LAKELAND LABORATORIES LIMITED

Manufacturers of Speciality Surfactants

2 Phosphate Esters

Why? Which? Where?

1 Amphoterics

2 Phosphate Esters

3 Imidazolines

4 Wax Emulsions

CHEMICALS FOR INDUSTRY

Certificate No.890395

Why Phosphate Esters?

INTRODUCTION

Phosphate esters are 100% active anionic surfactants which are produced as the free acid by either of two chemical routes. Monoesters are produced by the reaction of either alcohols, alcohol ethoxylates or phenyl ethoxylates with polyphosphoric acid, whereas mixtures of mono and diesters are produced by reaction of the same feedstock with phosphorous pentoxide.

Phosphate esters are highly versatile surfactants offering a wide range of properties and applications. The main advantages of phosphate esters over many other surfactants are their alkali stability and solubility. They are excellent hydrotropes and are effective coupling agents which give outstanding wetting, emulsification and detergency. As such they are used widely in emulsion polymerisation, textile auxiliaries, maintenance chemicals, metal finishing, and many other applications.

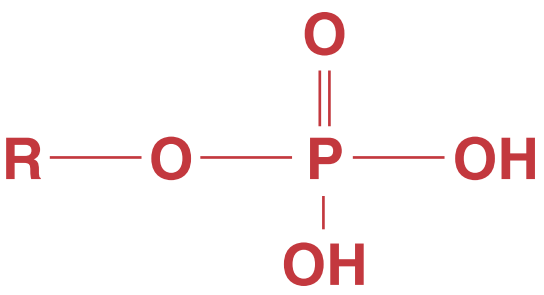
Phosphate esters have a unique range of properties which are exploited in the production of specialised chemical processing aids for industry. Being stable in high concentrations of alkali, they are especially useful in household and maintenance cleaning products, where high active heavy duty products are required.

Phosphate Esters

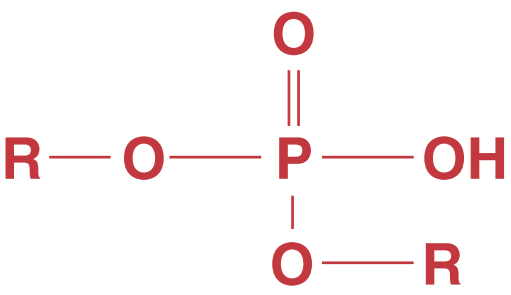
Lakeland manufacture phosphate esters based on either alcohols, ethoxylated alcohols or phenyl ethoxylates.

1. Alcohol based
   The R-group is derived from a specific alcohol.
2. Ethoxylated alcohol based
   The R-group is derived from a specific ethoxylated alcohol.
3. Ethoxylated phenol based
   The R-group is derived from a specific ethoxylated phenol.

MONO-ESTERS



DI-ESTERS



Phosphate esters are available as the free acid and in most cases as the potassium or sodium salt.

Some of the useful properties are:

- Anionic character. Anionic surfactants are the preferred choice for use in textile auxiliaries.
- 100% active. Economic for shipment, easily incorporated into powder blended products.
- In some cases their emulsifying properties make them ideal for use in oil/water systems.
- Phosphate esters can be neutralised by alkaline earth metals or amines, adding to their versatility.
- Foaming properties of phosphate esters varies, from high to low.
- The variety of wetting, foaming and surface tension reduction properties helps the formulator to develop the required product.
- Very good hydrotroping properties which enable high active products to be produced without the use of additional auxiliary hydrotropes.
- Stability in alkali and builders enabling heavy duty cleaners to be formulated.
- Lubricating properties that enable phosphate esters to be used in metal working fluids and water based lubricants.
- Excellent free rinsing properties leading to smear free surfaces.
- Corrosion inhibition and prevention as well as load carrying properties make phosphate esters ideal for use in metalworking.
- In general low orders of toxicity and relatively low orders of irritation for the potassium salts.
- Some phosphate esters exhibit solvent solubility.

