other process variables such as catalyst age. Thus, a need has arisen for a process that addresses the foregoing issues.

SUMMARY

[0013] In ~~accordance with~~ one aspect, there is provided a process for manufacturing an alkylene oxide by reacting a feed gas comprising an alkylene, oxygen, and at least one organic chloride over a high efficiency silver catalyst to yield a reaction product comprising the alkylene oxide, ~~is~~wherein ~~provided. T~~the feed gas has an overall catalyst chloriding effectiveness, and the reaction is carried out at a reaction temperature~~.~~, ~~T~~the process comprise~~s~~ing: selecting a decrease in at least one of the concentration of the alkylene oxide in the reaction product and the yield of the alkylene oxide; varying the overall catalyst chloriding effectiveness ~~of the feed gas~~ and the reaction temperature in an alternating sequence such that when one of the overall catalyst chloriding effectiveness and the reaction temperature is varied, the other of the overall catalyst chloriding effectiveness and the reaction temperature is maintained at a ~~substantially~~ constant value for a selected period of time~~.~~, ~~In certain illustrative embodiments,~~ wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises varying ~~an alternating~~ one of the overall catalyst chloriding effectiveness and the reaction temperature in response to ~~a~~the selected decrease in at least one of the concentration of the alkylene oxide in the reaction product ~~or a selected decrease in~~and the yield of the alkylene oxide.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Referring now to the drawings, illustrative embodiments are shown in detail. Although the drawings represent some embodiments, the drawings are not necessarily to scale and certain features may be exaggerated, removed, or partially sectioned to better illustrate and explain the present invention. Further, the embodiments set forth herein are exemplary and are not intended to be exhaustive or otherwise limit or restrict the claims to the precise forms and configurations shown in the drawings and disclosed in the following detailed description.

[0015] FIG. 1 is a process flow diagram depicting an embodiment of a process for making an alkylene oxide by epoxidizing an olefin;

~~REPLACEMENT SHEET~~ CLAIMS

1. A process for manufacturing an alkylene oxide by reacting a feed gas comprising an alkylene, oxygen, and an at least one organic chloride over a high efficiency silver catalyst to yield a reaction product comprising the alkylene oxide, wherein the feed gas has an overall catalyst chloriding effectiveness, and the reaction is carried out at a reaction temperature, the process comprising:

selecting a decrease in at least one of the concentration of the alkylene oxide in the reaction product and the yield of the alkylene oxide;

varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence such that when one of the overall catalyst chloriding effectiveness and the reaction temperature is varied, the other of the overall catalyst chloriding effectiveness and the reaction temperature is maintained at a constant value for a selected period of time, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises varying one of the overall catalyst chloriding effectiveness and the reaction temperature in response to the selected decrease in at least one of the concentration of the alkylene oxide in the reaction product and the yield of the alkylene oxide.

2. The process for manufacturing an alkylene oxide of claim 1, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises maintaining the overall catalyst chloriding effectiveness at a constant first overall catalyst chloriding effectiveness value for a first selected period of time, maintaining the reaction temperature at a constant first reaction temperature value for a second selected period of time, and increasing the overall catalyst chloriding effectiveness from the constant first overall catalyst chloriding effectiveness value to a constant second overall catalyst chloriding effectiveness value at the expiration of the first selected period of time, wherein the first period of time is different from the second period of time.

3. The process for manufacturing an alkylene oxide of claim 1, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises maintaining the reaction temperature at a constant first reaction temperature value for a first selected period of time, maintaining the overall catalyst chloriding effectiveness at a constant first overall catalyst chloriding effectiveness value for a second selected period of time, and increasing the reaction temperature from the constant first reaction temperature value to a constant second reaction temperature value at the expiration of the first selected period of time, wherein the first period of time is different from the second period of time.

4. The process of manufacturing an alkylene oxide of claim 1, wherein the selected decrease in the concentration of the alkylene oxide in the reaction product is less than about 0.5 mole percent.

5. The process for manufacturing an alkylene oxide of claim 1, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises varying an alternating one of the overall catalyst chloriding effectiveness and the reaction temperature at intervals that correspond to catalyst age increments of less than about 1.0 kt alkylene oxide/m^3 catalyst.

