



CHEMISTRY CREATES AMERICA COMPETES

REPORT:

Chemistry in Cleaning Products Boosting U.S. Leadership and Consumer Safety





Executive Summary

The report "Chemistry in Cleaning Products" reveals the powerhouse behind products Americans depend on every day. From boosting the economy to pioneering chemical innovations, the U.S. cleaning products industry is a global leader. Essential in every household, these products rely on a wide range of chemistries to help keep us safe. Here are five key findings:

- Economic Impact: The cleaning products industry is a significant segment of the U.S. chemical manufacturing sector, contributing \$60 billion to the economy and employing 66,000 people. The U.S. is a net exporter of cleaning products, adding \$1.1 billion to the nation's trade balance in 2024.
- **Global Leadership:** The U.S. is a world leader in the production of cleaning products, accounting for more than a quarter of global output. This leadership is supported by continuous innovation and improvement in chemical formulations.
- **Consumer Use:** On average, each U.S. household consumes approximately \$400 worth of cleaning products per year. These products are essential for maintaining cleanliness and safety in homes, schools, healthcare facilities, and other environments.
- Extensive Chemistries: Cleaning products utilize a wide range of chemical ingredients, including abrasives, acids, solvents, surfactants, disinfectants, enzymes, oils, waxes, fragrances, water softeners, preservatives, emulsifiers, foam-boosting agents, propellants, and polymers. Each category plays a specific role in enhancing the effectiveness of cleaning products.
- **Regulatory Impact:** Smart regulatory policies, particularly enhancements to the Toxic Substances Control Act (TSCA), are crucial for promoting innovation in cleaning product chemistries. A more efficient regulatory framework benefits consumers, manufacturers, and lawmakers by ensuring predictability and consistency, driving investment in new technologies.

Introduction

Chances are you have already encountered a cleaning product at least once today. Think about the clean shirt you put on this morning that was washed with laundry detergent. Maybe you enjoyed a cup of coffee or tea in a clean mug from the dishwasher. Or even on your way to work on a bus or train that was cleaned before you arrived. Or maybe at the bagel shop where the food preparation surfaces were disinfected and equipment cleaned. The list of places you may have encountered that use cleaning products goes on and on. You might not think about them, but you're probably really glad they're there.

One of the oldest manufacturing segments of the chemical industry, cleaning products manufacturing is vital to American jobs and trade. It is a \$60 billion business in the U.S., employing 66,000 people, according to the American Cleaning Institute¹. Cleaning products comprise nearly 10% of U.S. chemical manufacturing and the U.S. is a net exporter of cleaning products, contributing \$1.1 billion to the nation's trade balance in 2024. The U.S. is a world leader in the production of cleaning products, accounting for more than a quarter of global output².

From household laundry detergent to surface cleaners to powerful disinfectants used in hospital operating rooms, cleaning products help us maintain a cleaner, safer, and more comfortable environment. And a wide variety of chemistries are at work to make it all happen. In fact, each U.S. household consumes and benefits from the use of approximately \$400 cleaning products per year. This report discusses some of the key chemistries that are used to make the broad array of cleaning products used in our homes and throughout the economy every day.

2 According to Oxford Economics (value-added output as a share of world total for NACE 20.4)



¹ https://media.acihq.org/gsp/gs/mediaobjects/Docs/economic-report/USA.pdf

Chemistries Used in Household Cleaning Products

There are thousands of cleaning products available in the U.S., each formulated for a particular purpose, whether to clean grease off a casserole dish, make an office bathroom sparkle, or disinfect surfaces in a doctor's office. Behind all of these products is a vast portfolio of innovative chemical ingredients. While many of the ingredients are sourced from conventional fossil-based chemicals, biobased ingredients have long been used in this sector. Here's a look at how several key categories of chemicals are used to make cleaning products effective at the tough jobs they're asked to do.

Abrasives are small particles of a hard material used to scour dirt from a surface. Examples include calcium carbonate, sodium carbonate, feldspar, glass beads, nutshells, aluminum oxide, and silicon dioxide.

Acids are used to dissolve mineral deposits and hard water stains on surfaces. Examples include citric acid (e.g., found in lemon juice), acetic acid (e.g., found in vinegar), oxalic acid, phosphoric acid, formic acid, sulfuric acid, lactic acid, and muriatic acid.