PRODUCT	PROPERTIES		GENERAL INFORMATION				
	APPEARANCE	Acid Value (mgKOH/g) (Typical)	pH (1%) (Typical)	R	MOLES EO (Nominal)	MONO/DI-ESTER RATIO (Typical)	% ACTIVE (Nominal)
PHOSPHATED ALCOHOLS							
PA 100	Clear pale brown viscous liquid	950	0.5	CH_3	0	40 : 1	100
PA 800	Clear viscous pale brown liquid	360	1.3	C_8H_{17}	0	1 : 1	100
PA 800K	Clear pale amber liquid	N/A	9 - 10 neat	C_8H_{17}	0	1 : 1	43
PA 801	Clear light brown liquid	370	1.3	C_8H_{17}	0	1 : 1	100
PHOSPHATED ALCOHOL ETHOXYLATES							
PAE 802	Clear colourless to pale amber liquid	190	1.5	C_8H_{17}	2	1 : 1	100
PAE 106	Clear viscous pale brown to brown liquid	160	1.0	$C_{10}H_{21}$	6	3 : 2	100
PAE 126	Clear viscous pale brown to brown liquid	190	1.0	$C_{12}H_{25}$	6	3 : 2	100
PAE 136	Clear viscous pale brown to brown liquid	210	1.0	$C_{13}H_{27}$	6	3 : 2	100
PAE 147	Homogeneous viscous pale yellow liquid	220	1.2	$C_{14}H_{29}$	7	12 : 1	100
PAE 176	Yellow viscous liquid clear at 40°C	150	2.5	$C_{17}H_{35}$	6	5.5 : 4.5	100
PAE 185	Amber paste clear liquid at 40°C	150	2.5	$C_{18}H_{35}$	5	5.5 : 4.5	100
PAE 1780	Light brown solid	30	2.8	$C_{18}H_{35}$	80	2 : 1	100
PHOSPHATED PHENOL ETHOXYLATES							
PPE 604	Clear viscous amber liquid	320	1.0	C_6H_5	4	40 : 1	100
PPE 604K	Clear colourless to pale amber liquid	N/A	9 - 10 neat	C_6H_5	4	40 : 1	65
PPE 154	Clear viscous amber to brown liquid	240	1.0	C_6H_4-C_9H_{19}	4	40 : 1	80
PPE 156	Clear viscous amber to light brown liquid	90	1.5	C_6H_4-C_9H_{19}	6	2 : 3	100
PPE 159	Clear viscous amber to light brown liquid	100	1.5	C_6H_4-C_9H_{19}	9	3 : 2	100
PPE 1513	Clear viscous amber liquid	230	2.0	C_6H_4-C_9H_{19}	13	48 : 1	100

Which Phosphate Ester?

The case has been made “WHY” phosphate esters are used. The problem for the formulator then becomes - “WHICH PHOSPHATE ESTER”? A series of comparative tests have been carried out:

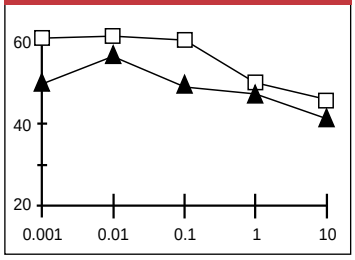
- Surface tension reduction
- Solubilisation
- Wetting properties
- Foam height/stability

The detailed results that follow are designed to help the formulator decide which phosphate ester best suits the application.

