



# The SulphCo® Process for Sweetening or Mercaptan Reduction

## Overview

The SulphCo® process for mercaptan reduction, or sweetening, is designed to convert mercaptan sulfur to disulfides and sulfonic acids in light petroleum through the use of high-power ultrasound. Butanes, natural gasoline, sour condensate, naphtha and kerosene are ideal candidates for the SulphCo® process.

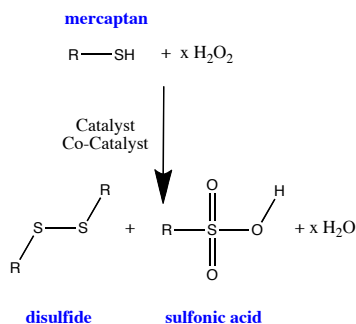
The SulphCo® process consists of two-steps—sonication and separation. In the sonication step, the SulphCo® process uses an aqueous additive package of hydrogen peroxide, a catalyst, and a co-catalyst. High-power ultrasound creates an intimate dispersion of these aqueous additives in the target petroleum stream. No persistent emulsions are formed. In the separation step, the aqueous reaction phase is separated from the petroleum stream by gravity.

Typical customer objectives include:

1. Reducing mercaptan sulfur concentration to meet a pipeline specification.
2. Reducing or eliminating objectionable odor due to volatile mercaptans.

## Chemistry

The chemistry of the conversion step is shown below:



Reaction conditions are typically mild, with temperatures < 200 °F and pressures < 60 psig. The aqueous additive package typically comprises < 2% of the total petroleum stream volume. The amounts

of additives needed are directly proportional to the sulfur content of the petroleum stream.

The use of high-power ultrasound breaks down the aqueous / petroleum phase barrier by creating an intense cavitation field. This dramatically increases the interfacial surface between the additive bearing aqueous phase and the mercaptan bearing petroleum phase, accelerating the oxidation of mercaptan sulfur.

Apart from the conversion of mercaptan sulfur to disulfides and sulfonic acids, no significant changes in petroleum stream properties occur.

## Process Description

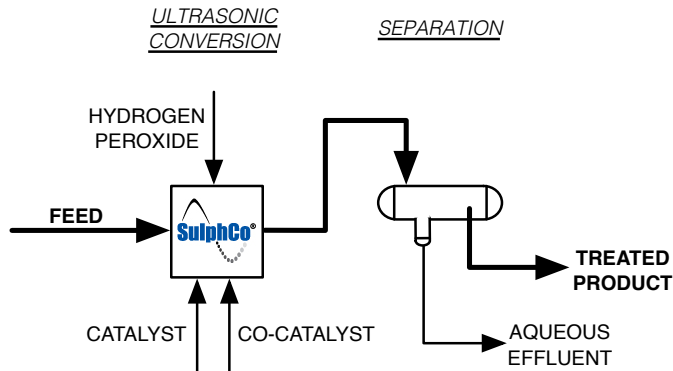
Untreated petroleum feed is sent to the SulphCo® ultrasonic processing module, which consists of a skid-mounted ultrasound reactor assembly and a feed system for the aqueous additive solutions. Hydrogen peroxide, the catalyst, and the co-catalyst are injected into the petroleum and subjected to intense ultrasound in the reactor. Reactor residence times are typically less than 500 milliseconds. The effluent from the ultrasound reactor is an essentially homogenous phase, consisting of an extremely fine dispersion of aqueous droplets in petroleum.

The reactor effluent is sent to a continuous flow gravity separator, in which the aqueous droplets coalesce and drop out of the petroleum phase. Additional mercaptan conversion continues in the separator. An average residence time in the gravity separator is 30 minutes.



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## Process



The treated petroleum product is withdrawn from the top of the gravity separator. The aqueous effluent consists of water, very low concentrations of the catalyst and spent co-catalyst. The aqueous effluent is typically treated in existing wastewater treatment facilities or disposal wells. If desired, the catalyst can be reclaimed.

## Process Advantages

### Scalability

The SulphCo® process is easily scalable in response to increases in feed flow rate. The ultrasound assembly is a modular, skid-mounted unit with a processing capacity of 1,000 - 3,500 BPD. Skids are designed to work in parallel. Additional capacity is available merely by installing additional skids.

### Feed Quality Flexibility

Swings in mercaptan sulfur level, both gradual and abrupt, are handled easily by the SulphCo® process. Additive flow rates are automatically adjusted, in real-time, based on feed sulfur concentration; resulting in consistent, on-spec product.

### Operations are Cost Effective

Operating expenses depend upon the feed's sulfur concentration. Additionally, operating expenses depend upon the objective. Reducing mercaptan sulfur to meet a pipeline specification can be less expensive than eliminating mercaptan odor.

## Simple to Operate

The ultrasound assembly is completely automated, with minimal operator attention needed. Ultrasonic probes degrade over time, and must be replaced every 2+ months, requiring approximately 60 minutes of operator attention.

## About SulphCo®

SulphCo® is an energy technology company engaged in the business of developing and commercializing its patented and proprietary Sonocracking™ technology that is designed to desulfurize liquid petroleum streams. SulphCo is based in Houston, Texas, and trades on the NYSE-Amex under the ticker symbol "SUF."

## Contacts

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