Claims

1. A continuous process for preparing propylene oxide comprising a start-up stage and a normal run stage, wherein the normal run stage comprises

(i) continuously providing a liquid feed stream comprising propene, hydrogen peroxide, acetonitrile, a formate salt, water and optionally propane, wherein in the liquid feed stream, the molar amount of the formate salt relative to the molar amount of hydrogen peroxide at a given point of time during the normal run stage is $a^N(Fo/H_2O_2)$;

(ii) continuously passing the liquid feed stream provided in (i) into an epoxidation zone comprising a catalyst comprising a titanium zeolite having framework type MWW, and subjecting the liquid feed stream to epoxidation reaction conditions in the epoxidation zone, obtaining a reaction mixture comprising propylene oxide, acetonitrile, water, the formate salt, optionally propene, and optionally propane;

(iii) continuously removing an effluent stream from the epoxidation zone, the effluent stream comprising propylene oxide, acetonitrile, water, at least a portion of the formate salt, optionally propene, and optionally propane;

wherein the normal run stage is characterized in an average rate of change of $a^N(Fo/H_2O_2)$ of less than 0 h^{-1};

wherein the start-up stage, which is prior to the normal run stage, comprises

(a) continuously providing a liquid feed stream comprising propene, acetonitrile, and optionally propane and continuously passing said liquid feed stream under start-up conditions for a period of time t_1 into the epoxidation zone comprising the catalyst comprising a titanium zeolite having framework type MWW;

wherein after the period of time t_1, the start-up stage further comprises

(b) continuously providing a liquid feed stream comprising hydrogen peroxide, admixing said liquid feed stream to the liquid feed stream provided in (a) obtaining a liquid feed stream comprising hydrogen peroxide, propene, acetonitrile, and optionally propane, and continuously passing said liquid feed stream under start-up conditions for a period of time t_2 into the epoxidation zone comprising the catalyst comprising a titanium zeolite having framework structure type MWW,

wherein the liquid feed stream according to (b) comprises the formate salt, wherein the molar amount of the formate salt relative to the molar amount of hydrogen peroxide at a given point of time during step (b) of the start-up stage is $a^S(Fo/H_2O_2)$, wherein after the period of time t_2, the normal run stage begins and $a^S(Fo/H_2O_2)$ is $a^N(Fo/H_2O_2)$ at the beginning of the normal run stage.

2. The continuous process of claim 1, wherein the average rate of change of $a^N(Fo/H_2O_2)$ is in the range of from -10^{-10} to -10^{-6} h^{-1}.

3. The continuous process of claim 1 or 2, wherein at the beginning of the normal run stage, $a^N(Fo/H_2O_2)$is in the range of from $1.0*10^{-4}$ to $1.0*10^{-2}$.

4. The continuous process of any one of claims 1 to 3, wherein during the normal run stage, the epoxidation conditions according to (ii) comprise an epoxidation temperature T^N and wherein during the normal run stage, the average rate of change of T^N is in the range of from 0 to 50 $K*h^{-1}$, wherein T^N is the temperature of a heat transfer medium used for adjusting the temperature of the reaction mixture in the epoxidation reaction zone according to (ii).

5. The continuous process of claim 4, wherein during the initial stage of the normal run stage, the average rate of change of T^N is in the range of from 0 to 0.5 $K*h^{-1}$, and wherein, after said initial stage, when $a^N(Fo/H_2O_2)$ is in the range of from 40 to 60 % of a $a^N(Fo/H_2O_2)$ at the beginning of the normal run stage, T^N is increased by at least 0.1 °C.

6. The continuous process of claim 4 or 5, wherein during the normal run stage, T^N is in the range of from 20 to 70 °C.

7. The continuous process of any one of claims 1 to 6, wherein during the normal run stage, the epoxidation conditions according to (ii) comprise a hydrogen peroxide conversion $c^N(H_2O_2)$, wherein the average rate of change of $c^N(H_2O_2)$ is in the range of from $-1.0*10^{-3}$ to $1.0*10^{-3}$ %-points$*h^{-1}$, wherein $c^N(H_2O_2)$ is defined as the molar amount of hydrogen peroxide comprised in the effluent stream removed in (iii) relative to the molar amount of hydrogen peroxide comprised in the liquid feed stream provided in (i) at a given point of time during the normal run stage.

8. The continuous process of claim 7, wherein during the normal run stage, $c^N(H_2O_2)$ is in the range of from 99.5 to 100 %.

9. The continuous process of any one of claims 1 to 8, wherein the formate salt according to (i) consists of a potassium formate salt.

10. The continuous process of any one of claims 1 to 9, wherein during the normal run stage, the epoxidation conditions according to (ii) comprise an epoxidation reaction pressure in the range of from 14 to 100 bar, wherein the epoxidation reaction pressure is defined as the absolute pressure at the exit of the epoxidation zone.