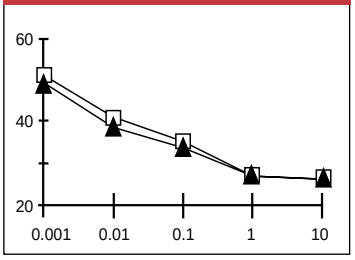
Surface Tension Reduction

PHOSPHATED ALCOHOLS

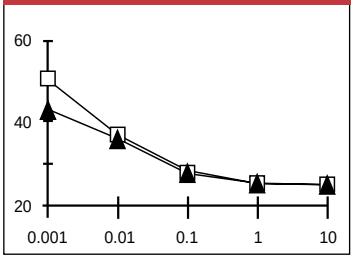
PA 100



PA 800

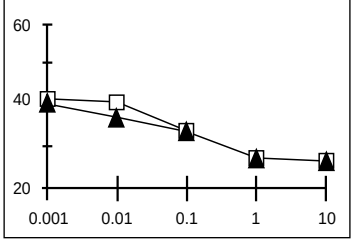


PA 801

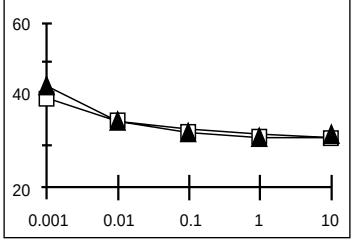


PHOSPHATED ALCOHOL ETHOXYLATES

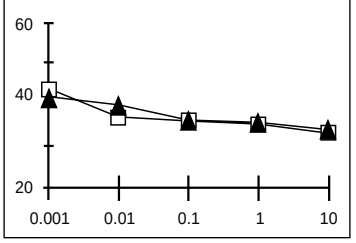
PAE 802



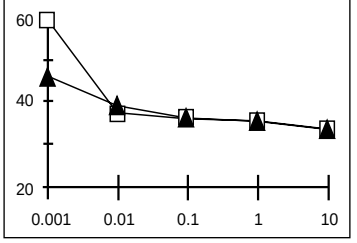
PAE 106



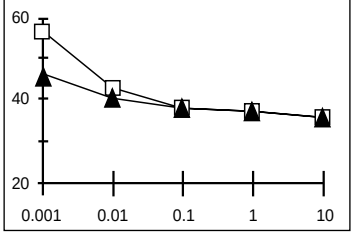
PAE 126



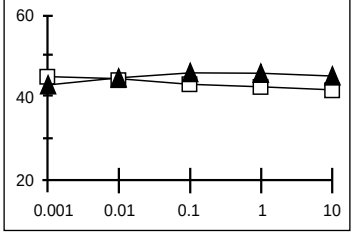
PAE 136



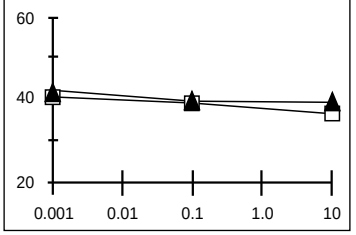
PAE 147



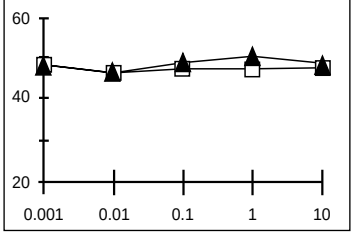
PAE 176



PAE 185

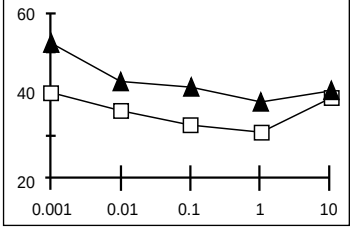


PAE 1780

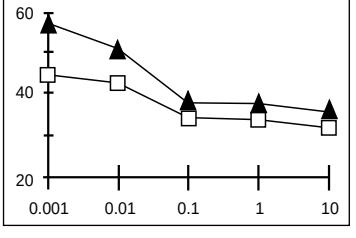


PHOSPHATED PHENOL ETHOXYLATES

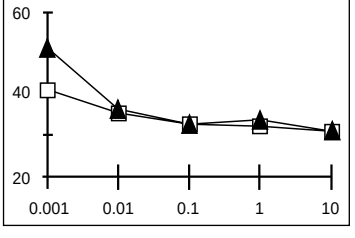
PPE 604



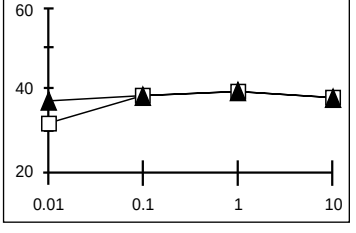
PPE 154



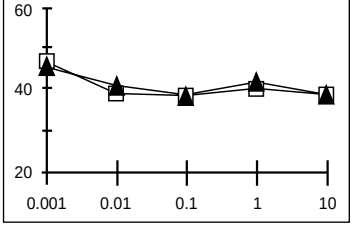
PPE 156



PPE 159



PPE 1513



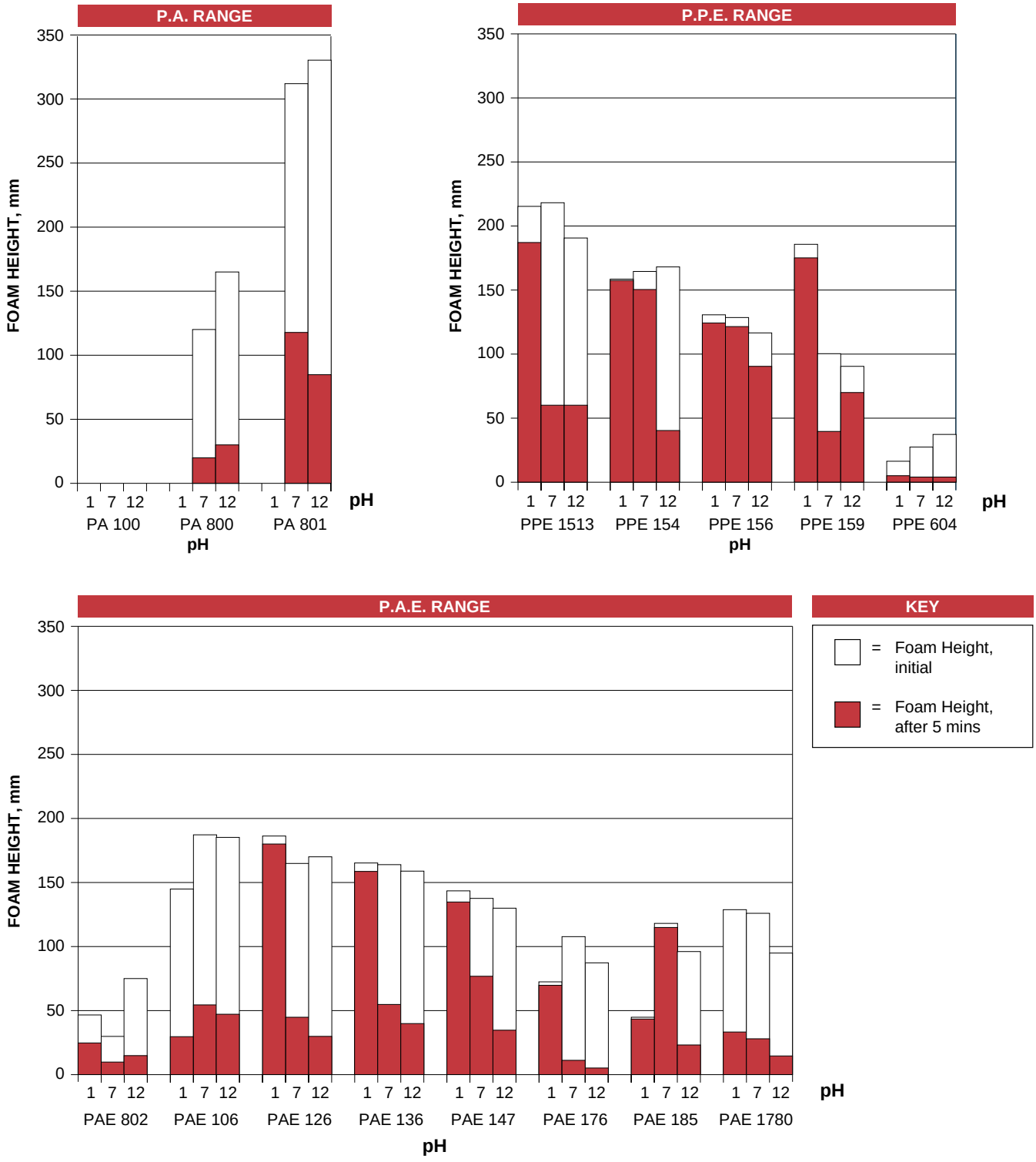
KEY

▲ p.H. 12.0
□ p.H. 7.0

x Axis = Conc. %ai
y Axis = Dynes.cm^{-2}

Foaming Properties

Ross Miles Foam Heights, ASTM D1173, 0.1% active solutions performed at pH 1, 7 and 12.



N.B. It should be noted that some phosphate esters are prone to hydrolysis in strong mineral acids over a long period of time.

Solubilisation Properties

The following table is designed to show the formulator the effectiveness of each phosphate ester as a solubiliser in three different systems. The solubilisation property is illustrated by the cloud point in °C for each system.

PHOSPHATE ESTER	FORMULATION 1	FORMULATION 2	FORMULATION 3
	5g Alcohol Ethoxylate❶ 10g TKPP❷ 2g Phos Ester❸ 83g Water	5g Alcohol Ethoxylate❶ 5g STPP❺ 5g METSO❹ 3g Phos Ester❸ 82g Water	5g Phenol Ethoxylate❻ 10g TKPP❷ 5g STPP❺ 4g Phos Ester❸ 76g Water
PHOSPHATED ALCOHOLS			
PA 100	42°C	Not Stable	20°C
PA 800	77.5°C	33.5°C	76°C
PA 801	82°C	51.5°C	87°C
PHOSPHATED ALCOHOL ETHOXYLATES			
PAE 802	54°C	44.5°C	22°C
PAE 106	>100°C	66°C	48°C
PAE 126	89°C	86°C	69°C
PAE 136	90°C	82°C	82°C
PAE 147	78.5°C	72°C	>100°C
PAE 176	81°C	90°C	>100°C
PAE 185	70°C	56°C	>100°C
PAE 1780	51.5°C	Not Stable	Not Stable
PHOSPHATED PHENOL ETHOXYLATES			
PPE 1513	63.5°C	54°C	66°C
