



DOWFAX ANIONIC SURFACTANTS FOR HIGH-PERFORMANCE PRODUCTS

The Right Choice in Formulations with Acids, Bleach, and Caustic

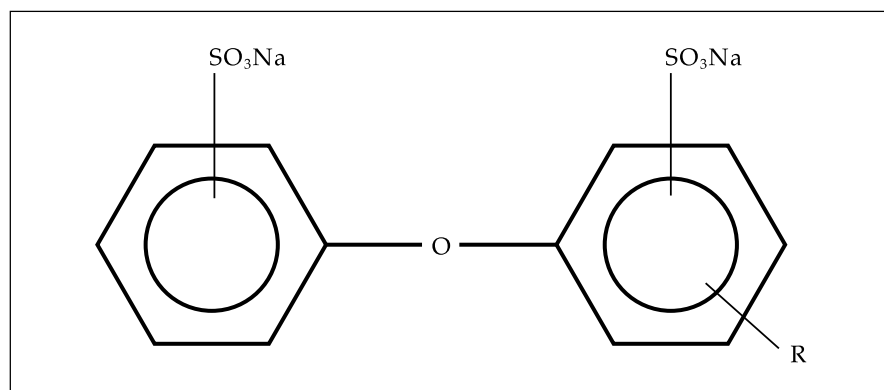


DOWFAX ANIONIC SURFACTANTS: DISCOVER THE POWER OF A UNIQUE DISULFONATED STRUCTURE FOR THE TOUGHEST APPLICATIONS

DOWFAX surfactants are the right choice for formulations containing acids, bleach, or caustic. They provide excellent solubility and stability in concentrated electrolytes, and they're remarkably resistant to oxidative and thermal degradation.

Disulfonated structure is the key

While most other surfactants have only one ionic charge per molecule, DOWFAX surfactants have two. The structural formula below shows that each molecule of DOWFAX surfactant consists of a pair of sulfonate groups on a diphenyl oxide backbone; the hydrophobe may be a linear or branched alkyl group comprised of from six to sixteen carbons. Two sulfonates mean double charge density—in short, a more powerful, more durable, more versatile surfactant molecule.



DOWFAX surfactants can take you far beyond the performance limits of conventional anionic surfactants in tough product applications. When you're formulating with the extra power of acids, bleach, caustic, or other alkalies you can rely on DOWFAX surfactants for stable performance. DOWFAX surfactants provide wetting action, detergency, and coupling ability in harsh environments where conventional surfactants often won't work at all.*

Why do DOWFAX surfactants work better than other anionics?

Three potential mechanisms have been identified for the superior performance of DOWFAX surfactants.

First, DOWFAX surfactants have two ionic charges located in close proximity on the molecule. This higher local charge density results in greater potential for solvating and coupling action.

Second, recall that the Schultz-Hardy rule predicts higher electrolytic efficiency with increasing valence. And disulfonated DOWFAX surfactants can display electrolytic strengths three times as strong as monosulfonated products.

Third, the flexible ether linkage allows variable distance between the sulfonates, allowing interactions with a broad variety of other materials in solution. This flexibility may help explain the unusually broad solubility and coupling capabilities of DOWFAX surfactants.

Highly soluble and stable in acids, alkalies, and salts

If you want to formulate concentrated aqueous products, consider DOWFAX surfactants first. With their disulfonated structure, DOWFAX surfactants are highly soluble in strong acid and alkali solutions. These surfactants are not deactivated by mono- or divalent ions, so they're an excellent choice for hard water applications. With DOWFAX surfactants, you can formulate over a wide pH range, and choose from a long list of formulation electrolytes.

Unmatched solubilizer and coupler

DOWFAX surfactants act as highly active solubilizers as well as detergents in formulations. Use DOWFAX surfactants to solubilize weakly charged anionics such as DDBSA¹, AOS², and SLS³. DOWFAX surfactants readily couple into solution troublesome additives such as phenolics, perfumes, hydrocarbons, and foam control agents. Need to increase the cloud point of a nonionic? Reach for a DOWFAX surfactant.

The top performer in bleach formulations

If you want to get maximum cleaning power in a *stable* bleach formulation, you won't find anything better than a

DOWFAX surfactant. DOWFAX surfactants themselves are very stable in bleach environments. And DOWFAX surfactants are soluble and stable in a wide variety of other oxidizing agents. But what's more important is that bleach products containing DOWFAX surfactants exhibit exceptional shelf life compared to those containing most other surfactants.

Excellent thermal stability

For cleaning products intended for high temperature uses, you can rely on the thermal stability of DOWFAX surfactants. This also allows DOWFAX surfactants to be dried to a free-flowing powder for dry formulations.

Seven surfactants for a wide range of applications

Dow currently manufactures a range of anionic surfactants in both the sodium salt and acid form. Here are some highlights:

DOWFAX C6L surfactant Linear 6-carbon hydrophobe. Best caustic solubility of product family. Can be used as a hydrotrope for a number of applications.

DOWFAX 3B2 surfactant Linear 10-carbon hydrophobe. Good dispersant, wetting agent, solubilizer. Excellent general surface cleaning properties.

DOWFAX C10L surfactant Linear 10-carbon hydrophobe. Higher charge density than DOWFAX 3B2 surfactant. Provides enhanced solubility in concentrated solutions.

DOWFAX 2A1 surfactant Branched 12-carbon hydrophobe. Best detergency in product family on cotton/synthetic blends.

DOWFAX 8390 surfactant Highest molecular weight of product family, with linear 16-carbon hydrophobe. Best detergent of product family. Also provides excellent solubilization of greases and oils.

DOWFAX 3B0 surfactant Acid form of DOWFAX 3B2 surfactant. A potential surfactant choice for acid formulations.

DOWFAX 2AO surfactant Acid form of DOWFAX 2A1 surfactant. Selected additional salts of DOWFAX 2AO surfactant are listed in the TSCA inventory.

That's an initial look at why more and more formulators are turning to the high-performance properties of DOWFAX surfactants. On the following pages, you'll learn more about the many reasons to consider a DOWFAX surfactant for your next formulation.

Following is detailed information on the outstanding solubility and solubilizing properties of DOWFAX products, a closer look at DOWFAX surfactants in bleach products, and much more.