Solvents are cleaning chemicals that break up (or dissolve) oil and grease. They're used in a variety of cleaning products including all-purpose cleaners, rug cleaners, drain cleaners, spot removers, etc. Common solvents used in household cleaning products include isoparaffin, ammonia, glycerin, propylene glycol, polyethylene glycol, denatured alcohol, mineral spirits, isopropyl alcohol (aka isopropanol), 2-butoxyethanol, toluene, and methyl ethyl ketone.

Surfactants (aka surface-active agents) are chemicals that reduce the surface tension of liquids and help trap and remove dirt from surfaces. The largest categories of surfactants used in cleaning products are anionic and nonionic surfactants.

Some examples of anionic surfactants include:





- Linear alkyl benzene (LAB) is a base for many detergent ingredients, including LAB sulfonic acid and LAB sulfonic salt used in laundry powders, dishwashing liquids, and other allpurpose cleaners.
- Alkyl sulfates (AS), including sodium lauryl sulfate, sodium laureth sulfate and ammonium laureth
- Alkyl ether sulfates (AES) include sodium lauryl ether sulfate, which is an example of alkyl ether sulfates used in some dishwashing liquids.
- Soaps are the salts of a fatty acid and are one of the earliest chemistries. Early soaps were made from animal fat and a basic material, for example lye (aka sodium hydroxide) or potash (potassium hydroxide).
- Some examples of nonionic surfactants (derived from ethylene oxide and propylene oxide):
- Alcohol ethoxylates, including nonylphenol ethoxylate, octylphenol ethyloxylate and dodecylphenol ethyoxylate.
- Fatty-acid esters, including polyglycerol fatty acid esters, ethoxylated sorbitan, sorbital fatty acid esters.
- Ethylene oxide/propylene oxide block copolymers

Disinfectants & Antimicrobials are used in kitchens, bathrooms and other places to prevent the dangerous spread of disease and keep harmful pathogens out of our food. Sodium hypochlorite bleach, chlorohexidine, quaternary ammonium compounds, hydrogen peroxide, peracetic acid, ethanol and isopropyl alcohol are popular disinfectants used in household cleaning products. Hand sanitizers use isopropyl alcohol or ethanol.

Specialized disinfectants using a wide variety of biocide chemistries (including alcohols, aldehydes, halogenated chemicals, oxidative compounds, peroxides, phenolics, quaternary ammonium compounds and benzalkonium chloride) are used in industrial and institutional disinfection products used in food processing, restaurants, hospitals, etc. **Enzymes** are biological materials that break down fats and proteins that cause stains and odors. Examples include protease, amylase, lipase, cellulase, mannanase etc.

Oils are used for their cleaning and disinfecting properties in addition to fragrance. Examples include lemon, tea tree, pine, eucalyptus, lavender, and orange oils.

Waxes and surface protection chemicals are added to cleaning products to create a protective layer on surfaces. Examples include paraffin, microcrystalline waxes, beeswax, carnauba wax, dimethicone, etc.

Fragrances are used to make cleaning products more appealing and to impart certain scents to a space. Cleaning products use a wide range of fragrances, including citrus and floral. Fragrance chemistries include plant-based and synthetic compounds. Examples include limonene, coumarin, camphor, citronellol, diphenyl ether and benzyl acetate.

Water softeners boost the efficacy of surfactants by neutralizing minerals in tap water (including calcium and magnesium). Borax, bentonite, sodium carbonate, sodium citrate, trisodium phosphate, ammonia, and acetic acid are all examples of some chemistries used in this application.

Preservatives in water-based compounds prevent the growth of bacteria, molds, and yeasts. Sodium benzonate, bronopol, isothiazolones, glutaraldehyde, lactic acid are examples.

Emulsifiers help keep liquid mixtures from separating into their component parts (like egg yolks keep oil and vinegar together in mayonnaise). Sorbitan oleate and similar products are used to emulsify components of furniture polish mixtures.

Foam-boosting agents help produce foams which increase the coverage and contact time of surface- active ingredients. Examples include sodium lauryl sulfate, sodium laureth sulfate, cocamidopropyl betaine, cocamide DEA, lauramine oxide and



sodium gluconate, which improves foaming in hard water. Many of these are also surfactants.

Propellants in an aerosol-can format deliver cleaning products as a spray or mist for greater coverage. Butane, propane, isobutane, isoalkanes, and other hydrocarbon gases are examples of common propellants

Polymers are used in various applications in cleaning products.

Polymer thickeners increase the viscosity of some cleaning products. Examples of thickeners include sodium polyacrylate, hydroxyethyl cellulose, hydroxyethyl methyl cellulose, and hydroxypropyl methyl cellulose.