11. The continuous process of any one of claims 1 to 10, wherein during the normal run stage, the epoxidation conditions according to (ii) comprise a catalyst loading in the range of from 0.05 to 1.25 h^{-1}, wherein the catalyst loading is defined as the ratio of the mass flow rate in kg/h of hydrogen peroxide contained in liquid feed stream provided in (i) relative to the amount in kg of catalyst comprising a titanium zeolite having framework type MWW comprised in the epoxidation zone according to (ii).

12. The continuous process of any one of claims 1 to 11, wherein the titanium zeolite having framework type MWW comprised in the catalyst according to (ii) contains titanium, calculated as elemental titanium, in an amount in the range of from 0.1 to 5 weight-%, based on the total weight of the titanium zeolite having framework type MWW.

13. The continuous process of any one of claims 1 to 11, wherein the titanium zeolite having framework type MWW comprised in the catalyst according to (ii) contains titanium, calculated as elemental titanium, in an amount in the range of from 0.1 to 5 weight-%, based on the total weight of the titanium zeolite having framework type MWW, and contains zinc, calculated as elemental zinc, in an amount in the range of from 0.1 to 5 weight-%, based on the total weight of the titanium zeolite having framework type MWW.

14. The continuous process of any one of claims 1 to 13, wherein during the normal run stage, the liquid feed stream provided in (i) comprises
the acetonitrile in an amount in the range of from 60 to 75 weight-%, based on the total weight of the liquid feed stream;
the hydrogen peroxide in an amount in the range of from 6 to 10 weight-%, based on the total weight of the liquid feed stream;
the water at a molar ratio of water relative to acetonitrile in the range of from 1:50 to 1:4;
the propene at a molar ratio of propene relative to hydrogen peroxide comprised in the liquid feed stream in the range of from 1:1 to 1.6:1, and
optionally the propane at a molar ratio of propane relative to the sum of propene and propane in the range of from 0.0001:1 to 0.15:1;
wherein at least 95 weight-% of the liquid feed stream provided in (i) consist of propene, hydrogen peroxide, acetonitrile, the formate salt, water and optionally propane.

15. The continuous process any one of claims 1 to 14, wherein at least 98 weight-% of the liquid feed stream provided in (a) consist of propene, acetonitrile, and optionally propane, wherein the liquid feed stream according to (a) comprises hydrogen peroxide in an amount in the range of from 0 to 0.01 weight-%, based on the total weight of the liquid feed stream, and wherein the liquid feed stream according to (a) comprises the formate salt in an amount in the range of from 0 to 0.01 weight-%, based on the total weight of the liquid feed stream.

16. The continuous process of any one of claims 1 to 15, wherein during the start-up stage, the start-up conditions comprise a start-up temperature T^S, wherein T^S is the temperature of a heat transfer medium used for adjusting the temperature of the mixture in the epoxidation reaction zone, wherein at the beginning of the start-up stage, T^S is in the range of from 30 to 40 °C, and wherein during the start-up stage, the average rate of change of TS is in the range of from -1 to 1 $K*h^{-1}$.

17. The continuous process of any one of claims 1to 16, wherein during the start-up stage, the average rate of change of $a^S(Fo/H_2O_2)$ is greater than 0 h^{-1}.

18. The continuous process of any one of claims 1 to 17, wherein during the start-up stage, the maximum temperature of the liquid mixture in the epoxidation zone is in the range of from 70 to 100 °C.

19. A method for increasing the propylene oxide selectivity of a catalyst comprising a titanium zeolite having framework type MWW in a continuous process for preparing propylene oxide, said continuous process for preparing propylene oxide comprising

(i) continuously providing a liquid feed stream comprising propene, hydrogen peroxide, acetonitrile, a formate salt, water and optionally propane, wherein in the liquid feed stream, the molar amount of the formate salt relative to the molar amount of hydrogen peroxide at a given point of time is $a^N(Fo/H_2O_2)$;

(ii) continuously passing the liquid feed stream provided in (i) into an epoxidation zone comprising the catalyst comprising a titanium zeolite having framework type MWW, and subjecting the liquid feed stream to epoxidation reaction conditions in the epoxidation zone, obtaining a reaction mixture comprising propylene oxide, acetonitrile, water, the formate salt, optionally propene, and optionally propane;

said method for increasing the propylene oxide selectivity comprising decreasing $a^N(Fo/H_2O_2)$ in the course of said continuous process at otherwise constant epoxidation conditions, wherein the formate salt is a potassium formate salt and the titanium zeolite having framework type MWW comprised in the catalyst according to (ii) contains titanium, calculated as elemental titanium, in an amount in the range of from 0.1 to 5 weight-%, based on the total weight of the titanium zeolite having framework type MWW, and contains zinc, calculated as elemental zinc, in an amount in the range of from 0.1 to 5 weight-%, based on the total weight of the titanium zeolite having framework type MWW.