You'll see why when you're formulating with the ABC's—acids, bleach, or caustic—it pays to remember the "D": **DOWFAX surfactants.**

¹ Dodecyl benzene sulfonic acid, Na salt

² Alpha olefin sulfonate, Na salt

³ Sodium lauryl sulfate

USE THE OUTSTANDING ELECTROLYTE SOLUBILITY OF DOWFAX SURFACTANTS TO FORMULATE *CONCENTRATED, STABLE PRODUCTS*

DOWFAX surfactants open up a broad spectrum of formulation possibilities because their unique disulfonated structure makes them highly soluble in concentrated aqueous solutions of acids, alkalis, and salts. If you've chosen a particular electrolyte to accomplish a specific cleaning task, chances are very good you can enhance its performance with the surface activity of a DOWFAX surfactant.

Table 1 provides starting point solubility information about DOWFAX products and other common standard surfactants in various 20% electrolyte solutions. Data are provided for DOWFAX surfactant products in the sodium salt form. DOWFAX surfactants are also available in the acid form.

A "clear" rating indicates that a surfactant is completely soluble in a given electrolyte. "Cloudy" ratings indicate that the solubility limit of the surfactant was exceeded by the electrolyte. In all cases, the DOWFAX surfactant products are completely soluble. But more conventional surfactants such as AOS, SLS, and others exhibit solubility problems with many of the electrolytes shown.

From Table 1, it's obvious that DOWFAX surfactants should be your first choice in strong electrolytes. But DOWFAX surfactants can also boost the solubility of many conventional surfactants in those electrolytes.

Get excellent hard water performance

DOWFAX surfactants retain exceptionally good performance even when used with hard water. DOWFAX products will not precipitate or deactivate in the presence of hard water ions.

Reduce packaging and shipping costs with concentrated formulations

Many surfactants provide wetting and detergent action in electrolytes like those listed in Table 1—but not all perform in *concentrated* aqueous electrolyte solutions. Because DOWFAX surfactants are disulfonated, they work in concentrated electrolytes.

That means you can formulate *concentrated products*, which result in lower packaging and shipping costs.

DOWFAX surfactants can also be dried into a free-flowing powder which easily rewets for use.



DOWFAX surfactants are soluble and stable in strong acids, including hydrochloric, nitric, phosphoric, and sulfuric. If your goal is to get effective surfactant action into concentrated acidic, basic, or other strong electrolytes, DOWFAX surfactants are a great choice.

Table 1—Solubilities of DOWFAX surfactants, and other common surfactants in 20% electrolyte solutions¹

| 20% Electrolyte | DOWFAX C6L | DOWFAX 3B2 | DOWFAX C10L | DOWFAX 2A1 | DOWFAX 8390 | nonyl-phenyl ethoxylate | C ₉ -C ₁₁ linear primary alcohol ethoxylate | DDBSA | SLS | octyl-phenol ethoxylate 9.5 mol | C ₁₄ -C ₁₆ AOS |
|----------------------------------|------------|------------|-------------|------------|-------------|-------------------------|---|--------|--------|---------------------------------|--------------------------------------|
| Nitric acid | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Clear | Clear | Clear |
| Phosphoric acid | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Clear | Clear | Clear |
| Hydrochloric acid | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Cloudy | Cloudy | Clear | Cloudy |
| Sulfuric acid | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Clear | Clear | Clear |
| NaCl | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Cloudy | Clear | Cloudy |
| NaOH | ≥31% | ≥27% | ≥29% | ≥20% | ≥25% | Cloudy | Cloudy | Cloudy | Cloudy | Cloudy | Cloudy |
| Na metasilicate | Clear | Clear | Clear | Clear | Clear | Cloudy | Cloudy | Cloudy | Clear | — | Clear |
| Na sulfate | Clear | Clear | Clear | Clear | Clear | Cloudy | Cloudy | Cloudy | Clear | Cloudy | Clear |
| ZnCl | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Cloudy | Clear | Clear |
| CaCl ₂ | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Cloudy | Clear | Cloudy |
| Ca bromide | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Cloudy | Cloudy | Clear | Cloudy |
| 3% H ₂ O ₂ | Clear | Clear | Clear | Clear | Clear | Cloudy | Clear | Clear | Clear | Clear | Clear |

¹Solubilities were determined by diluting a 5% active surfactant solution to 10 times its volume with a 20% electrolyte solution and judging the resulting solution.

PUT MORE CLEANING PERFORMANCE INTO YOUR FORMULATION WITH THE SOLUBILIZING AND COUPLING POWER OF DOWFAX SURFACTANTS

DOWFAX surfactants can help you put the additional cleaning power of many difficult-to-dissolve substances into your formulation.

While they perform as good detergents, DOWFAX surfactants are also highly effective solubilizers. They're similar to common hydrotropes such as sodium xylene sulfonate in their ability to solubilize normally insoluble or slightly insoluble organic materials into aqueous media.

Couple in DDBSA, SLS and other surfactants

If you're working with conventional surfactants but can't get the needed level of dissolution, try a DOWFAX surfactant as a coupling agent. DOWFAX surfactants can bring them into aqueous media where they simply won't dissolve by themselves. And there are many additional materials you can couple with DOWFAX surfactants used at active levels of about 0.25% of total formulation weight.

Excellent coupler for fragrances

If you want to get a fragrance into solution, try the proven coupling performance of DOWFAX surfactants. They are a particularly good choice when you need to incorporate a coupling agent to get fragrances into solutions. DOWFAX products can also be used for coupling phenolics.

Excellent couplers for nonionic surfactants

DOWFAX surfactants can help you couple nonionic surfactants into a wide range of formulations, including those with alkaline or acid environments.

Figures 1 and 2 demonstrate the coupling abilities of DOWFAX surfactants with two nonionic surfactants: octylphenol ethoxylate 9.5 mol, and C₉-C₁₁ linear primary alcohol ethoxylate.

As shown, the addition of very small amounts of DOWFAX surfactants to the solutions of the nonionics drives cloud points higher—a very practical demonstration of the efficient coupling ability of the DOWFAX products.

Figure 3 provides another view of coupling performance, this time by showing the solution viscosities obtained with various DOWFAX surfactants and sodium xylene sulfonate (SXS) in 35% linear alkylbenzene sulfonate (LAS). As the nonionic LAS is coupled into solution, viscosity decreases. Note the excellent performance of DOWFAX C6L surfactant. At the 5% level, it provides coupling performance superior to sodium xylene sulfonate, a popular hydro-trope. At the same time, DOWFAX C6L surfactant can provide the wetting action of a surfactant.



