

## What is a hydrotrope?

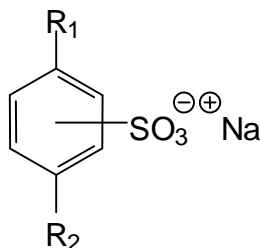
A hydrotrope is an organic substance that increases the solubility of surfactants and other substances in an aqueous solution. Hydrotropes are not surfactants; they do not adsorb onto the surface or interface and do not form micelles.

## Are there other names for hydrotropes?

Hydrotropes are sometimes incorrectly called solubilizers.

## What is the structure of a hydrotrope?

Hydrotropes have structures somewhat similar to surfactants in that they have a hydrophilic group and hydrophobic groups. Hydrotropes differ from surfactants in that the hydrophobic group is generally short, cyclic and/or branched. One group of hydrotropes has the structure shown here:



where:

R <sub>1</sub>	R <sub>2</sub>	Hydrotrope
H	H	sodium benzene sulfonate
H	CH <sub>3</sub>	sodium toluene sulfonate
CH <sub>3</sub>	CH <sub>3</sub>	sodium xylene sulfonate (SXS)
H	CH(CH <sub>3</sub> ) <sub>2</sub>	sodium cumene sulfonate
CH <sub>3</sub>	CH(CH <sub>3</sub> ) <sub>2</sub>	sodium cymene sulfonate

Pilot SXS-40 and SXS-96 are sodium xylene sulfonates; they are a mixture of o-, m- and p-isomers.

Other hydrotropes include sodium hydroxynaphthoate, sodium hydroxynaphthalene sulfonate and sodium ethylhexyl sulfate.

### **How does a hydrotrope work?**

Surfactants with strong chain-chain and head-head interaction (due to long, straight chains and close-packed heads) form either an insoluble crystal or liquid crystal aggregates (type of micelles). The crystal formation usually limits the solubilization capacity of the surfactant solution.

Hydrotropes inhibit the formation of surfactant liquid crystalline phases by forming mixed micellar structures with surfactants. Since the hydrotrope hydrophilic heads are large and their hydrophobic groups are small (packing factor,  $\Phi \ll 1$ ), they tend to form spherical rather than lamellar or liquid-crystalline structures, thus inhibiting the formation of the latter. This destruction or inhibition of the liquid crystalline phase increases the solubility of the surfactant in the aqueous phase and the capacity of its micellar solution to solubilize material.

### **What is the difference between a hydrotrope and a true solubilizer?**

A solubilizer is a surfactant. A solvent insoluble material is solubilized in the interior of the surfactant micelle. Factors that cause an increase in either the diameter of the micelle or its aggregation number generally increase solubilization (this is why bivalent salts show greater solubilization for hydrocarbons than the corresponding sodium salts). Typical solubilizers are: fatty soaps, polyethoxylated nonionics, quaternary ammonium surfactants. Solubilization greatly increases once the CMC has been reached. Hydrotropes are effective only at high concentrations.