PPE 154	88.5°C	>100°C	>100°C
PPE 156	49°C	36°C	Not Stable
PPE 159	77°C	68.5°C	90°C
PPE 604	60°C	67°C	80.5°C

❶ = Alcohol Ethoxylate (C13-15 + 9EO)
❷ = Tetrapotassium Pyrophosphate (50%)
❸ = Phosphate Ester
❹ = Sodium Metasilicate $5H_2O$
❺ = Sodium Tripolyphosphate
❻ = Nonyl Phenol + 9 E.O.

Wetting Properties

Under testing parameters of ASTM D2281, Skein test, the following phosphate esters all produced wetting times of under 4 minutes. The following table shows actual times in seconds.

PRODUCT	RESULTS (Seconds)					
	1% Active Solution			0.1% Active Solution		
	pH 1	pH 7	pH 12	pH 1	pH 7	pH 12
PA 800	Insoluble	1	1	Insoluble	10	16
PA 801	Insoluble	1	1	Insoluble	7	10
PAE 802	0	0	0	17	9	10
PAE 106	1	1	1	20	14	22
PAE 126	1	6	15	23	16	46
PAE 136	1	8	14	18	12	21
PAE 147	4	14	18	14	16	30
PAE 176	83	74	57	50	67	89
PAE 185	22	59	141	184	225	125
PPE 1513	32	27	95	40	38	90
PPE 154	1	16	17	11	17	20
PPE 156	1	1	11	10	10	11
PPE 159	15	20	24	40	30	30

Solubility

The table below is a rough guide to the solubility of Lakeland Phosphate Esters in three different types of media; aqueous, alkaline and a hydrophobic solvent.

PRODUCT	MEDIUM		
	WATER	NaOH (10-30%)	WHITE SPIRIT
PA 100	Infinitely soluble	Soluble	Insoluble
PA 800	Insoluble	Insoluble	Soluble
PA 801	Forms instable dispersions	Insoluble	Soluble
PAE 802	Dispersable	Soluble at 10 - 20%	Soluble
PAE 106	Soluble	Soluble at 10 - 20%	Soluble
PAE 126	Soluble	Soluble	Soluble
PAE 136	Soluble hazy solution obtained	Soluble	Soluble
PAE 147	Soluble	Soluble	Soluble
PAE 176	Emulsion obtained	Soluble at low concentrations	Soluble
PAE 185	Emulsion obtained	Dispersable at low concentrations	Soluble
PAE 1780	Soluble	Insoluble	Insoluble
PPE 154	Emulsion obtained	Soluble	Soluble
PPE 156	Disperses	Soluble in 10% NaOH	Soluble
PPE 159	Soluble	Soluble in 10% NaOH	Disperses
PPE 1513	Soluble	Soluble in 10% NaOH	Insoluble
PPE 604	Soluble	Soluble	Virtually insoluble

Corrosion Inhibition

Phosphate esters exhibit good corrosion inhibition properties either as the free acid or as the metal/amine salt. The triethanolamine salt of phosphate esters give optimum corrosion protection in both water and oil-based systems.