DOWFAX surfactants offer excellent solubility and stability in sodium hydroxide and other alkalis. DOWFAX surfactants can also couple otherwise insoluble formulation ingredients into caustic systems.

Figure 1 — Effect of four DOWFAX surfactants on cloud point of 1% solution of octylphenol ethoxylate, 9.5 mol

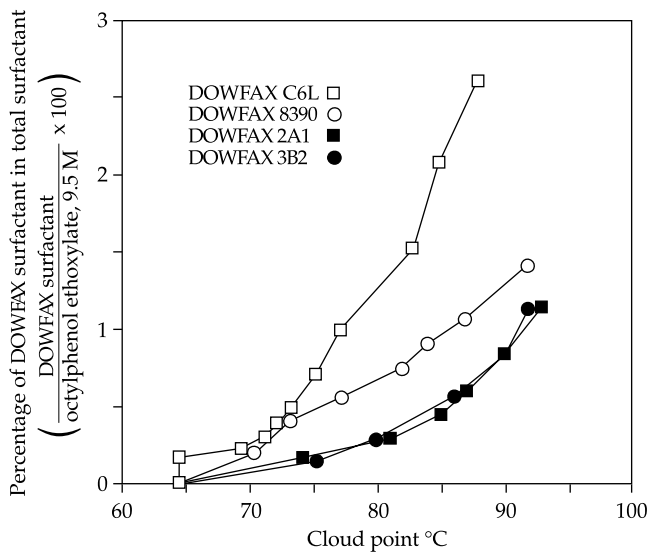


Figure 2 — Effect of four DOWFAX surfactants on cloud point of 1% solution of C₉-C₁₁ linear primary alcohol ethoxylate

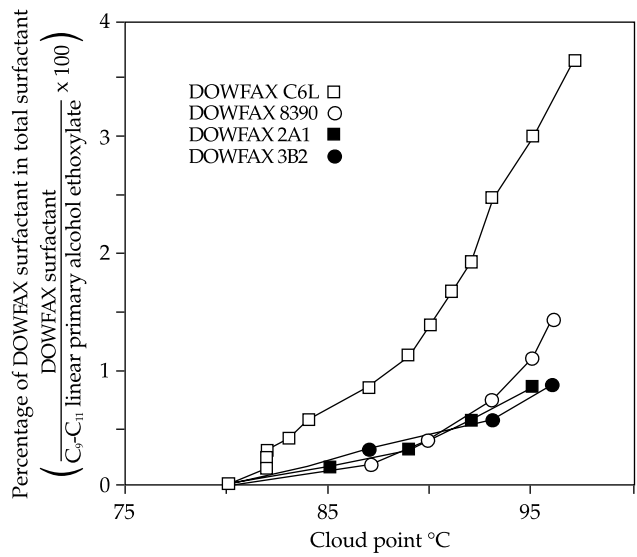
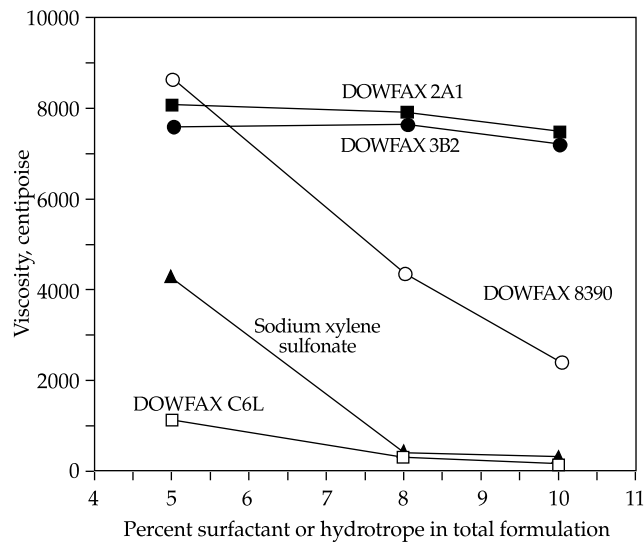


Figure 3 — Effect of DOWFAX surfactants and sodium xylene sulfonate on coupling 35% linear alkylbenzene sulfonate into solution



NOTE: Data in Figures 1 and 2 reflect performance of DOWFAX surfactants on "as received" basis, rather than percent active concentration.

BLEACH FORMULATIONS GET PENETRATING POWER AND LONG SHELF LIFE WITH DOWFAX SURFACTANTS

DOWFAX surfactants give you a formulating edge because they don't accelerate degradation of bleach systems. Even in the presence of hard water ions, they force bleach into intimate contact with soils on hard surfaces.

DOWFAX surfactants can help you formulate hypochlorite-based bleach products that work harder and last longer.

That's often a tall order for surfactants. Some aren't stable in oxidizing environments. Some simply aren't soluble in hypochlorite systems. And many others that give good initial performance cause too-rapid hypochlorite degradation and reduce product shelf life.

Not so with DOWFAX surfactants—their powerful, durable disulfonated structure is a natural for demanding bleach product applications.

Excellent detergency for hard surface cleaning

DOWFAX surfactants can make bleach products work better because they add detergency to the oxidizing action of the hypochlorite. DOWFAX surfactants force many types of hard surfaces to take on a strongly hydrophilic character, forcing bleaching action into intimate contact with soils. They provide that action even in the presence of hard water ions, and they promote free rinsing of residue.

High solubility and stability in hypochlorite

DOWFAX surfactants are completely soluble in concentrated solutions of sodium hypochlorite—even in 15% by weight formulas. If you choose to incorporate caustic, metasilicate, or other alkaline builders, you'll find that DOWFAX products are readily soluble in these additives as well.

Excellent tolerance for oxidizing agents

When you want oxidizing action in a formulation, you can enhance its performance with the wetting action and detergency of a DOWFAX surfactant. DOWFAX surfactants are stable in solutions with less than -1 volt (E) electromotive potential. In fact, DOWFAX surfactants are soluble and stable in strong oxidizing solutions like these:

30% H_2O_2
34% H_2SO_4
10% CrO_3
20% HNO_3

Bleach formulations get unmatched shelf life

More important, sodium hypochlorite itself retains excellent stability in the presence of DOWFAX surfactants. Table 2 shows the stability of a typical bleach formulation incorporating various surfactants.