Water-soluble films made from polyvinyl alcohol allow convenient single-use packets of laundry or dishwashing detergent.

Some polymers can also be used as *surfactants*. Examples include polyethylene glycol, polyvinyl alcohol, polyvinyl pyrrolidone, polyacrylamide, and block copolymers like polyethylene oxide-polypropylene oxide.

Plastic resins are widely used in containers, lids, and dispensing mechanisms (i.e., pumps, spray nozzles, etc.). High-density polyethylene (HDPE) is a common plastic used to package household cleaning products. Polyethylene terephthalate (PET), polyvinyl chloride (PVC) and polypropylene (PP) are also popular packaging materials.



Conclusion

Chemistry is at the heart of the cleaning products that keep our homes, schools, healthcare facilities and other places of business cleaner, safer, and more comfortable. The U.S. is a leader in cleaning chemistries, producing a quarter of the world's cleaning products.

That's why companies and organizations work diligently to continuously improve and innovate new chemistries. Congress has an important role too when it comes to promoting smart regulatory policies that allow chemistry to help improve the cleaning products of today and tomorrow. This includes making improvements to the Toxic Substances Control Act (TSCA), the EPA's primary authority for regulating chemicals.

Consumers, manufacturers, and lawmakers all benefit from a more efficient and effective regulatory framework, including enhancements to TSCA. It ensures predictability and consistency, driving investment in groundbreaking innovations that will benefit American consumers.

Disclaimer

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Appendix – The ABCs of Chemistry in Cleaning Products

Chemical	Category	Use
2-Butoxyethanol	Solvents	Dissolves oil/grease
Acetic acid (i.e., vinegar)	Acids/Water Softener	Dissolves mineral deposits and hard water stains; neutralizes minerals in water
Aluminum oxide	Abrasive	Scouring dirt from surfaces
Ammonia	Solvents/Water Softener	Dissolves oil/grease; neutralizes minerals in water
Ammonium laureth	Anionic surfactant	Reduces surface tension of liquids & removes dirt
Amylase	Enzymes	Break down fats and proteins in stains
Beeswax	Waxes and surface protectionCreates protective layer	
Bentonite	Water softeners	Neutralizes minerals in tap water
Benzalkonium chloride	Disinfectants	Kills germs
Benzyl acetate	Fragrance	Imparts scent
Borax	Water softeners	Neutralizes minerals in tap water
Bronopol	Preservatives	Prevents growth of germs
Butane	Propellent	Disperse spray or mist
Calcium carbonate	Abrasive	Scouring dirt from surfaces
Camphor	Fragrance	Imparts scent
Carnauba wax	Waxes and surface protectionCreates protective layer	
Cellulase	Enzymes	Break down fats and proteins in stains
Chlorohexidine	Disinfectants	Kills germs
Citric acid (i.e., lemon juice)	Acids	Dissolves mineral deposits and hard water stains
Citronellol	Fragrance	Imparts scent
Cocamide DEA	Foam-boosting agents	Helps produce foam for better coverage and contact of active ingredients
Cocamidopropyl betaine	Foam-boosting agents	Helps produce foam for better coverage and contact of active ingredients
Coumarin	Fragrance	Imparts scent
Denatured alcohol	Solvents	Dissolves oil/grease

Chemical	Category	Use
Dimethicone	Waxes and surface protect	tionCreates protective layer
Diphenyl ether	Fragrance	Imparts scent
Dodecylphenol ethoxylate	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Ethanol	Solvents/Disinfectants	Dissolves oil/grease; kills germs
Ethoxylated sorbitan	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Ethylene oxide/propylene oxide block copolymers	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Eucalyptus oil	Oils	Cleaning, disinfecting, and fragrance
Feldspar	Abrasive	Scouring dirt from surfaces
Formic acid	Acids	Dissolves mineral deposits and hard water stains
Glass beads	Abrasive	Scouring dirt from surfaces
Glutaraldehyde	Preservatives	Prevents growth of germs
Glycerin	Solvents	Dissolves oil/grease
High-density polyethylene (HDPE)	Plastic resins	Packaging
Hydrogen peroxide	Disinfectants	Kills germs
Hydroxyethyl methyl cellulose	Polymer thickener	Increases viscosity
Hydroxylethyl cellulose	Polymer thickener	Increases viscosity
Hydroxypropyl methyl cellulose	Polymer thickener	Increases viscosity
Isoalkane	Propellent	Disperse spray or mist
Isobutane	Propellent	Disperse spray or mist
Isoparaffin	Solvents	Dissolves oil/grease
Isopropyl alcohol (isopropanol)	Solvents/Disinfectants	Dissolves oil/grease; kills germs
Isothiazolones	Preservatives	Prevents growth of germs
LAB sulfonic acid	Anionic surfactant	Reduces surface tension of liquids & removes dirt
LAB sulfonic salt	Anionic surfactant	Reduces surface tension of liquids & removes dirt
Lactic acid	Acids/Preservative	Dissolves mineral deposits and hard water stains; prevents growth of germs
Lauramine oxide	Foam-boosting agents	Help produce foam for better coverage and contact of active ingredients

