR BAG lubricants that are essential for the tire manufacturing business, and lubricants for extrusion molding.

④ Textile industry

It is widely used in the textile industry as an intermediary material to a conditioner, antistatic agent, detergent, disperser and emulsifier.

⑤ Paper manufacture industry

As it has low volatility, It is suitable as a paper conditioner(PEG-200~400) and as a lubricant for calendaring processes(PEG-1,000~2,000).

⑥ Surfactant

Fatty acid mono or di-esters of KONION PEG are used as an emulsifier, disperser, detergent, anti-foaming agent and lubricant in the textile, oil and pesticide industries.

Besides, it is possible to manufacture important compounds such as ether, amine, acetal and other intermediary materials by reacting with various chemical substances.

⑦ Metalworking industry

In the metalworking industry, it is used as a component of abrasives, a binding agent for the powder metallurgy process, a grease and lubricant.

⑧ Resin industry

It is used as a resin antistatic agent and resin modifier, and flexible plasticizer of synthetic leather and synthetic resins.

⑨ Ink

It is possible to improve the performance of ink by using it to control the hygroscopic properties and viscosity of ink by mixing it to be used as a printing, stencil, stamp or mimeograph ink.

⑩ Lumber

As it has a property of replacing the moisture content inside lumber, it is possible to increase the morphostasis of lumber by preventing contraction when soaking it in the water solution of KONION PEG-1000, or applying it to a wooden surface.

MONOMER FOR POLYCARBOXYLATE CONCRETE ADMIXTURE

Type

| Product Name | Chemical Structure | Molecular Weight(g/mol) | Density (g/cm ³ , 60°C) | Viscosity (60°C, cps) | Freezing Point (°C) |
|-----------------|---|-------------------------|------------------------------------|-----------------------|---------------------|
| KONION MEG-1000 | | 960 ~ 1050 | 1.076 | 37 | 37 ~ 44 |
| KONION MEG-1200 | | 1100 ~ 1300 | 1.080 | 47 | 40 ~ 48 |
| KONION MEG-2000 | CH ₃ O-(CH ₂ CH ₂ O) _n -H (MPEG Type, Polyoxyethylene Methyl Ether) | 1900 ~ 2115 | 1.087 | 99 | 48 ~ 58 |
| KONION MEG-2200 | | 2110 ~ 2250 | 1.087 | 130 | 48 ~ 58 |
| KONION MEG-3000 | | 2850 ~ 3150 | 1.089 | 197 | 53 ~ 62 |
| KONION MEG-5000 | | 4800 ~ 5200 | 1.091 | 670 | 55 ~ 65 |
| KONION RS-123 | CH ₂ =CHCH ₂ O(CH ₂ CH ₂ O) _n H (APEG Type, Polyoxyethylene Allyl Ether) | 1000 ~ 1100 | 1.080 | 40 | 34 ~ 41 |
| KONION MA-2400 | $\begin{array}{c} \text{CH}_2 \\ \\ \text{CH}_3\text{CHCH}_2\text{O}(\text{CH}_2\text{CH}_2\text{O})_n\text{H} \end{array}$ (VPEG Type, Polyoxyethylene Methallyl Ether) | 2250 ~ 2550 | 1.083 | 198 | 48 ~ 58 |
| KONION MA-4500 | | 4155 ~ 4880 | 1.090 | 650 | 55 ~ 65 |

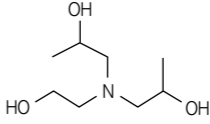
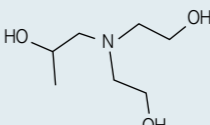
Characteristics

KONION MEG is a major ingredient of a PC (polycarboxylate)-type compound, the 3rd generation concrete compound. Methoxy-PEG with diverse molecular weights is applied to the related businesses depending on the purpose of compound, and KONION RS and MA, Allyl- and Vinyl-PEG, which have a reactive double bond in their molecules, are also supplied with diverse molecular weights.

In particular, KONION MEG, a Methoxy-PEG, can be widely applied as an intermediary material of basic chemicals, a plasticizer for synthetic resins and viscosity reducer, just like polyethylene glycol (PEG).

