

Periodic Graphics

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog **Compound Interest**

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online

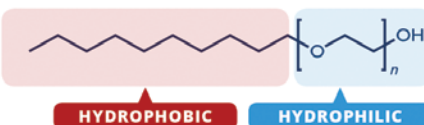
To see more of Brunning's work, go to compoundchem.com. To see all of C&EN's Periodic Graphics, visit cenm.ag/periodicgraphics.

POWDER VS. LIQUID DETERGENTS

Detergents come in solid and liquid forms. What's the difference chemically, and how do their ingredients work together to clean your clothes?

SURFACTANTS

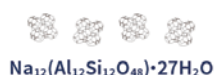
One end of a surfactant molecule (example shown) dissolves in water, and the other latches onto oily substances, removing them from clothes.



Liquid detergents commonly have a higher surfactant content than powders.

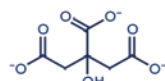
BUILDERS AND FILLERS

Builders form complexes with metal ions to soften water, and they optimize pH. Liquid detergents don't need as much builder because their surfactants are less sensitive to water hardness.



ZEOLITE A

Typical builder in powder detergents



CITRATE

Typical builder in liquid detergents

Fillers are bulking agents. The main one in powders is sodium sulfate; in liquid detergents, it's water.



POWDER

LIQUID

SURFACTANTS

17% 20%

BUILDERS AND FILLERS

65% 5%^a

^a Does not include water as filler.

BLEACHING SYSTEMS

11% <1%

POLYMERS AND ENZYMES

4% <2%

Note: Figures do not sum to 100% because they do not include antifoamers, brighteners, complexing agents, and hydrotropes.

Source: Battelle. Credit: Shutterstock.

BLEACHING SYSTEMS

Bleaching agents oxidize molecules to remove stains. In powders, peroxygen compounds activate in water to release hydrogen peroxide, the oxidizing agent.



SODIUM PERCARBONATE

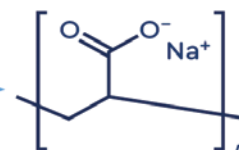
HYDROGEN PEROXIDE

Liquid detergents don't contain bleach. It can react with their other ingredients.

POLYMERS AND ENZYMES

Polymers in detergents help keep dirt suspended. Common polymers for this purpose are polycarboxylates, such as sodium polyacrylate, and ethoxylated polyethyleneimines.

SODIUM POLYACRYLATE



Enzymes break down protein-, starch-, and saccharide-based stains.