Note that DOWFAX 2A1 surfactant provides the greatest formulation stability of all the soluble products tested—and DOWFAX C6L, DOWFAX 8390, and DOWFAX 3B2 surfactant offer nearly equal performance. In fact, several of the better-performing competitive surfactants were not even fully soluble in the test formulation.



Table 2 — Stability of typical bleach formulation containing popular commercial surfactants

4.5% bleach
 0.3% sodium hydroxide
 1.0% active surfactant
 Aged at room temperature

| Surfactant | Type | Percent original bleach remaining at: | | | | | | | | |
|--------------------------------|--|---------------------------------------|---------|---------|----------|----------|----------|----------|----------|-------------------------|
| | | Start | 28 days | 43 days | 108 days | 137 days | 179 days | 208 days | 319 days | observation at 319 days |
| None | | 100.0 | 97.8 | 95.2 | 96.7 | 92.6 | 90.0 | 89.5 | 84.1 | |
| DOWFAX C6L | diphenyl oxide disulfonate | 100.0 | 97.5 | 93.2 | 91.3 | 88.0 | 84.7 | 81.2 | 76.4 | |
| DOWFAX 3B2 | diphenyl oxide disulfonate | 100.0 | 97.8 | 91.3 | 87.1 | 87.1 | 84.5 | 80.8 | 74.3 | |
| DOWFAX 2A1 | diphenyl oxide disulfonate | 100.0 | 98.4 | 91.5 | 92.6 | 90.8 | 87.1 | 83.0 | 80.6 | |
| DOWFAX 8390 | diphenyl oxide disulfonate | 100.0 | 96.9 | 91.2 | 90.5 | 87.0 | 83.7 | 79.5 | 75.8 | |
| SLS | sodium lauryl sulfate | 100.0 | 98.0 | 93.8 | 93.1 | 92.3 | 87.0 | 85.0 | | severe floc |
| Sulfotex ¹ 6040 | sodium lauryl ether sulfate | 100.0 | 76.2 | 64.2 | 55.5 | 54.4 | 51.1 | 49.1 | | moderate floc |
| C550 | dodecyl benzene sulfonic acid | 100.0 | 93.0 | 84.7 | 81.0 | 76.4 | 71.8 | 65.5 | 60.5 | slight floc |
| Calsoft ² AOS 40 | alpha olefin sulfonate | 100.0 | 86.4 | 73.2 | 64.1 | 57.6 | 51.7 | 46.8 | | moderate floc |
| Rhodapon ³ BOS | sodium 2-ethylhexyl sulfate | 100.0 | 96.1 | 90.6 | 88.2 | 86.2 | 83.6 | 78.8 | 75.7 | |
| Triton ⁴ X-100 | octylphenol ethoxylate, 9.5 mol | 100.0 | 94.3 | 88.7 | 83.7 | 79.7 | 69.5 | 60.8 | 0.0 | |
| Petro ⁵ ULF | alkyl naphthalene sodium sulfonate | 100.0 | 91.0 | 81.8 | 75.6 | 71.0 | 65.3 | 57.8 | 28.8 | |
| T-Mulz ⁶ 734-2 | organic phosphate ester free acid | 100.0 | 92.6 | 84.8 | 85.4 | 81.8 | 75.4 | 0.0 | 0.0 | |
| Alipal ⁷ CO-433 | sulfated nonyl-phenoxypoly (ethyleneoxy) ethanol | 100.0 | 93.5 | 87.2 | 86.3 | 85.7 | 82.3 | 72.3 | 73.6 | hazy |
| APG ⁸ 325 Glycoside | alkyl polysaccharide ether | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Witconate ⁹ 1260 | linear alkylaryl sodium sulfonate | 100.0 | 91.0 | 82.4 | 79.8 | 75.5 | 69.5 | 62.7 | 61.8 | slight floc |
| Neodol ¹⁰ 91-8 | linear primary alcohol ethoxylate | 100.0 | 93.0 | 85.9 | 82.3 | 47.4 | 68.8 | 59.6 | 0.0 | slight floc |

¹Trademark of Henkel Corporation

²Trademark of Pilot Chemical Company

³Trademark of Rhone-Poulenc

⁴Trademark of Union Carbide Chemicals and Plastics Company

⁵Trademark of Witco Corporation

⁶Trademark of Harcros Chemicals Inc.

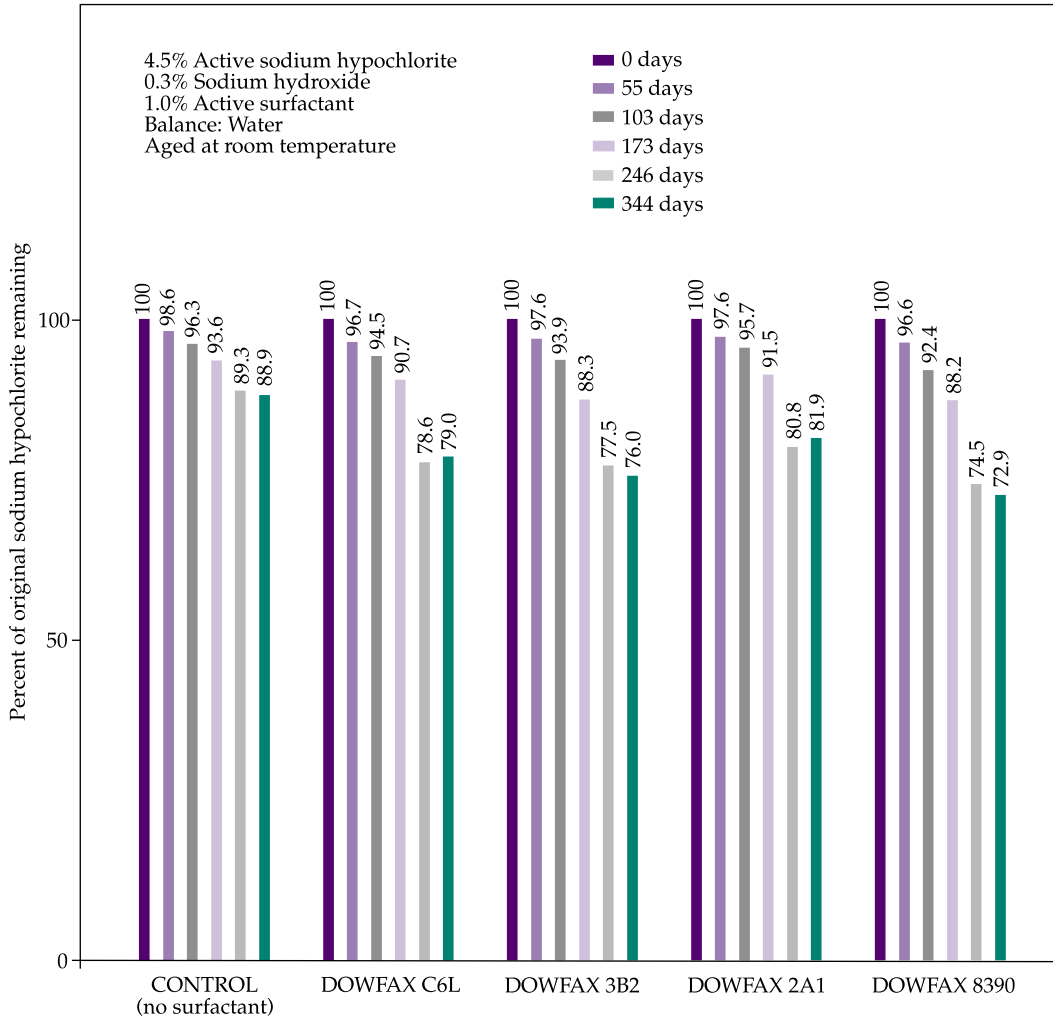
⁷Trademark of International Specialty Products

