It is desirable to provide an improved method of producing ethylene oxide which resolves some of the issues associated with operating the epoxidation reaction at optimal efficiency.

BRIEF DESCRIPTION

The present disclosure~~invention~~ allows the production of the same amount of alkylene oxide at both higher efficiency (resulting in raw material savings, and less greenhouse gas generation) and lower temperature (resulting in less by-product impurities and less Ag sintering) than earlier processes. Higher selectivity and lower operating temperatures can be achieved through the use of this disclosure~~invention~~ without the need for a control system capable of automatically maintaining constant productivity or conversion. Operation at lower temperatures can enable longer catalyst lifetimes as well. The present disclosure~~invention~~ allows the determination of a set of operating conditions that results in a higher efficiency, for a given productivity, than would be obtained by earlier processes.

In one embodiment, a method of producing an alkylene oxide is provided. The method includes passing a reaction mixture comprising alkylene, oxygen and a gaseous chlorine-containing promoter species over a supported catalyst containing silver and a promoting amount of rhenium to undergo an epoxidation reaction at a first operating condition to form an alkylene oxide in a reactor. The method further includes subsequently performing the epoxidation reaction within the reactor at a preferred operating condition. The preferred operating condition is characterized by an efficiency of the epoxidation reaction toward the alkylene oxide where the efficiency is lower than that of a maximum efficiency achievable at an operating temperature corresponding to the preferred operating condition.

In another embodiment, a method of determining a preferred operating condition of an epoxidation reaction over a catalyst containing silver and a promoting amount of rhenium in the presence of a gaseous chlorine-containing promoter species is provided. The method includes determining a derivative of efficiency to productivity of the epoxidation reaction as a function of overall catalyst chloriding effectiveness value at a fixed operating temperature. The preferred operating condition is characterized by the derivative which is in a range of about -1 to about -4 when the efficiency of the epoxidation reaction to form alkylene oxide is expressed in percent and productivity of the epoxidation

reaction is expressed as the concentration of alkylene oxide in the reactor outlet stream, in mole percent.

In a first aspect, there is provided a method of determining a preferred operating condition of an epoxidation reaction in a reactor in presence of a supported catalyst comprising silver and a promoting amount of rhenium, and in presence of a gaseous chlorine-containing promoter species; comprising: determining a derivative of efficiency to productivity of the epoxidation reaction as a function of the overall catalyst chloriding effectiveness value at a fixed operating temperature, wherein the preferred operating condition is characterized by a derivative which is in a range of about -1 to about -4 when the efficiency of the epoxidation reaction to form alkylene oxide is expressed in percent and productivity of the epoxidation reaction is expressed as the concentration of alkylene oxide in the reactor outlet stream in mole percent.

In yet another embodiment, a method of determining a preferred operating condition of an epoxidation reaction in the presence of a supported catalyst containing silver and a promoting amount of rhenium in the presence of a gaseous chlorine-containing promoter species is provided. The method includes generating a first data set on efficiency and productivity of the epoxidation reaction at at least three overall catalyst chloriding effectiveness values at a first temperature. The method further includes determining a maximum efficiency value at the first temperature from the first data set. The method further includes selecting a range of efficiency values lower than the maximum efficiency value. The range of efficiency values corresponds to higher productivity of the epoxidation reaction than that achievable when the epoxidation reaction is operated at maximum efficiency and at the first temperature. The range of efficiency values corresponds to the preferred operating condition.

In a second aspect, there is provided a method of determining a preferred operating condition of an epoxidation reaction in a reactor in presence of a catalyst comprising silver and a promoting amount of rhenium, and in presence of a gaseous chlorine-containing promoter species; comprising:

a) generating a first data set on efficiency and productivity of the epoxidation reaction at at least three overall catalyst chloriding effectiveness values at a first temperature;

b) determining a maximum efficiency value at the first temperature from the first data set; and

c) selecting a range of efficiency values lower than the maximum efficiency value, wherein the range of efficiency values correspond to higher productivity of the epoxidation reaction than that corresponding to the maximum efficiency value, and wherein the range of efficiency values correspond to the preferred operating condition.

DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein;

FIG. 1 is a flowchart of a method of determining a preferred operating condition according to embodiments of the present invention;

FIG. 2 is a flowchart of another method of determining a preferred operating condition according to one embodiment of the present invention;

FIG. 3 is an illustration of a plot of efficiency against productivity of an epoxidation reaction obtained using the method shown in FIG.2, in accordance with embodiments of the present invention;

FIG. 4 is a flowchart of yet another method of determining a preferred operating condition according to embodiments of the present invention;

FIG. 5 is an illustration of a plot of efficiency against productivity of an epoxidation reaction obtained using the method shown in FIG.4, in accordance with embodiments of the present invention;

WHAT IS CLAIMED IS:

1. A method of determining a preferred operating condition of an epoxidation reaction in a reactor in presence of a supported catalyst comprising silver and a promoting amount of rhenium, and in presence of a gaseous chlorine-containing promoter species; comprising: determining a derivative of efficiency to productivity of the epoxidation reaction as a function of the overall catalyst chloriding effectiveness value at a fixed operating temperature, wherein the preferred operating condition is characterized by a derivative which is in a range of about -1 to about -4 when the efficiency of the epoxidation

reaction to form alkylene oxide is expressed in percent and productivity of the epoxidation reaction is expressed as the concentration of alkylene oxide in the reactor outlet stream in mole percent.

2. A method of determining a preferred operating condition of an epoxidation reaction in a reactor in presence of a catalyst comprising silver and a promoting amount of rhenium, and in presence of a gaseous chlorine-containing promoter species; comprising:

a) generating a first data set on efficiency and productivity of the epoxidation reaction at at least three overall catalyst chloriding effectiveness values at a first temperature;

b) determining a maximum efficiency value at the first temperature from the first data set; and

c) selecting a range of efficiency values lower than the maximum efficiency value, wherein the range of efficiency values correspond to higher productivity of the epoxidation reaction than that corresponding to the maximum efficiency value, and wherein the range of efficiency values correspond to the preferred operating condition.

3. The method of claim 2, wherein determining the maximum efficiency value comprises generating a first plot, or using a program, or using a mathematical equation or any combinations thereof.

4. The method of claim 3 further comprising generating the first plot by generating a first curve with a first maximum by plotting efficiency against productivity and wherein the first maximum corresponds to the maximum efficiency value; and

selecting a first region on the first curve corresponding to the preferred operating condition, wherein the first region lies to the right of the first maximum of the first curve when abscissa of the plot is productivity of the epoxidation reaction.