Chemical	Category	Use
Lavender oil	Oils	Cleaning, disinfecting, and fragrance
Lemon oil	Oils	Cleaning, disinfecting, and fragrance
Limonene	Fragrance	Imparts scent
Linear alkyl benzene (LAB)	Anionic surfactant	Reduces surface tension of liquids & removes dirt
Lipase	Enzymes	Break down fats and proteins in stains
Mannanase	Enzymes	Break down fats and proteins in stains
Methyl ethyl ketone	Solvents	Dissolves oil/grease
Microcrystalline waxes	Waxes and surface protectionCreates protective layer	
Mineral spirits	Solvents	Dissolves oil/grease
Muriatic acid (hydrochloric acid)	Acids	Dissolves mineral deposits and hard water stains
Nonylphenol ethoxylate	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Nutshells	Abrasive	Scouring dirt from surfaces
Octylphenol ethyloxylate	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Orange oil	Oils	Cleaning, disinfecting, and fragrance
Oxalic acid	Acids	Dissolves mineral deposits and hard water stains
Paraffin	Waxes and surface protectionCreates protective layer	
Peracetic acid	Disinfectants	Kills germs
Phosphoric acid	Acids	Dissolves mineral deposits and hard water stains
Pine oil	Oils	Cleaning, disinfecting, and fragrance
Polyacrylamide	Polymer surfactant	Removes dirt
Polyethylene glycol	Solvents/Polymer surfactant	Dissolves oil/grease; removes dirt
Polyethylene oxide- propylene block copolymer	Polymer surfactant	Removes dirt
Polyethylene terephthalate (PET)	Plastic resins	Packaging
Polyglycerol fatty acid esters	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Polypropylene (PP)	Plastic resins	Packaging
Polyvinyl alcohol	Water-soluble film/Polymer surfactant	Single-use detergent packets; reduces surface tension of water and removes dirt

Chemical	Category	Use
Polyvinyl chloride (PVC)	Plastic resins	Packaging
Propane	Propellent	Disperse spray or mist
Propylene glycol	Solvents	Dissolves oil/grease
Protease	Enzymes	Break down fats and proteins in stains
Quaternary ammonium compounds	Disinfectants	Kills germs
Silicon dioxide	Abrasive	Scouring dirt from surfaces
Sodium benzonate	Preservatives	Prevents growth of germs
Sodium carbonate (soda ash)Abrasive/Water Softener	Scouring dirt from surfaces; neutralizes minerals in water
Sodium citrate	Water softeners	Neutralizes minerals in tap water
Sodium Gluconate	Foam-boosting agents	Help produce foam for better coverage and contact of active ingredients
Sodium hypochlorite	Disinfectants	Kills germs
Sodium laureth sulfate	Anionic surfactant/Foam- boosting	Reduces surface tension of liquids & removes dirt; helps create foam
Sodium lauryl ether sulfate	Anionic surfactant	Reduces surface tension of liquids & removes dirt
Sodium lauryl sulfate	Anionic surfactant/Foam- boosting	Reduces surface tension of liquids & removes dirt; helps create foam
Sodium polyacrylate	Polymer thickener	Increases viscosity
Sorbitol fatty acid esters	Nonionic surfactant	Reduces surface tension of liquids & removes dirt
Sorbitan oleate	Emulsfier	Keeps liquid mixtures from separating
Sulfuric acid	Acids	Dissolves mineral deposits and hard water stains
Tea tree oil	Oils	Cleaning, disinfecting, and fragrance
Toluene	Solvents	Dissolves oil/grease
Trisodium phosphate	Water softeners	Neutralizes minerals in tap water

For more information about cleaning product chemistries or to look up specific chemistries, please visit the Cleaning Chemistry Catalog¹ available on the American Cleaning Institute's website².

2 Home Page|The American Cleaning Institute (ACI)

^{1 &}lt;u>Cleaning Chemistry Catalog | The American Cleaning Institute (ACI)</u>

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