⁸Trademark of Henkel Corporation

⁹Trademark of Witco Corporation

¹⁰Trademark of Shell Chemical Company

Figure 4 — Stability of 4.5% active sodium hypochlorite formulation containing DOWFAX surfactants at 1%



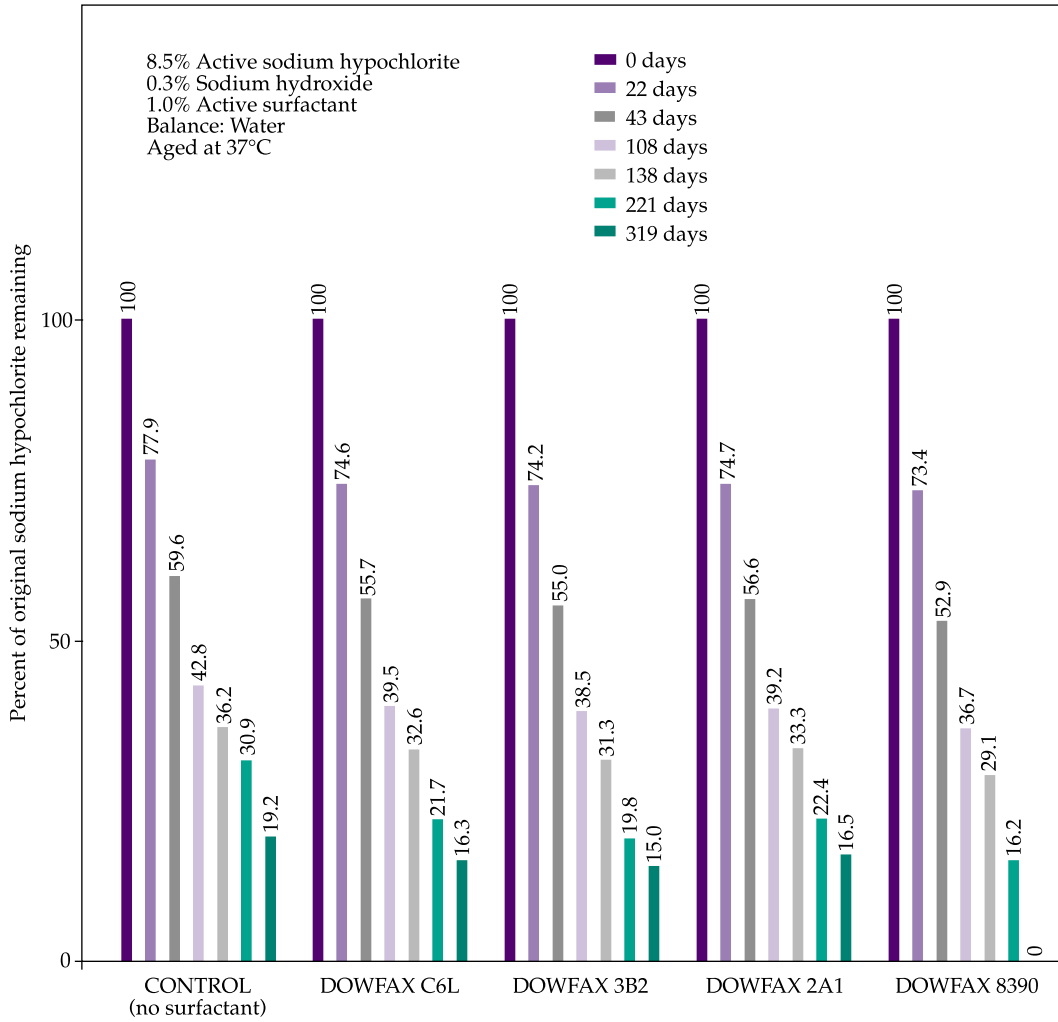
Concentrated formulations stay stable too

If you want to formulate concentrated, penetrating bleach products that are less expensive to package and ship, consider DOWFAX surfactants first. They're among the few surfactants that won't cause unacceptable hypochlorite degradation, yet have enough chemical stability themselves to withstand harsh oxidizing conditions.

Figure 4 shows the results of stability tests conducted on a 4.5% bleach system containing various DOWFAX surfactants at 1% concentration. Compare the stability of the control formulation versus those containing DOWFAX surfactants—the stability differences are minimal.

At higher bleach levels and at higher temperature, tests show similar results. Figure 5 again points to the excellent stability of concentrated bleach systems containing DOWFAX surfactants.

