Claims

1. A continuous process for the preparation of propylene oxide, comprising
   (i) providing a liquid feed stream comprising propene, hydrogen peroxide, methanol, water, at least one dissolved potassium salt of hydroxyethylidenediphosphonic acid, and optionally propane;
   (ii) passing the liquid feed stream provided in (i) into an epoxidation reactor comprising a catalyst comprising a titanium zeolite of structure type MFI, and subjecting the liquid feed stream to epoxidation reaction conditions in the epoxidation reactor, obtaining a reaction mixture comprising propylene oxide, methanol, water, and the at least one dissolved potassium salt of hydroxyethylidenediphosphonic acid, and optionally propane;
   (iii) removing an effluent stream from the epoxidation reactor, the effluent stream comprising propylene oxide, methanol, water, at least a portion of the at least one potassium salt of hydroxyethylidenediphosphonic acid, and optionally propane.

2. The process of claim 1, wherein the molar ratio of potassium relative to phosphorus in the at least one potassium salt of hydroxyethylidenediphosphonic acid is in the range of from 1:2 to 2:1, preferably from 1:2 to 1.5:1, more preferably from 0.75:1 to 1.25:1, more preferably from 0.9:1 to 1.1:1.

3. The process of claim 1 or 2, wherein the at least one potassium salt of hydroxyethylidenediphosphonic acid comprises, preferably is the dipotassium salt of hydroxyethylidenediphosphonic acid, wherein the liquid feed stream provided in (i) preferably comprises the dipotassium salt of hydroxyethylidenediphosphonic acid as the at least one dissolved potassium salt of hydroxyethylidenediphosphonic acid.

4. The process of any of claims 1 to 3, wherein in the liquid feed stream provided in (i), the molar ratio of the potassium comprised in the at least one potassium salt of hydroxyethylidenediphosphonic acid relative to the hydrogen peroxide is in the range of from $5x10^{-6}$: 1 to $1000x10^{-6}$: 1, preferably from $10x10^{-6}$: 1 to $700x10^{-6}$: 1, more preferably from $10x10^{-6}$:1 to $500x10^{-6}$:1, and wherein in the liquid feed stream provided in (i), the molar ratio of the potassium relative to the the potassium comprised in the at least one potassium salt of hydroxyethylidenediphosphonic acid is in the range of from 1.2:1 to 1:1, preferably from 1.1:1 to 1:1, more preferably from 1.05:1 to 1:1.

5. The process of any of claims 1 to 4, wherein in the liquid feed stream provided in (i), the molar ratio of the phosphorus relative to the phosphorus comprised in the at least one potassium salt of hydroxyethylidenediphosphonic acid is in the range of from 1.2:1 to 1:1, preferably from 1.1:1 to 1:1, more preferably from 1.05:1 to 1:1.

6. The process of any of claims 1 to 5, wherein the liquid feed stream passed into the epoxidation reactor in (ii) has a temperature in the range of from 0 to 60 °C, preferably from 25 to 50 °C, and wherein the liquid feed stream passed into the epoxidation reactor in (ii) is at a pressure in the range of from 14 to 100 bar, preferably from 15 to 25 bar.

7. The process of any of claims 1 to 6, wherein in (ii), the temperature of the reaction mixture is controlled using a heat transfer medium, preferably by passing the heat transfer medium through a jacket of the epoxidation reactor, and wherein in (ii), the epoxidation conditions comprise an epoxidation reaction temperature in the range of from 10 to 100 °C, preferably from 30 to 80 °C, more preferably from 40 to 65 °C, wherein the epoxidation reaction temperature is defined as the temperature of the heat transfer medium prior to controlling of the temperature of the reaction mixture, preferably as the temperature of the heat transfer medium at the entrance of the jacket of the epoxidation reactor, and wherein in (ii), the epoxidation conditions comprise an epoxidation reaction pressure in the range of from 14 to 100 bar, preferably from 15 to 32 bar, more preferably from 15 to 25 bar, wherein the epoxidation reaction pressure is defined as the pressure at the exit of the epoxidation reactor.

