



Process Technology and Equipment

Caustic-Free Merox™ Process for Fixed-Bed Naphtha Sweetening

INTRODUCTION

The Caustic-Free Merox process for naphtha sweetening is one of the family of Merox process applications developed for control of mercaptans (thiols) in naphtha and gasoline. The Caustic-Free Merox process was developed specifically to eliminate the use of caustic for mercaptan sweetening. This was accomplished by the development of special high activity catalysts and activators that allow the mercaptan sweetening reaction to take place in the presence of a weak base, ammonia.

Caustic-Free Merox naphtha sweetening can be applied to light and heavy FCC gasolines, natural gas liquids, and light straight-run naphthas. In addition to eliminating the use of NaOH, Caustic-Free Merox gasoline sweetening offers simplicity of design (one major vessel), ease of operation, and minimal effluent disposal concerns. A refiner's existing Minalk™ Caustic Merox units can easily be converted to Caustic-Free technology.

CHEMISTRY

Caustic-Free Merox naphtha sweetening involves the catalytic oxidation of mercaptans to disulfides in the presence of ammonia. The disulfides formed remain in the treated hydrocarbon stream.

The sweetening reaction is shown below:

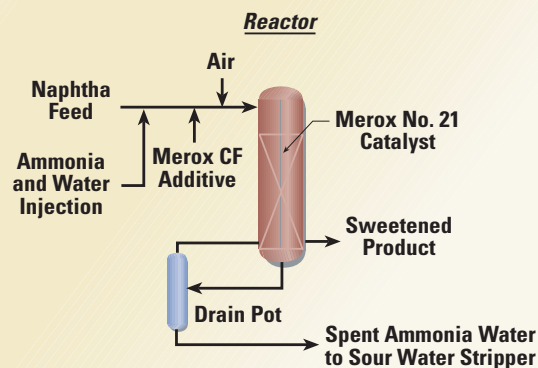


R represents a hydrocarbon radical that may be aliphatic, aromatic, or cyclic; and saturated or unsaturated. A special pre-impregnated catalyst developed specifically for Caustic-Free sweetening accelerates the reaction rate to permit economical treating at normal refinery product rundown temperatures without the need for the presence of a strong base (NaOH). Instead, a weak base, ammonia (NH₃) is employed. A catalyst activator is also used in this application.

PROCESS FLOW DESCRIPTION

A small quantity of anhydrous or aqueous ammonia solution, is continuously injected into the gasoline feed, along with a small amount of Merox CF™ activator prior to the addition of air. The combined stream passes through a fixed bed of Merox No. 21™ catalyst where the mercaptans are oxidized to disulfides and the dilute caustic is coalesced. The sweetened product requires no further filtration or separation. The small amount of coalesced dilute ammoniated water effluent is collected in a drain pot and sent to the refinery's sour water stripper.

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BENEFITS

LOW CAPITAL INVESTMENT

The non-corrosive environment, near ambient operating temperature and low design pressure allow for carbon steel construction throughout. The simple process flow lends itself well to modular fabrication.

LOW OPERATING COSTS

Although operating costs are higher than a Minalk Caustic Merox unit, the operating costs of a Caustic-Free Merox unit are still low. Catalyst, chemical, and utility costs are only a few U.S. cents per barrel of treated product.

ELIMINATION OF CAUSTIC

- This technology has been developed by UOP specifically for refiners that require complete elimination of caustic for sweetening applications due to environmental concerns or high caustic disposal costs.
- Replacing existing liquid-liquid sweetening units that generate large quantities of high concentration spent phenolic caustic effluents can be a very economic solution for refiners with high caustic disposal costs.
- Existing sweetening units can easily be converted to Caustic-Free Merox technology.

EASE OF OPERATION

A naphtha sweetening Caustic-Free Merox unit requires minimal operator attention. Air, ammonia and activator injection rates are the only adjustments necessary to accommodate a wide range of feed rates and mercaptan concentrations.

HIGH EFFICIENCY DESIGN

The fixed-bed reactor in a naphtha sweetening Caustic-Free Merox unit uses the same effective distribution / collector internals used in a Minalk Caustic Merox unit. Sweetening takes place in the presence of ammonia and a high surface area pre-impregnated catalyst designed specifically for naphtha and gasoline sweetening.

PRODUCT QUALITY

- The Caustic-Free Merox process reliably produces a sweetened product containing less than 5 wt-ppm mercaptan sulfur.
- Since the naphtha sweetening Caustic-Free Merox process utilizes a weak base, only very minimal amounts of phenols (“acid oils”) are removed from the feed. Phenols are natural oxidation inhibitors that have high octane blending value.

EXPERIENCE

The first gasoline sweetening Caustic-Free Merox was placed into commercial operation in 1990. To date, a total design capacity of 98,200 barrels per stream day have been placed on stream.

CATALYST

To ensure that catalyst of the highest quality is available, UOP manufactures a family of highly active and selective catalysts and activators for the Caustic-Free Merox process. Merox No. 21 catalyst has been developed specifically for gasoline sweetening applications. Merox No. 21, which is supplied as a pre-impregnated catalyst, is used with Merox CF activator.

FOR MORE INFORMATION

For more information, contact your UOP representative or UOP at:

Phone: +1-847-391-2000

Fax: +1-847-391-2253