Anti-Wear Lubricant Additives

Phosphate esters have useful properties which enable them to be formulated into cutting and grinding fluids as anti-wear and anti-corrosive additives. Phosphate esters are also used in water-based hydraulic fluids as a lubricant to decrease pump wear and inhibit corrosion. They are also used in the manufacture of greases, drawing compounds, chain belt lubricants and gear oils.

Phosphate Esters
General Information

PRODUCT NAME	CHEMICAL NAME	S.G. 20°C	PACK SIZE/ WEIGHTS	VISCOSITY (cPs/20°C)	CAS/ EINECS	DATA SHEET
PA 100	Methyl phosphate	1.55 typical	250 kgs	350 typical	CAS Number: 812-00-0 EINECS Number: 212-379-1	1500
PA 800	2-ethylhexyl phosphate	1.20 typical	200 kgs	200 typical	CAS Number: 12645-31-7 EINECS Number: 235-741-0	1600
PA 800K	2-ethylhexyl phosphate salt	1.20 typical	200 kgs	200 typical	CAS Number: 68550-93-6 EINECS Number: 271-355-9	1601
PA 801	n-octyl phosphate	1.20 typical	200 kgs	200 typical	CAS Number: 3115-39-7 Polymer	1602
PAE 802	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_8 branched alkyl ether, phosphate	1.10 typical	200 kgs	300 typical	CAS Number: 68909-65-9 Polymer	1710
PAE 106	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{10} branched alkyl ether, phosphate	1.10 typical	200 kgs	3000 typical	CAS Number: 68909-65-9 Polymer	1800
PAE 126	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{12} branched alkyl ether, phosphate	1.10 typical	200 kgs	3000 typical	CAS Number: 68909-65-9 Polymer	1900
PAE 136	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{13} branched alkyl ether, phosphate	1.10 typical	200 kgs	3000 typical	CAS Number: 68909-65-9 Polymer	2000
PAE 147	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{14} branched alkyl ether, phosphate	1.10 typical	200 kgs	3000 typical	CAS Number: 68909-65-9 Polymer	2100
PAE 176	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_8 to C_{22} branched alkyl ether, phosphate	1.05 typical	200 kgs	20000 typical	CAS Number: 68909-65-9 Polymer	2105
PAE 185	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{18} branched alkyl ether, phosphate	1.05 typical	200 kgs	2000 typical	CAS Number: 68909-65-9 Polymer	2110
PAE 1780	Poly(oxy-1,2-ethanediol)-hydro-hydroxy, mono C_{17} branched alkyl ether, phosphate	1.05 typical	200 kgs	Solid	CAS Number: 39464-69-2 Polymer	2107
PPE 604	Poly(oxy-1,2-ethanediol)-phenyl-hydroxy-phosphate	1.25 typical	250 kgs	15000 typical	CAS Number: 39464-70-5 Polymer	2500
PPE 604K	Poly(oxy-1,2-ethanediol), α– phenyl-ϖ–hydroxy-phosphate potassium salt	1.25 typical	200 kgs	600 typical	CAS Number: 39464-70-5 Polymer	2550
PPE 154	Poly(oxy-1,2-ethanediol)-dinonylphenyl-hydroxy phosphate	1.10 typical	200 kgs	2000 typical	CAS Number: 68909-65-9 Polymer	2295
PPE 156	Poly(oxy-1,2-ethanediol)-dinonylphenyl-hydroxy phosphate	1.10 typical	200 kgs	2000 typical	CAS Number: 39464-64-7 Polymer	2300
PPE 159	Poly(oxy-1,2-ethanediol)-dinonylphenyl-hydroxy phosphate	1.10 typical	200 kgs	2000 typical	CAS Number: 39464-64-7 Polymer	2400
PPE 1513	Poly(oxy-1,2-ethanediol)-dinonylphenyl-hydroxy phosphate	1.10 typical	200 kgs	40000 typical	CAS Number: 39464-64-7 Polymer	2600

Where to Use Phosphate Esters?

We now have the answers to WHY and WHICH Phosphate Ester. The following examples of WHERE Phosphate Esters are often applied should give the formulator a complete picture of the flexibility of these types of surfactants.

Hard Surface Cleaners

Due to their alkali tolerance, phosphate esters have specific uses in heavy duty alkaline cleaners. As well as having excellent detergent properties, phosphate esters also possess hydrotroping properties which assist in the formulation of high active alkaline cleaners, oven cleaners and floor cleaners/strippers.

Laundry Detergents

Phosphate esters can be used in spray dried, powder blended and liquid laundry detergents as low foaming detergent/hydrotropes. High active detergents with outstanding cleaning properties can be prepared by combining Lakeland PPE604 with Lakeland AMA LF40 or AMA LF70 salt free amphoteric surfactants. In liquid products, extra alkali is required to neutralise phosphate esters.