8. The process of any of claims 1 to 7, wherein the effluent stream removed in (iii) additionally comprises hydrogen peroxide and optionally propene, the process further comprising
(iv) separating propylene oxide from the effluent stream, obtaining a stream being depleted in propylene oxide and comprising hydrogen peroxide, methanol, water, at least a portion of the at least one potassium salt of hydroxyethylidenediphosphonic acid optionally propene and optionally propane;
(v) passing the stream being depleted in propylene oxide and comprising hydrogen peroxide, methanol, water, at least a portion of the at least one potassium salt of hydroxyethylidenediphosphonic acid optionally propene and optionally propane obtained in (iv) into an epoxidation reactor comprising a catalyst comprising a titanium zeolite of structure type MFI, and subjecting the stream to epoxidation reaction conditions in the epoxidation reactor, obtaining a reaction mixture comprising propylene oxide, methanol, water, the portion of the at least one dissolved potassium salt of hydroxyethylidenediphosphonic acid, and optionally propane;
(vi) removing an effluent stream from the epoxidation reactor, the effluent stream comprising propylene oxide, methanol, water, at least a portion of the portion of the at least one potassium salt of hydroxyethylidenediphosphonic acid, and optionally propane.

9. The process of any of claims 1 to 8, preferably of claim 8, wherein the epoxidation conditions comprise a hydrogen peroxide conversion in the range of from 90 to 100 %, preferably from 95 to 100 %, more preferably from 99 to 100 %, wherein the hydrogen peroxide conversion is calculated based on the amount of hydrogen peroxide comprised in the effluent stream

removed in (iii), preferably in (vi), relative to the amount of hydrogen peroxide comprised in the liquid feed stream provided in (i).

10. The process of any of claims 1 to 9, preferably 8 or 9, wherein in (ii), preferably in (ii) and (v), the catalyst comprising a titanium zeolite of structure type MFI is present in the reactor as fixed-bed catalyst, and wherein in (ii), preferably in (ii) and (v), the titanium zeolite of structure type MFI comprises, preferably consists of, titanium silicalite-1.

11. The process of any of claims 1 to 10, preferably of any of claims 8 to 10, wherein the oxygen selectivity of the epoxidation reaction according to (ii), preferably of the epoxidation reactions according to (ii) and (v), is at most 1.2 %, preferably at most 1.0 %, more preferably at most 0.8 %, wherein the oxygen selectivity is defined as the molar amount of oxygen comprised in the effluent stream removed in (iii), preferably the molar amount of oxygen comprised in the effluent streams removed in (iii) and (vi), relative to the molar amount of hydrogen peroxide comprised in the liquid feed stream provided in (i), and wherein the organic by-product selectivity of the epoxidation reaction according to (ii), preferably of the epoxidation reactions according to (ii) and (v), is at most 9.0 %, preferably at most 8.0 %, more preferably at most 7.5 %, wherein the organic by-product selectivity is defined as the molar amount of hydrogen peroxide consumed to produce the molar amount of organic by-products comprised in the effluent stream removed in (iii), preferably the molar amount of oxygen comprised in the effluent streams removed in (iii) and (vi), relative to the total molar amount of hydrogen peroxide consumed.

12. A catalytic system comprising a catalyst comprising a titanium zeolite of structure type MFI and at least one potassium salt of hydroxyethylidenediphosphonic acid.

13. The catalytic system of claim 12, wherein the molar ratio of potassium relative to phosphorus in the at least one potassium salt of hydroxyethylidenediphosphonic acid is in the range of from 1:2 to 2:1, preferably from 1:2 to 1.5:1, more preferably from 0.75:1 to 1.25:1, more preferably from 0.9:1 to 1.1:1.

14. The catalytic system of claim 12 or 13, wherein the at least one potassium salt of hydroxyethylidenediphosphonic acid is the dipotassium salt of hydroxyethylidenediphosphonic acid.

15. Use of the catalytic system of any of claims 12 to 14 for the epoxidation of propene.