CEMENT GRINDING AID

Type

| Product Name | Composition | Chemical Structure | Total amine Value (mgKOH/g) | Specific Gravity (20°C) | Viscosity (25°C) |
|-----------------|--------------------------------------|---|-----------------------------|-------------------------|------------------|
| KONION KSM-102P | Ethanol-Diisopropanol-Amine (EDIPA) |  | 310 ~ 320 | 1.048 | 2100 |
| KONION DEIPA-P | Diethanol-Isoopropanol-Amine (DEIPA) |  | 329 ~ 359 | 1.078 | 2500 |

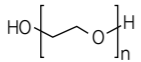
Characteristics

Compared to EG (ethylene glycol) and DEG (diethylene glycol), which are used as an existing grinding material, the amine-type products of our company has benefits which make grinding easily and maintains granularity uniformly by ionizing the cement particles.

It is possible to increase the bonding strength when mixing with gravel or sand when manufacturing the concrete.

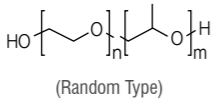
Type

KONION SK-Series (High Purity Polyoxyethylene Glycol)

| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | Average M/W (g/mol) |
|---------------|---|------------------|-------------------|---------------------|
| KONION SK-9T |  | 2 | Liquid | 400 |
| KONION SK-14T | | | | 600 |
| KONION SK-23T | | | 1000 | |
| KONION SK-33T | | | Solid | 1540 |
| KONION SK-45T | | | 2000 | |

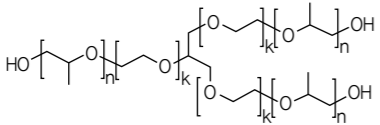
- * High-purity PEGs(Poly Ethylene Glycols)
- * Stable reactivity as an urethane resin modifying agent
- * Improves the feel of water-repellent fabrics and hydrophile properties
- * Increases the hygroscopic properties of thermoplastic PU resin
- * Possible to use as a base oil in a wet chemical water system cleaner for electronic materials

KONION RT-Series (High Purity Polyoxy(ethylene-propylene) Copolymer)

| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | Average M/W (g/mol) |
|----------------|---|------------------|-------------------|---------------------|
| KONION RT-5013 |  | 2 | Liquid | 3000 |
| KONION RT-6316 | | | | 3500 |

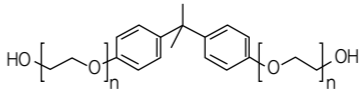
- * Urethane resin modifying agent for water-repellent fabrics
- * Possible to improve the performance and feel of water-repellent fabrics when coating by controlling the EO/PO ratio and molecular weight

KONION TR, FC-Series (High Purity Glycerol Ethoxylated propoxylated)

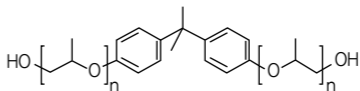
| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | Average M/W (g/mol) |
|----------------|---|------------------|-------------------|---------------------|
| KONION TR-503 |  | 3 | Liquid | 2500 |
| KONION TR-705 | | | | 5300 |
| KONION FC-340R | | | | 3400 |
| KONION FC-350R | | | | 3400 |

- * Modifying agent for urethane resins
- * Resin modifying agent for the PU water-repellent coating of fabrics
- * Possible to improve the water-repellent performance and feel by controlling the EO/PO ratio and molecular weight

KONION BA-Series (Ethoxylated Bisphenol-A)

| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | EO Unit | Hydroxyl Value (mgKOH/g) |
|----------------|---|------------------|-------------------|-----------|--------------------------|
| KONION BA-320T |  | 2 | Powder | 2 mole | 325 ~ 360 |
| KONION BA-400 | | | | 4 mole | 272 ~ 283 |
| KONION BA-490 | | | 6 mole | 218 ~ 238 | |
| KONION BA-660 | | | Liquid | 10 mole | 165 ~ 175 |
| KONION BA-1100 | | | 20 mole | 99 ~ 104 | |
| KONION BA-1550 | | | 30 mole | 70 ~ 75 | |

KONION BAP-Series (Proxylated Bisphenol-A)

| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | PO Unit | Hydroxyl Value (mgKOH/g) |
|----------------|---|------------------|-------------------|---------|--------------------------|
| KONION BAP-355 |  | 2 | Liquid | 2 mole | 307 ~ 325 |
| KONION BAP-400 | | | | 3 mole | 273 ~ 287 |
| KONION BAP-810 | | | | 10 mole | 135 ~ 150 |

- * Used as a modifying agent for resins such as polyesters, urethanes and epoxies
- * EO and PO derivatives of Bisphenol-A are often used for increasing the thermal resistance and strength of resins
 - Binder for paints, resins for coatings and toners
 - Resin material for highly refractive UV coatings, etc.