Figure 5 — Stability of 8.5% active sodium hypochlorite formulation containing DOWFAX surfactants at 1%



USE DOWFAX SURFACTANTS IN HIGH-TEMPERATURE APPLICATIONS, OR WHERE THE FINAL FORM IS A POWDER

DOWFAX surfactants are stable for long periods at elevated temperatures. This can extend formulation flexibility in a number of ways.

Formulations get maximum thermal stability

Whether you're formulating a product like a steam cleaner for high-temperature use, or simply want assurance of long shelf life under warm storage conditions, you can rely on DOWFAX surfactants for high-temperature stability.

DOWFAX surfactants are thermally stable in air at temperatures up to 180°C (356°F). Thermal gravimetric analysis under nitrogen shows DOWFAX products can tolerate temperatures as high as 449°C (840°F) without degradation. Figure 6 shows the half-life data for DOWFAX products under varying temperature and pH conditions.

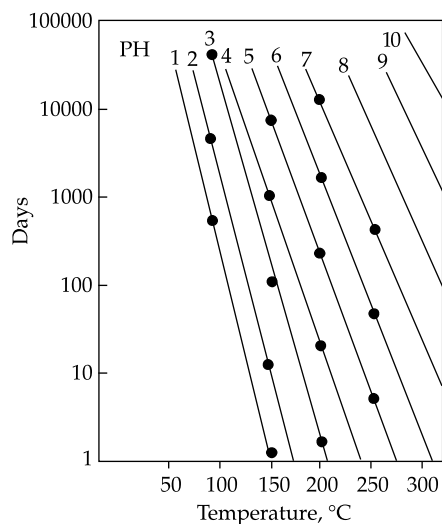
These anionics are dryable

DOWFAX surfactants easily provide the thermal stability required for spray drying. So if your goal is a dry product that maximizes efficiency for shipping and package size, DOWFAX surfactants are a great choice. They can be dried to a free-flowing powder, which easily rewets for use. Call Dow first for details regarding dry DOWFAX surfactants.



DOWFAX surfactants were the products used in the original formulations of liquid automatic dishwashing detergents. Their combination of high thermal stability and bleach stability did the trick.

Figure 6 — Temperature vs. time to 50% desulfonation (thermal decomposition) for DOWFAX surfactants at varying pH levels.



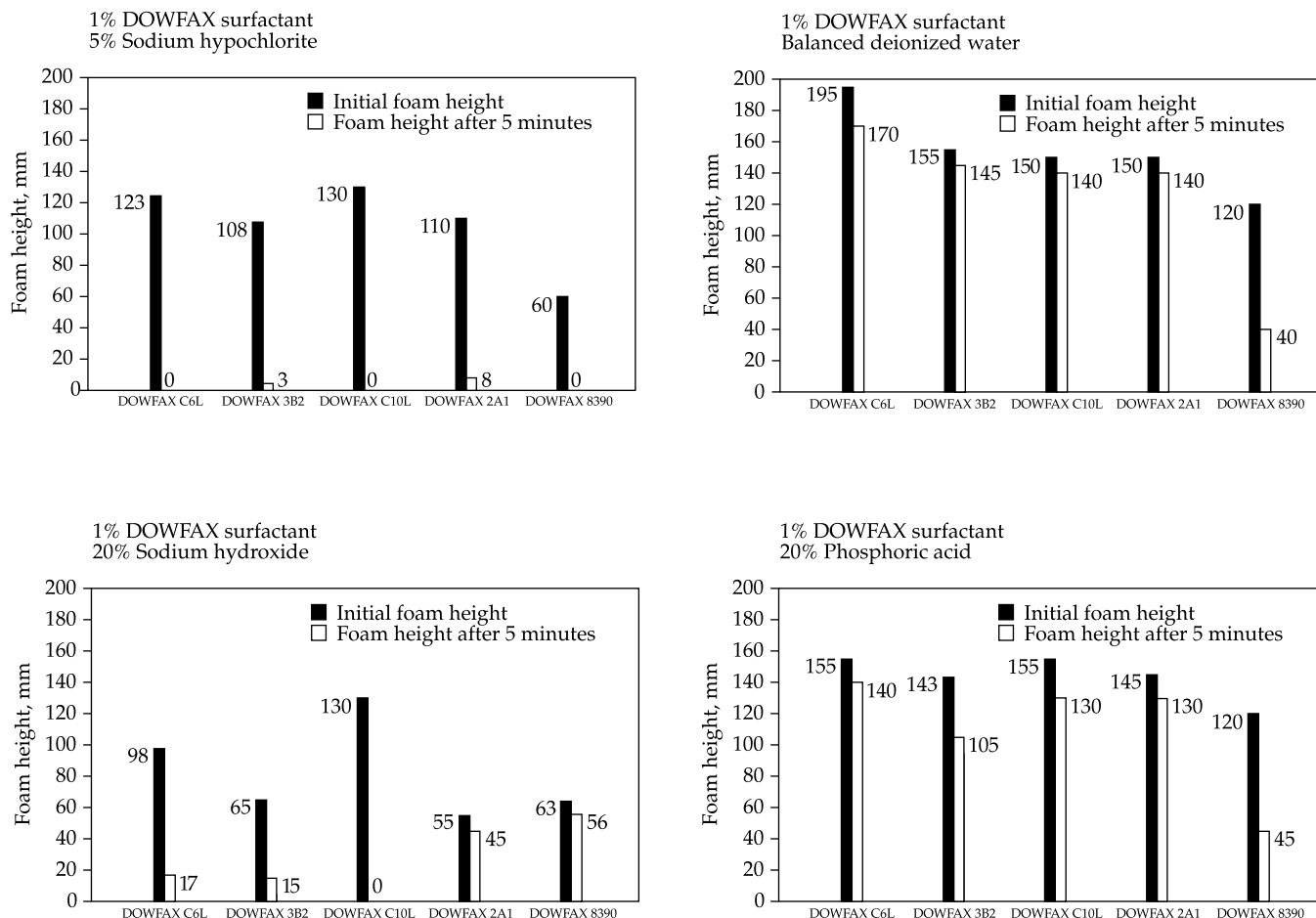
NOTE:
Data for 1% aqueous solution, no oxygen

EXAMPLE FOAM PROFILES

The foaming properties of DOWFAX surfactants vary with the specific formulation environment. Figure 7 shows foam profiles obtained with the Ross-Miles column with solutions of DOWFAX surfactants in deionized water, sodium hydroxide, sodium hypochlorite, and phosphoric acid.