6. The process for manufacturing an alkylene oxide of claim 1, wherein the overall catalyst chloriding effectiveness value is represented by the formula:

$$Z^* = \frac{\text{ethyl chloride equivalent (ppmv)}}{\text{ethane equivalent (mole percent)}}$$

wherein the ethyl chloride equivalent is the total concentration in ppmv of ethyl chloride which provides the same catalyst chloriding effectiveness of the at least one organic chloride in the feed gas at the concentration of the at least one organic chloride in the feed gas; and

the ethane equivalent is the total concentration in mole percent of ethane which provides the same dechloriding effectiveness as the non-chloride containing hydrocarbons in the feed gas at the concentration of the non-chloride containing hydrocarbons in the feed gas.

7. The process for manufacturing an alkylene oxide of claim 6, wherein the at least one organic chloride is selected from the group consisting of ethyl chloride, ethylene dichloride, and vinyl chloride, and the ethyl chloride equivalent has the following formula:

ethyl chloride equivalent (ppmv) = ECL +2EDC +VCL

wherein, ECL is the concentration of ethyl chloride in the feed gas in ppmv, EDC is the concentration of ethylene dichloride in the feed gas in ppmv, and VCL is the concentration of vinyl chloride in the feed gas in ppmv.

8. The process for manufacturing an alkylene oxide of claim 6, wherein the non-chloride containing hydrocarbons in the feed gas comprise at least one selected from the group consisting of ethylene and ethane, and the ethane equivalent has the following formula:

ethane equivalent (mole percent) = $C_2H_6 + 0.01\,C_2H_4$

wherein, C_2H_6 is the concentration of ethane in the feed gas in mole percent, and C_2H_4 is the concentration of ethylene in the feed gas in mole percent.

9. The process for manufacturing an alkylene oxide of claim 6, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises making alternating increases in the overall catalyst chloriding effectiveness and the reaction temperature, wherein the increases in the catalyst chloriding effectiveness are made in Z* increments of less than about 5.0 and the increases in reaction temperature are made in increments of less than about 10°C.

10. The process for manufacturing an alkylene oxide of claim 6, wherein Z* is less than about 20.

11. The process for manufacturing an alkylene oxide of claim 1, wherein the alkylene oxide is ethylene oxide and the alkylene is ethylene.

12. The process for manufacturing an alkylene oxide of claim 1, wherein the organic chloride is at least one selected from ethylene dichloride, ethyl chloride, and vinyl chloride.

13. The process for manufacturing an alkylene oxide of claim 1, wherein the high efficiency silver catalyst includes a rhenium promoter.

14. The process for manufacturing an alkylene oxide of claim 1, wherein the catalyst age is less than about 10 kt alkylene oxide/m^3 of catalyst.

15. The process for manufacturing an alkylene oxide of claim 1, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises varying the concentration of the at least one organic chloride in the feed gas and the reaction temperature in an alternating sequence.

16. The process for manufacturing an alkylene oxide of claim 1, wherein the step of varying the overall catalyst chloriding effectiveness and the reaction temperature in an alternating sequence comprises varying the overall catalyst chloriding effectiveness and one selected from the flow rate of a reactor coolant fluid and the pressure of a reactor steam coolant in an alternating sequence.

17. The process for manufacturing an alkylene oxide of claim 1, wherein the feed gas further comprises at least one nitrogen-containing promoter.

18. The process for manufacturing an alkylene oxide of claim 17, wherein the feed gas has an overall effectiveness of at least one nitrogen-containing promoter, and when the overall chloriding effectiveness in the feed gas is varied, the overall effectiveness of the at least one nitrogen-containing promoter is varied.

19. The process for manufacturing an alkylene oxide of claim 18, wherein the overall effectiveness of the at least one nitrogen-containing promoter is represented by the formula:

$$N^* = \text{nitric oxide equivalent (ppmv)}^*(P_{inlet}/2{,}300\ \text{kPa})$$

wherein P_{inlet} is the reactor inlet pressure in kilo Pascals and the nitric oxide equivalent is the nitric oxide concentration in ppmv which provides the same promoting effectiveness as the at least one nitrogen-containing promoter.

20. The process of manufacturing an alkylene oxide of claim 19, further comprising selecting a ratio of the overall effectiveness of the at least one nitrogen-containing promoter to the overall chloriding effectiveness, wherein when the overall chloriding effectiveness is varied, the overall effectiveness of the at least one nitrogen-containing promoter is varied to maintain the selected ratio.