Textiles and Leather

Phosphate esters are the preferred surfactant type for textile and leather processing because of their anionic, wetting, low foaming, alkali tolerance and building/hydrotropic properties. Lakeland PA800 and PAE802 are widely used as wetting agents with low foaming properties. The amine salts of phosphate esters are used as emulsifiers in solvent scouring systems. Lakeland PPE159 is used as a levelling agent in the direct dying of cotton. PPE604 is used in jet dying machines to pre-scour and remove lubricant from knitted polyester. PAE176 is used as a component in leather processing chemicals.

Traffic Film Removal

Small quantities of Lakeland PPE159 combined with Lakeland amphoterics improve free rinsing properties of traffic film remover. This is particularly important in hard water areas.

Dish and Glass Rinsing

Phosphate esters such as PPE 604K are widely used in combination with EO/PO copolymers in the manufacture of rinse aids for automated dish and glass washing systems. The pH of the rinse aid is made sufficiently acidic with citric or phosphoric acid to neutralise any residual alkali from the cleaning cycle. As many biodegradable EO/PO copolymers have low cloud points and poor solubility, a low foaming hydrotroping phosphate ester such as PPE604K can be used to raise the cloud point to 50°C. This ensures that the rinse aid does not phase separate if the temperature rises above the cloud point of the EO/PO copolymer.

Agrochemical Additives

Many agricultural adjuncts such as herbicides are required in water solution for application to foliage. Phosphate esters are ideal for emulsification/solubilisation of additives into water together with good wetting to ensure optimum spreading onto a leaf's surface.

Paper De-inking

Phosphate esters are widely used in the de-inking of paper. As the paper being treated varies, the broad range of foaming properties of Lakeland phosphate esters, together with their excellent wetting and emulsification properties, make them ideally suited for this application.

Oilfield Chemicals

Phosphate esters possess outstanding load carrying and corrosion inhibition properties which makes them ideal for oil drilling and transport applications. Phosphate esters are often used as amine/amido-amine salts to enhance their corrosion inhibition properties. PAE136 in its amine neutralised form is widely used in oilfield applications.

Cutting and Grinding Fluids

The amine salts of phosphate esters have been found to have excellent anti-wear properties due to their lubricity and anti-corrosive properties. These twin properties mean low foaming phosphate esters can be used in water-based cutting and grinding fluids. Lakeland PAE185 is recommended for these purposes.

Acid Cleaning

Compared to neutral detergents acid based cleansers have greatly enhanced dirt removing properties. Phosphoric acid is the preferred acid for metal cleaning as it is less reactive than other mineral acids. Additional protection is obtained by combining it with Lakeland PA 100; mixtures of PA100 and phosphoric acid shows vastly reduced corrosion effects on aluminium and steel. Stainless steel cleaning formulations give much brighter finishes.

The use of Lakeland PA 100 allows the formulator to produce safer acid cleaners both in terms of toxicity and metal attack, without losing detergency. Lakeland PA 100 is less than one tenth as aggressive and one third as toxic as phosphoric acid. It is compatible with surfactants, particularly salt free amphoterics such as Lakeland AMA and AMA LF 40. Cleaning formulations can be produced which are safe on metals and painted surfaces.

Phosphate ester based acid cleansers are particularly useful for aluminium, stainless steel, and are ideal for cleaning trains and trams where the removal of iron oxide, combined with oil, grease and diesel smut is beyond the capability of neutral cleaners. Light duty cleaners, which can be perfumed, are used to clean kitchens, bathrooms and toilets containing metal fittings and ceramics, where lime scale produces unsightly scale. It has also been found that the addition of Lakeland PA 100 to traditional acetic acid based cleaners retards the peeling of chrome plated copper and brass bathroom fittings.

Emulsion Polymerisation

Phosphate alcohol and phenol ethoxylates like Lakeland PAE 136 and PPE 159 are used in emulsion polymerisation. However, a wide range of ethoxylates can be phosphated giving the formulator greater flexibility to produce polymers with the desired characteristics. Further, by varying the mono to di-ester ratio the HLB value can be tuned to give optimum performance.

Miscellaneous

Due to the outstanding properties of phosphate esters, they are used in numerous specialised applications. These include fountain solutions used in lithographic printing, fuel oil/explosive emulsions used in quarrying and open cast mining. Other specialised applications are in dry cleaning "soaps", spin finishes (as an antistatic agent) and processing aids for improving the flow properties of powders.

Formulary

FORMULATION IDEAS

Detailed below are formulation ideas for a variety of products. These are suggestions for the formulator to consider before starting his work. The formulator will have his own skills and experience to add to the finished product.

VEHICLE CLEANING PRODUCTS

1. TRAFFIC FILM REMOVER

10% Lakeland AMA
2% Alcohol Ethoxylate (C_9-C_{11}, 6 Moles EO)
2% Lakeland PAE 136
17% NTA Solution (38%)
5% Sodium Metasilicate
1% NaOH
Balance water.

2. CAUSTIC FREE TRAFFIC FILM REMOVER

3% Lakeland PPE159
1.8% Triethanolamine
20% NTA Solution (38%)
5% Alcohol Ethoxylate (C_9-C_{11}, 6 Moles EO)
10% Lakeland AMA
Balance water.

3. CAR RINSE HYDROPHOBE CONCENTRATE

5% Lakeland PA100
15% Lakeland Imidazoline 18DA
5% Lakeland AMA LF40
Balance water.

