CLAIMS

1. A process comprising:

   reacting, in a plug flow reactor having a fixed bed containing a solid catalyst comprising a heterogeneous ion exchange resin, hydrogen sulfide and ethylene oxide in the presence of the solid catalyst to yield a reaction product comprising beta-mercaptoethanol, wherein during steady state operation of the reactor, the hydrogen sulfide and the ethylene oxide are present in a mole ratio in a range of about 9:1 to about 20:1, wherein an effluent of the reactor comprises the reaction product, wherein after a single pass through the reactor a conversion of ethylene oxide to the reaction product is greater than about 99 wt. % and the reaction product in the effluent further comprises less than about 0.5 wt. % thiodiglycol on a hydrogen sulfide-free basis, wherein the conversion of ethylene oxide to the reaction product is based on a weight of the ethylene oxide that converts to the reaction product divided by a weight of the ethylene oxide fed to the reactor.

2. The process of claim 1, further comprising:

   converting, in the reactor, at least a portion of the hydrogen sulfide from a liquid phase to a vapor phase to absorb a heat of reaction created in the step of reacting.

3. The process of claim 2, wherein the step of reacting and the step of converting occur about simultaneously.

4. The process of claim 1, wherein no internal and/or external cooling source is used to cool the reactor.

5. The process of claim 1, wherein the reaction product in the effluent consists essentially of the beta-mercaptoethanol and the thiodiglycol.

6. The process of claim 1, wherein no detectable amount of ethanedithiol is present in the reaction product when analyzing a sample of the effluent of the reactor via gas chromatography to two decimal places for weight percent or to three decimal places for mole percent.

7. The process of claim 1, wherein the reactor is an adiabatic reactor.

8. The process of claim 1, wherein the solid catalyst has weakly basic active groups to allow a conversion of the ethylene oxide by the hydrogen sulfide with a selectivity to beta-mercaptoethanol greater than about 99 wt. % based on a total weight of the ethylene oxide that converts to beta-mercaptoethanol divided by a total weight of the ethylene oxide that converts into the reaction product.

9. The process of claim 1, wherein the solid catalyst comprises a styrene-divinylbenzene copolymer with weakly basic active groups comprising alkyl amines.

10. The process of claim 1, performed at a temperature in a range of about 30° C. to about 80° C.

11. The process of claim 1, wherein the fixed bed of the reactor has a weight average bed temperature of about 65° C. to about 70° C.

12. The process of claim 1, performed at a pressure in a range of about 300 psig to about 500 psig.

13. The process of claim 12, performed at a pressure of about 450 psig.

14. The process of claim 1, wherein a weight hourly space velocity of the ethylene oxide is in a range of about 0.1 to about 1 hr^{-1}.

15. The process of claim 1, further comprising:

    recovering a vapor phase of the hydrogen sulfide from the reactor;

    condensing the vapor phase of the hydrogen sulfide to a liquid phase; and

    recycling the liquid phase of the hydrogen sulfide to the reactor.