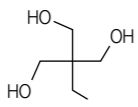
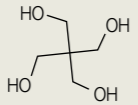
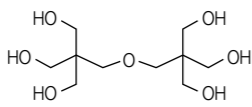
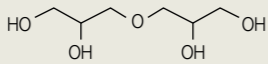
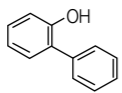
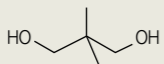
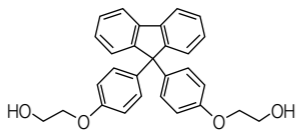
KONION PH-Series (Phenol, Ethoxylated)

| Product Name | Chemical Structure | Functional Group | Appear. (at 20°C) | EO Unit | Hydroxyl Value (mgKOH/g) |
|---------------|---|------------------|-------------------|---------|--------------------------|
| KONION PH-100 |  | 1 | Liquid | 1 mole | 378 ~ 412 |
| KONION PH-400 | | | | 4 mole | 204 ~ 212 |

- * Resin material for UV coatings
- * Low toxicity and odor compared to phenol
- * Solvent for dyes, disperser solvent for resin

OTHER ALKOXYLATED MONOMER ALCOHOLS

Type

| Chemical Name | Nature Alcohol Structure | Functional Group |
|---------------------------------------|---|------------------|
| Trimethylolpropan Derivatives |  | 3 |
| Pentaerythritol Derivatives |  | 4 |
| Dipentaerythritol Derivatives |  | 6 |
| Diglycerol Derivatives |  | 4 |
| 2-Phenylphenol Derivatives |  | 1 |
| Neopentyl Glycol Derivatives |  | 2 |
| Bisphenoxyethanolfluorene Derivatives |  | 2 |

- * Raw material of acrylate monomer and polyurethane
- * Intermediary material for flexible resins, etc.
- * CrossLinking Agent
- * High reflexation index comparing to the low viscosity
- * Low-end color

ETHANOLAMINES

Type

| SECTION | MEA (Monoethanolamine) | DEA (Diethanolamine) | TEA (Triethanolamine) |
|------------------------------|--|---|--|
| Formula | H ₂ NCH ₂ CH ₂ OH | HN(CH ₂ CH ₂ OH) ₂ | N(CH ₂ CH ₂ OH) ₃ |
| Molecular Weight (g/mol) | 61.08 | 105.14 | 149.19 |
| Sp.Gr.(20/20°C) | 1.017~1.019 | 1.090~1.094 | 1.124~1.127 |
| Freezing Point (°C) | 10.5 | 28.0 | 21.2 |
| Boiling Point (°C) | 170.5 | 269 | 360 |
| Equivalent Wt. | 61.0~62.5 | 104.0~106.0 | 148.0~150.0 |
| Vapor Pressure at 20°C, mmHg | < 1 | < 0.01 | < 0.001 |
| Flash Point (°C) | 93 | 149 | 185 |
| Refractive Index(nD) | 1.4539(20°C) | 1.4747(30°C) | 1.4852(20°C) |
| Viscosity (cps) | 24.1(28°C) | 350(30°C) | 1.013(20°C) |
| Solubility in Water | Complete | Complete | Complete |
| Appearance | Clear Liquid | Clear Liquid | Light Yellow Liquid |
| Color(APHA No.) | 15 Max | 15 Max | 50 Max |
| Water Content(%) | 0.3 Max | 0.15 Max | 0.2 Max |
| MEA(Wt%) | 99.0 Min | 0.5 Max | - |
| DEA(Wt%) | 1.0 Max | 99.0 Min | 0.5 Max |
| TEA(Wt%) | - | 0.5 Max | 99.0 Min |