GENERAL CLEANING PRODUCTS

4. HARD SURFACE CLEANER

8% Lakeland AMA
8% Alkylbenzene Sulphonate (25%)
15% Tetrapotassium Pyrophosphate (50%)
2% Lakeland PAE136
3% Sodium Metasilicate
5% Butyl Oxitol
Balance water.

5. HEAVY DUTY ALKALINE CLEANER

10% Sodium Metasilicate
5% Sodium Hydroxide
5% NTA Solution (38%)
12% Lakeland AMA
3% Lakeland PAE136
Balance water.

6. LOW FOAM CARPET CLEANER

4% Sodium Metasilicate
6% Sodium Tripolyphosphate
2% NTA Solution (38%)
3% Lakeland PAE802
6% Lakeland AMA LF40
4% Estasol™
Balance water.

7. LOW FOAM CARPET CLEANER HEAVY DUTY

10% Sodium Metasilicate
10.5% NTA Solution (38%)
12% Butyl Oxitol
4% Isopropanol
10% Lakeland AMA LF40
3% Lakeland PAE802
Balance water.

8. ALUMINIUM / STAINLESS STEEL CLEANER

10% Lakeland PA100
5% Lakeland AMA LF40
2% Alcohol Ethoxylate (C_{13}-$_{15}$, 9 Moles EO)
5% Butyl Oxitol
Balance water.

9. ALUMINIUM CLEANER (ANODISED)

10% Lakeland PA100
1% Alcohol Ethoxylate (C_{13}-$_{15}$, 9 Moles EO)
Balance water.

10. AUTOMATIC DISHWASHING LIQUID

5% Dequest 3000 S (blend of Polyphosphonic Acids - 40% active)
5% Sodium Hydroxide
16% Sodium Silicate (50%)
2% Lakeland PPE604K or PAE802
3% Lakeland AMA LF40
Balance water.

11. RINSE AID FOR AUTOMATIC DISHWASHER

11% Synperonic LFRA290
3% Synperonic LFRA260
5% Citric Acid
5% Isopropanol
2.5% Lakland PPE604K
73.5% Water.

12. LOW FOAM FLOOR CLEANER / WAX STRIPPER

10% Tetrapostasium Pyrophosphate (50%)
5% Sodium Tripolyphosphate
3% Sodium Metasilicate
6% Lakeland PPE604K
1% Low Foam Alkoxylate
Balance water.

13. ACIDIC BIOCIDAL BATHROOM CLEANER

4% Lonzabac 12.30 (Teritary Alkylamine)
2% Bardac 22 (50%) (Didecyldimethylammonium Chloride)
10% Phosphoric Acid (85%)
3% Acetic Acid
5% Lakeland PA100
Balance water.

14. LAKELAND HDL (LIQUID LAUNDRY DETERGENT)

4.85% Tall Oil Fatty Acid
1.07% Potassium Hydroxide (90%)
15.6% Lakeland AMA
5.5% Lakeland ODA
1% Lakeland PPE 604
5.8% NTA Solution (38%)
4% Tetrapotassium Pyrophosphate (50%)
9.3% Alcohol Ethoxylate (C_{13}-$_{15}$9 Mole EO)
0.2% Tinopal DMS/X (optical brighter)
Balance water.

15. BOTTLE WASH DETERGENT

20% Sodium Hydroxide
4% Sodium Glucoheptonate)
1% Low Form Alkoxylate
5% Lakeland AMA LF40
2% Lakeland PAE802
Balance water.

16. VISCOUS ACID CLEANING (PHOSPHORIC ACID)

5% PA 100
25% Phosphoric Acid (81%)
5% TAB II
65% Water
Add salt to desired viscosity.

17. VISCOUS ACID CLEANER (HYDROCHLORIC ACID)

3% PA 100
11% Hydrochloric Acid (conc)
5% TAB II
65% Water.

The formulations detailed above are suggested as starting points for formulators to add their own ideas and experience in producing their finished product. They are offered in good faith without warranty.

SYNTHESIS CAPABILITIES

The following represent the synthesis capabilities of Lakeland plant resources;

- Amidation
- Cyclisation
- Esterification
- Quaternisation
- Oxidation
- Condensation
- Dehydration
- Organophosphates
- Saponification
- Others Considered

TOLL MANUFACTURE AND CUSTOM SYNTHESIS

Toll manufacture has always been an important part of Lakeland's business. The strategic location and our proven track record has led to long-lasting working relationships. With on-site engineering facilities our existing plant can be easily modified to customer requirements. All custom and Toll manufacture is carried out under a mutually agreeable secrecy contract.

TECHNICAL SERVICE

Research and development of in-house products extends our expertise into new markets. Toll and custom synthesis is supported by lab-scale work and customer liaison. To supplement the above, and to develop and improve new products, the laboratory facilities include;

- FT Infrared Spectroscopy
- Ultraviolet/Visible Spectroscopy
- Automated Wet Analysis Methods:- Karl Fischer, Chloride Determination, Titroprocessor
- Classical Wet Analysis
- Autoclave Facilities
- Process Development
- Formulation
- HPLC

Small-scale custom laboratory synthesis will be considered. Applications and formulation help is given where possible.

