wherein, the ethyl chloride equivalent is the total concentration in ppmv of ethyl chloride which provides substantially 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 % of ethane which provides substantially 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. The feed gas has a Z* value ranging from 1.0 to 5.0. In a first aspect, there is provided a method for starting-up an alkylene oxide production process, the alkylene oxide production process comprising 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, the start-up method comprising: providing a feed gas comprising the alkylene, oxygen, and the at least one organic chloride, wherein the feed gas has an overall chloriding effectiveness represented by the formula:

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

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, the ethane equivalent is the total concentration in mole % 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, and the feed gas has a Z* value ranging from 1.0 to 5.0; reacting the feed gas over the high-efficiency silver catalyst at a reaction temperature such that within a catalyst aging period of no greater than 0.03 kT alkylene oxide/m^3 catalyst after the reactor is first on-stream, the reaction temperature is from 215°C to 240°C, and the molar ratio of oxygen to the alkylene in the feed gas is at least 0.2, thereby yielding a reaction product comprising a start up concentration of the alkylene oxide. The start-up method further comprises reacting the feed gas over the high-efficiency silver catalyst at a reaction temperature such that within a catalyst aging period of no greater than 0.03 kT alkylene oxide/m^3 catalyst after the reactor is first on-stream, the reaction temperature is from 215°C to 240°C, and the molar ratio of oxygen to the

alkylene in the feed gas is at least 0.2, thereby yielding a reaction product comprising a start up concentration of the alkylene oxide.

[0011] A method for producing an alkylene oxide by reacting an alkylene, oxygen, and at least one organic chloride over a high efficiency silver catalyst is also provided. The method comprises reacting a feed gas comprising the alkylene, oxygen, and at least one organic chloride over the high-efficiency silver catalyst at a reaction temperature and an overall chloriding effectiveness to yield a reaction product comprising the alkylene oxide such that the process has a molar ratio of oxygen to the alkylene in the feed gas and a first efficiency to the alkylene oxide, the first efficiency to the alkylene oxide being less than a desired efficiency to the alkylene oxide. At least one process parameter is adjusted such that the efficiency of the process to the alkylene oxide increases from the first efficiency to a second efficiency. The at least one process parameter is selected from the group consisting of the molar ratio of oxygen to the alkylene in the feed gas, reactor temperature, and overall chloriding effectiveness. Following the adjusting step, the molar ratio of oxygen to the alkylene in the feed gas is at least 0.2, the reaction temperature is from 215°C to 240°C, and the overall chloriding effectiveness is represented as Z* and is from 1.0 to 5.0, wherein Z* is represented as follows:

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

wherein the ethyl chloride equivalent is the total concentration in ppmv of ethyl chloride which provides substantially 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 % of ethane which provides substantially 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.

[0011a] In a second aspect, there is provided a method for producing an alkylene oxide by reacting an alkylene, oxygen, and at least one organic chloride over a high efficiency silver catalyst, the method comprising: reacting a feed gas comprising the alkylene, oxygen, and at least one organic chloride over the high-efficiency silver catalyst at a reaction temperature and an overall chloriding effectiveness to yield a reaction product comprising the alkylene oxide such that the process has a molar ratio of oxygen to the alkylene in the feed gas and a first efficiency to the alkylene oxide, the first efficiency to the alkylene oxide being less than a target efficiency to the alkylene oxide; adjusting at least one process parameter such that the efficiency of the process to the alkylene oxide increases from the first efficiency to a second efficiency, wherein the at least one process parameter is selected from the group consisting of the molar ratio of oxygen to the alkylene in the feed gas, reactor temperature, and overall chloriding effectiveness, following the adjusting step the molar ratio of oxygen to the alkylene in the feed gas is at least 0.2, the reaction temperature is from 215°C to 240°C, the overall chloriding effectiveness is represented as Z* and is from 1.0 to 5.0, and Z* is represented as follows:

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

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 % 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] 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.

[0013] FIG. 1 is a process flow diagram depicting an embodiment of a process for making an alkylene oxide by epoxidizing an olefin over a high efficiency catalyst;

[0014] FIG. 2 is flow chart depicting an embodiment of a method of starting-up a high efficiency alkylene oxide catalyst;

[0015] FIG. 3 is a flow chart depicting an embodiment of a method of reviving the performance of a high efficiency alkylene oxide catalyst;

[0016] FIG. 4A is a graph depicting the effect of lowering and subsequently increasing the start-up molar ratio of oxygen to ethylene on the efficiency to ethylene oxide in an experimental process of making ethylene oxide with a high efficiency catalyst;

[0017] FIG. 4B is a graph depicting inlet coolant temperature, overall chloriding effectiveness (Z*) and ΔEO data for the experimental process of FIG. 4A;

[0018] FIG. 5A is a graph depicting the effect of lowering the start-up molar ratio of oxygen to ethylene on the efficiency to ethylene oxide in an experimental process of making ethylene oxide with a high efficiency catalyst;