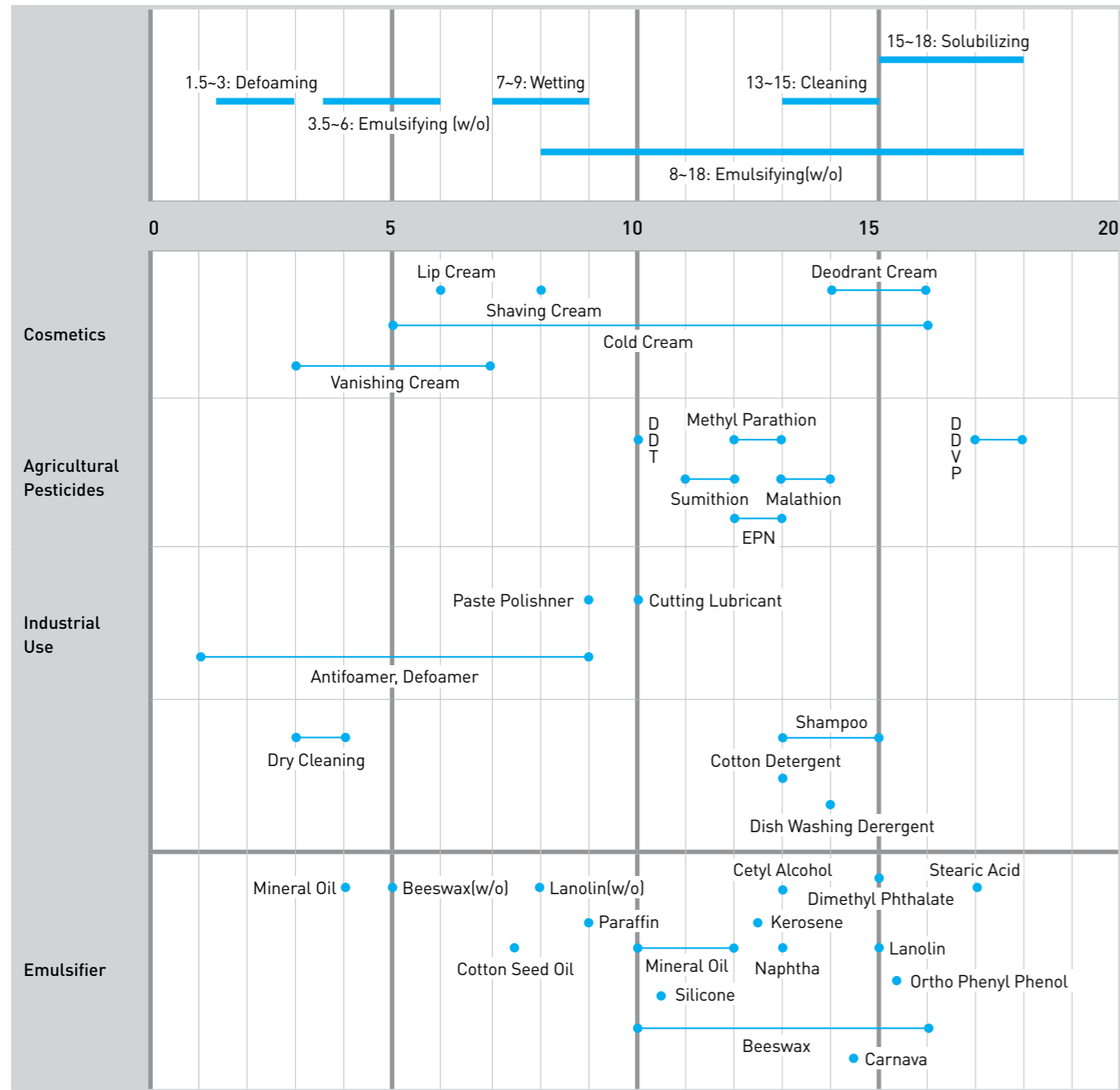
I Water Mixture Grade

| Properties | MEA-W | DEA-W | TEA-W | MEA-LF | DEA-LF | TEA-LF |
|---------------------|--------------|--------------|---------------------|--------------|--------------|---------------------|
| Appearance | Clear Liquid | Clear Liquid | Light Yellow Liquid | Clear Liquid | Clear Liquid | Light Yellow Liquid |
| Color(APHA No.) | 15 Max | 15 Max | 50 Max | 15 Max | 15 Max | 50 Max |
| Freezing Point (°C) | -8 | -7 | 1 | -13 | -2 | -8 |
| Water Content(%) | 10.0 ± 1.0 | 10.0 ± 1.0 | 10.0 ± 1.0 | 15.0 ± 1.0 | 15.0 ± 1.0 | 15.0 ± 1.0 |
| MEA(Wt%) | 88.0Min | 0.5 Max | - | 83.0Min | 0.5 Max | - |
| DEA(Wt%) | 0.5 Max | 88.0Min | 0.5 Max | 0.5 Max | 83.0Min | 0.5 Max |
| TEA(Wt%) | - | 0.5 Max | 88.0Min | - | 0.5 Max | 83.0Min |