QUALITY

At Lakeland we are fully aware of the necessity for complete customer service in terms of both technical support and quality/flexibility of supply. We are a BS EN ISO 9002 registered company which, in itself, shows our commitment to quality manufacture and customer satisfaction.

AMPHOTERICS

Types	Properties	Industrial Applications
Dipropionates	Solubilisation Hydrotrope Highly Alkali Stable Acid Stable	Detergents Maintenance Chemicals Metal Finishing Lubricants-Bottling/Conveyer
Monopropionate	Salt Free Corrosion Protection Low Foam/High Foam Biostatic Wetting	Vehicle Cleaning Toiletries Textiles Oil Fields Micro Emulsions
Amino Betaines	Emulsification Hydrophobe (In Acid) Free Rinsing Non Toxic	Agriculture Institutional Water Treatment
Amido Betaines	Hard Water Stable Skin Friendly Lubrication	

PHOSPHATE ESTERS

Types	Properties	Industrial Applications
Phosphated Alcohols	Wetting Solubilisation Hydrotropes Highly Alkali Stable Corrosion Inhibition	Metal Work/Finishing Detergents Maintenance Chemicals Textiles Agriculture
Phosphated Alcohol Ethoxylates	Low Foam/High Foam Emulsification Load Carrying Free Rinsing Hard Water Stable	Oil Fields Institutional Water Treatment Vehicle Cleaning
Phosphated Phenol Ethoxylates		Lubricants Emulsion Polymerisation

IMIDAZOLINES

Types	Properties	Industrial Applications
Aminoethyl	Corrosion Inhibition Dispersants Dewatering Emulsification	Oil Fields Metal Working Textiles Paper
Hydroxy Ethyl	Rheology Modifiers Oil Soluble Water Soluble (Salts) Adhesion Promoters	Lubricants Road Making Paints Inks
Amido Ethyl	Acid Stable Flocculation Textiles Softeners	Agriculture Maintenance Chemicals Lapping Compounds
Amide Blends	Bitumen Emulsification	Pigment Dispersion

WAX EMULSIONS

Types	Properties	Industrial Applications
Polyethylene	Completely Aqueous Nonionic	Floor Polish Printing Ink (Flexographic)
Oxidised Polyethylene	Cationic Small Particle Size Highly Stable	Temporary Protective Coatings Metal Working Wood Finishes
Polyethylene/ Acrylic Copolymers	Hard Waxes Soft Waxes 18-35% Solids	Facade Protection Textile Finishing Packaging Films
Montan Ester		Paints (Water Based) Fruit Coating Anti-Blocking Mould Release

AGENCIES AND DISTRIBUTION

AUSTRALIA
Fernz Speciality Chemicals — Tel: +61 (0) 2 9755 9600
NSW — Fax: +61 (0) 2 9755 9611

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Jauk GmbH & Co KG — Tel: +43 (0) 1 535 12 69
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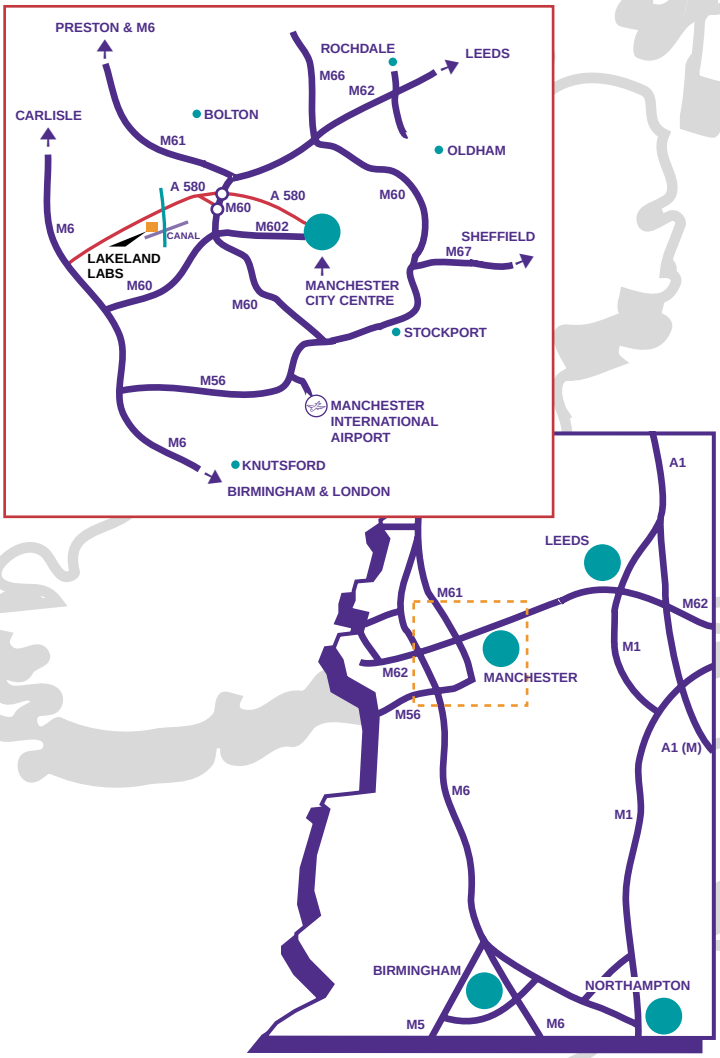

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