These foaming characteristics can be modified to suit end-use needs. You can achieve greater foaming action by adding foam boosters such as lauric diethanolamide or amine oxide. To depress foaming, you can add a variety of standard defoamers, or even use low-foaming nonionic surfactants.

Figure 7 — Foam Profiles¹ for DOWFAX surfactants



¹Modified Ross-Miles procedure conducted at 25°C

TYPICAL PHYSICAL PROPERTIES¹



Seven different DOWFAX surfactants give you a range of formulating options. While all DOWFAX products provide a core package of excellent solubility and stability, variations in hydrophobe and salt or acid forms let you match a wide variety of formulation needs.

| Typical Property | DOWFAX C6L |
|--|-----------------------------|
| Appearance | Clear amber liquid |
| Hydrophobe Source | C ₆ alpha-olefin |
| Average Molecular Weight | 474 |
| Active Ingredient, min | 45% |
| Caustic Solubility | 30% min. |
| Density, g/cc @ 25°C | 1.12-1.17 |
| Viscosity, cps @ 25°C | 130 |
| Critical Micellization Concentration, g/100g in 0.1 M NaCl | 0.017 |
| Surface Tension, dynes/cm | |
| Concentration in 0.1 M NaCl | |
| 0.001% | 69 |
| 0.01% | 38 |
| 0.1% | 32 |
| 1.0% | 32 |

Ross-Miles Foam Height

1.0% @ 25°C

| | Initial (mm) | 5 min. (mm) |
|------------------------|--------------|-------------|
| In Water | 195 | 170 |
| In 5% Bleach | 123 | 0 |
| In 20% Caustic | 98 | 17 |
| In 20% Phosphoric Acid | 155 | 140 |

| Typical Property | DOWFAX 3B2 |
|--|------------------------------|
| Appearance | Clear amber liquid |
| Hydrophobe Source | C ₁₀ alpha-olefin |
| Average Molecular Weight | 542 |
| Active Ingredient, min | 45% |
| Density, g/cc @ 25°C | 1.12-1.20 |
| Viscosity, cps @ 25°C | 120 |
| Critical Micellization Concentration, g/100g in 0.1 M NaCl | 0.012 |
| Surface Tension, dynes/cm | |
| Concentration in 0.1 M NaCl | |
| 0.001% | 63 |
| 0.01% | 38 |
| 0.1% | 35 |
| 1.0% | 37 |

Ross-Miles Foam Height

1.0% @ 25°C

| | Initial (mm) | 5 min. (mm) |
|------------------------|--------------|-------------|
| In Water | 155 | 145 |
| In 5% Bleach | 108 | 3 |
| In 20% Caustic | 65 | 15 |
| In 20% Phosphoric Acid | 143 | 105 |

| Typical Property | DOWFAX C10L |
|--|------------------------------|
| Appearance | Clear amber liquid |
| Hydrophobe Source | C ₁₀ alpha-olefin |
| Average Molecular Weight | 555 |
| Active Ingredient, min | 45% |
| Density, g/cc @ 25°C | 1.12–1.16 |
| Viscosity, cps @ 25°C | 120 |
| Critical Micellization Concentration, g/100g in 0.1 M NaCl | 0.011 |
| Surface Tension, dynes/cm | |
| Concentration in 0.1 M NaCl | |
| 0.001% | 65 |
| 0.01% | 38 |
| 0.1% | 35 |
| 1.0% | 38 |

| Ross-Miles Foam Height 1.0% @ 25°C | Initial (mm) | 5 min. (mm) |
|---------------------------------------|--------------|-------------|
| In Water | 150 | 140 |
| In 5% Bleach | 130 | 0 |
| In 20% Caustic | 130 | 0 |
| In 20% Phosphoric Acid | 155 | 130 |

| Typical Property | DOWFAX 2A1 |
|--|--------------------|
| Appearance | Clear amber liquid |
| Hydrophobe Source | Tetrapropylene |
| Average Molecular Weight | 576 |
| Active Ingredient, min | 45% |
| Density, g/cc @ 25°C | 1.10–1.20 |
| Viscosity, cps @ 25°C | 145 |
| Critical Micellization Concentration, g/100g in 0.1 M NaCl | 0.007 |
| Surface Tension, dynes/cm | |
| Concentration in 0.1 M NaCl | |
| 0.001% | 55 |
| 0.01% | 31 |
| 0.1% | 31 |
| 1.0% | 34 |

| Ross-Miles Foam Height 1.0% @ 25°C | Initial (mm) | 5 min. (mm) |
|---------------------------------------|--------------|-------------|
| In Water | 150 | 140 |
| In 5% Bleach | 110 | 8 |
| In 20% Caustic | 55 | 45 |
| In 20% Phosphoric Acid | 145 | 130 |

| Typical Property | DOWFAX 8390 |
|--|------------------------------|
| Appearance | Clear amber liquid |
| Hydrophobe Source | C ₁₆ alpha-olefin |
| Average Molecular Weight | 643 |
| Active Ingredient, min | 35% |
| Density, g/cc @ 25°C | 1.03–1.15 |
| Viscosity, cps @ 25°C | 10 |
| Critical Micellization Concentration, g/100g in 0.1 M NaCl | 0.014 |
| Surface Tension, dynes/cm | |
| Concentration in 0.1 M NaCl | |
| 0.001% | 54 |
| 0.01% | 49 |
| 0.1% | 47 |
| 1.0% | 46 |

| Ross-Miles Foam Height 1.0% @ 25°C | Initial (mm) | 5 min. (mm) |
|---------------------------------------|--------------|-------------|
| In Water | 120 | 40 |
| In 5% Bleach | 60 | 0 |
| In 20% Caustic | 63 | 56 |
| In 20% Phosphoric Acid | 120 | 45 |

| Typical Property | DOWFAX 3B0 |
|----------------------------------|------------------------------|
| Appearance | Amber liquid |
| Hydrophobe Source | C ₁₀ alpha-olefin |
| Average Molecular Weight | 498 |
| Active Ingredient, min | 40% |
| Density, g/cc @ 25°C | 1.03–1.20 |
| Viscosity, cps @ 25°C | 110 |
| Surface Tension @ 25°C, dynes/cm | |
| Concentration in Water | |
| 0.001% | 54 |
| 0.01% | 41 |
| 0.1% | 36 |
| 1.0% | 33 |