I Mixture Grade

| Properties | TEA-85% | TEA-H |
|------------------|---------------------|------------------|
| Appearance | Light Yellow Liquid | Red Brown Liquid |
| Color(APHA No.) | 50 | 18 (Gardner NO.) |
| Water Content(%) | 0.2 Max | 0.2 Max |
| MEA(Wt%) | - | - |
| DEA(Wt%) | 15.0 Max | - |
| TEA(Wt%) | 85.0 Min | 90.0 Min |

REQUIRED HLB



TERMS

pH (hydrogen ion concentration)

The pH of pure water is 7.0. If the number is greater than 7, it is alkaline, if it is 7, it is neutral, and if it is smaller than 7, it is acidic. Measure it with a pH test paper or pH meter. The water solution of soap is alkaline with a pH of greater than 8, and neutral detergent or shampoo is made by adjusting the pH to 7.

Color (APHA Color or Gardner Color)

It is a number indicating the degree of liquid color. APHA Color is indicated by comparing it with standard colors prescribed by American Public Health Association. 0 means colorless, and as the number increases, it changes from a light color to dark brown. Gardner Color is the number compared to the standard color of the Gardner–Holt test tube. As the number increases from 1, the color darkens.

Melting point (transparent °C or increasing °C)

Transparent melting point is the temperature when the sample becomes transparent when increasing the temperature according to the prescribed method after placing the sample in a capillary tube with an internal diameter of 1mm. The material is purer when the temperature difference is small between the initial dissolution and complete dissolution. To measure the increasing melting point, raise the temperature by using the prescribed method after placing the sample in a capillary tube correctly. When the dissolution begins, the sample rises towards the center of capillary tube, and the temperature of this time, when the dissolution of a solid sample is completed, is called the increasing melting point. It is different depending on the materials, however, it generally indicates the measured temperature of the increasing melting point which is lower by 1 to 2°C than that of the transparent melting point.

Freezing Point (Freezing Point, °C)

We call the temperature of the time as a freezing point when fatty acid solidifies and freezes. When cooling down the dissolved fluid slowly, it becomes solidified, and the temperature of this time is called a freezing point. It shows the similar number to that of the melting point.

Cloud Point

Generally, the solubility of the ionic surfactant tends to increase as the temperature rises, however, that of the nonionic surfactant decreases, and it becomes cloudy as the hydrated crystals are salted out at a temperature range of $\pm 0.1^\circ\text{C}$. We call this state as a cloud point. Nonionic surfactants are well dissolved in water at the temperature below the cloud point, however, it is hard to be dissolved at a temperature above the cloud point.

HLB

Selecting an emulsifier is most important for making safe emulsions. As the emulsification process of surfactants depends on the actions of a hydrophilic group and oleophilic group in molecules, we call the balance of these two as a HLB (hydrophile lipophile balance), and it is indicated by figures.

The role of the surfactant's water solution may be decided by the HLB of its activator, and the HLB 7–9 is used as a wetting agent, that of 13–15 is used as a detergent, and that of 14–18 is used as a solubilizer. In case of emulsifying the mineral oils, it is possible to select a proper emulsifier depending on the HLB for the milkiness of the oil. Depending on the surfactant's HLB, it is possible to know if the activator is water-soluble or oil-soluble. Generally, a product with low HLB is oil-soluble, and one with high HLB is water-soluble.

How to calculate HLB

- If ethylene oxide is used in the hydrophilic group (formula : polyoxyethylene ether of fatty alcohol, polyoxyethylene ester of fatty acid, etc.)

$$E/5 = \text{HLB} (E = \text{Weight \% of Ethylene Oxide \%})$$
- If the water-soluble part is composed of ethylene oxide and poly-hydric alcohol (E+P)/5=HLB (P=multiple values, weight ratio of alcohol)
- If it is poly-hydric alcohol ester of fatty acid (example : fatty acid ester of sorbitan, mono-glyceride, etc.)

$$20(1-S/N) = \text{HLB} (S = \text{value of hydrosis, } N = \text{neutralization value of fatty acid})$$