



SulphCo® Sulfur Reduction Process for Diesel

Overview

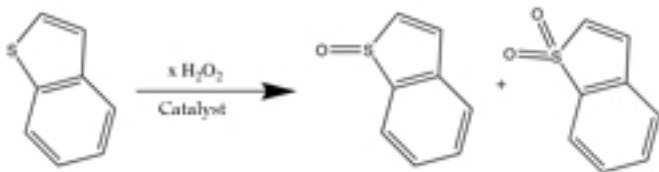
The SulphCo® oxidative desulfurization process for diesel is designed to convert sulfur to sulfoxides and sulfones. This sulfur conversion is dramatically accelerated by the use of high-power ultrasound. Diesel is an ideal application for SulphCo®'s process.

The SulphCo® process consists of two-steps: sonication/separation and adsorption or extraction. In the sonication phase of step one, the SulphCo® process uses an additive package of hydrogen peroxide and an aqueous catalyst. High-power ultrasound creates an intimate dispersion of these additives in the diesel stream. No persistent emulsions are formed. In the separation phase of step one, the aqueous phase is separated from the diesel stream by gravity. In step two, adsorption or extraction removes the converted sulfur compounds from the treated diesel stream.

The typical objective of the SulphCo® process is to reduce the sulfur in the incoming diesel stream from its initial value of 100-500+ ppm S to less than 8 ppm S.

Chemistry

The chemistry of the conversion step is shown below for benzothiophene. Oxidation of the sulfur compounds in diesel to sulfoxides and sulfones renders them more polar than their parent compounds, allowing them to be readily separated from the diesel by adsorption or extraction.



Reaction conditions are typically mild, with temperatures < 212 °F and pressures < 60 psig. The aqueous phase generally comprises < 2% of the total diesel stream volume. The amounts of additives

needed are directly proportional to the sulfur content of the diesel stream.

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

Apart from the conversion of sulfur compounds to sulfoxides and sulfones, and their subsequent removal, no significant changes in diesel properties occur.

Process Description

Untreated diesel 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 and catalyst solutions are injected into the diesel and subjected to intense ultrasound in the reactor. Reactor residence times are typically less than 500 milliseconds. The effluent from the ultrasound reactor is a homogenous phase, consisting of an extremely fine dispersion of aqueous droplets in petroleum.

The reactor effluent is sent to a gravity separator, in which the aqueous droplets coalesce and drop out of the petroleum phase. Additional conversion of sulfur bearing compounds continues in the separator. A typical residence time in the gravity separator is an average of 30 minutes or less.

The treated product exits the separator and enters post processing (i.e., either adsorption or extraction) the function of which is to remove oxidized sulfur compounds. This is typically accomplished by adsorption (for diesel streams with less than 100 ppm S) or extraction (for diesels with higher sulfur levels).



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The major waste stream from the SulphCo® process is the spent aqueous reaction phase, which contains low concentrations of the catalyst. The aqueous effluent is typically treated in existing wastewater treatment facilities or disposal wells. If desired, the catalyst can be reclaimed.

Process Advantages

Scalable

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 line capacity of 2,500 - 3,500 BPD. Skids are designed to have up to three processing lines working in parallel. Additional capacity is available merely by installing additional skids.

Responsiveness

Swings in sulfur level, both gradual and abrupt, are handled easily by the SulphCo® process. Additive flow rates are adjusted automatically in real-time, based on feed sulfur concentration. This results in consistent, on-spec product. The gravity separation unit is insensitive to variations in aqueous phase loading.

Operations are Cost Effective

Operating expenses depend upon the feed's sulfur concentration, since hydrogen peroxide and the catalyst consumption levels are a function of the starting sulfur concentration.

Simple to Operate

The ultrasound assembly is completely automated, with minimal operator attention needed. Ultrasonic probes degrade over time and must be replaced approximately every 2+ months, which requires about 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

For more information or application inquiries about the SulphCo® process, please contact SulphCo® at:

Phone – 713-896-9100

Fax – 713-896-8803

Email – requestinfo@sulphco.com

Website – www.sulphco.com

SulphCo, Inc.

4333 W Sam Houston Pkwy N
Suite 190
Houston, TX 77043
www.sulphco.com



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Process Block Flow Diagram