| Ross-Miles Foam Height 1.0% @ 25°C | Initial, mm | 5 minutes, mm |
|---------------------------------------|-------------|---------------|
| | 173 | 140 |

| Typical Property | DOWFAX 2A0 |
|----------------------------------|----------------|
| Appearance | Amber liquid |
| Hydrophobe Source | Tetrapropylene |
| Average Molecular Weight | 524 |
| Active Ingredient, min | 40% |
| Density, g/cc @ 25°C | 1.03–1.20 |
| Viscosity, cps @ 25°C | 235 |
| Surface Tension @ 25°C, dynes/cm | |
| Concentration in Water | |
| 0.001% | 46 |
| 0.01% | 34 |
| 0.1% | 30 |
| 1.0% | 33 |

| Ross-Miles Foam Height 1.0% @ 25°C | Initial, mm | 5 minutes, mm |
|---------------------------------------|-------------|---------------|
| | 170 | 143 |

COMPLIANCE WITH END-USE AND ENVIRONMENTAL REGULATIONS

Note: While assistance to customers on the regulated uses of DOWFAX surfactants is readily available from Dow, customers are responsible for registration and approvals on their particular formulated products.

Compliance with FDA/EPA

DOWFAX 2A1 surfactant, DOWFAX 3B2 surfactant, DOWFAX C10L surfactant and DOWFAX 8390 surfactant meet the requirements of Food Additive Regulation 21 CFR 178.3400 (Emulsifiers and/or surface-active agents). The substances listed in this “umbrella” regulation may be used in all *indirect* food additive applications where they have utility (i.e., adhesives, paper coatings, etc.), subject to any limitations in the regulation. These four surfactants are subject to *no* limitations other than good manufacturing practices.

Under 178.3400 the emulsifiers and/or surface active agents may be effectively used in the manufacture of articles or components of articles intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food.

EPA status

DOWFAX 2A1 surfactant, DOWFAX 3B2 surfactant, DOWFAX C10L surfactant and DOWFAX 8390 surfactant meet the requirements of EPA Pesticide Regulation 40 CFR 180.1001 (c) as an inert ingredient in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest.

Readers and customers are cautioned to check with their Dow sales representative on possible changes in regulations that could influence accuracy of the preceding statements of FDA and EPA regulations.

Degradation of DOWFAX surfactants

DOWFAX surfactants have been evaluated using the semi-continuous activated sludge (SCAS) confirming test specified by the Soap and Detergent Association’s Subcommittee on Biodegradation Test Methods. A 90% reduction in methylene blue active substance following 23 hours of aeration is required to classify an anionic surfactant as biodegradable, according to this procedure. DOWFAX 3B2 surfactant, DOWFAX C10L surfactant, and DOWFAX 8390 surfactant pass this criteria.

Hazards

DOWFAX surfactants, like many common surfactants, are toxic to fish. In a spill of any nature, the primary concern should be containment.

- Toxic to fish
- Will cause irritation and severe injury to the eyes and irritation to the skin.



DOWFAX surfactants. The right choice in formulations with acids, bleach, or caustic.

TRANSPORTATION AND STORAGE EQUIPMENT INFORMATION¹

Storage Tanks

For storing undiluted solutions, T316 SS is recommended due to resistance towards pitting and crevice corrosion. T304 stainless steel may be utilized if precautions are taken to ensure full penetration welds, no crevices, no solids buildup, etc.

Exposed steel in thin-medium thickness organic lining (coating) or DERAKANE* resin FRP construction tanks would corrode at a nominal rate, probably 5 to 10 mils per year (1 mil/year equals 0.001 inches per year). Iron contamination from the corrosion may cause clouding of the DOWFAX surfactant solution.

Pumps

A gear pump or centrifugal pump may be used for service. Stainless steel (316 SS) is the recommended material of construction for both types of pumps. A centrifugal pump generally performs better when the surfactant is fairly warm, 104°F (40°C). Undiluted surfactant becomes more viscous when cold, and for such service a gear pump is recommended.

Piping

Carbon steel pipe lined with polypropylene or TFE Teflon² polymer are satisfactory from a chemical resistance standpoint. Other acceptable piping materials include solid stainless steel and fiberglass reinforced plastic (FRP). Stainless alloys would typically have fewer flanged connections to act as potential leak sites and would therefore be the material of choice.

Small samples of polyethylene piping have been laboratory tested at 122°F (50°C) for 50 days. They appear to be satisfactory. However, polyethylene pipe is unsuitable for outdoor service and physical strength may not meet the necessary pressure-temperature conditions for indoor service.

*Trademark of The Dow Chemical Company

¹ NOTE: This information does not apply to the acid forms of DOWFAX surfactants. For information on handling the acid forms, consult with your Dow representative.

² Trademark of E.I. duPont de Nemours & Company, Inc.

CALL NOW FOR ADDITIONAL ASSISTANCE

If you'd like to learn more about how a DOWFAX surfactant can improve the performance of your specific formulation, then the next step is easy. Why not conduct testing in your present or planned product with a sample of a DOWFAX surfactant?

Get exactly the sample you need

If you'd like to experiment with one of the products discussed in this brochure, just call us at the phone number for your region listed on the back page of this brochure. We'll see to it that your request gets immediate attention.

Unmatched technical support

If you need help with formulation development, don't hesitate to contact Dow. Our Technical Service and Development staff is ready and willing to share a wealth of knowledge and experience with you as you work with DOWFAX products.

For further information about product sampling or technical support, call us at the phone number for your region listed on the back page of this brochure.

Product Stewardship

The Dow Chemical Company has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our Product Stewardship philosophy by which we assess the health and environmental information on our products. Our Product Stewardship program rests with each and every individual involved with Dow products—from the initial concept and research to the manufacture, sale, distribution, use and disposal of each product.

Customer Notice

Dow encourages its customers to review their applications of Dow products from the standpoint of human health and environmental quality. To help ensure that Dow products are not used in ways for which they are not intended or tested, Dow personnel will assist customers in dealing with ecological and product safety considerations. Your Dow sales representative can arrange the proper contacts.

DOWFAX ANIONIC SURFACTANTS FOR HIGH-PERFORMANCE PRODUCTS

The Right Choice in Formulations with Acids, Bleach, and Caustic

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Published July 2000

