WO 2012/157473 relates to a method for producing a titanosilicate-containing catalyst and its use in an epoxidation reaction of an olefin with hydrogen peroxide. A buffering agent may be added, wherein the specific examples of preferred buffering agents are ammonium salts, wherein ammonium benzoate, ammonium dihydrogen phosphate and diammonium hydrogen phosphate are preferred.

Xiangqing Fang *et al.*, *Phys. Chem. Chem. Phys.* **2013**, *15*, 4930-4938 relates to a titanosilicate of the MWW type in which fluorine species have been implanted by post-treatment.

US 2010/0234623 relates to a method for producing propylene oxide in the presence of a supported gold cluster catalyst.

Lihao Tang *et al.*, *Macromolecules*, **2008**, *41*, 7306-7315 discloses catalysts for the ring-opening polymerization of ethylene oxide and propylene oxide based on products of alkylammonium compounds with bulky tetraphenol ligands.

It was an object of the embodiments disclosed herein to provide an improved continuous process for the epoxidation of propene with hydrogen peroxide as oxidizing agent in the presence of a catalyst containing a titanium zeolite of framework structure type MWW and in the presence of acetonitrile as solvent.

It was a further object of the embodiments disclosed herein to provide a catalytic system which exhibits an excellent long-time stability, in particular in terms of propylene oxide selectivity and hydrogen peroxide conversion.

Surprisingly, it was found that these objects can be solved if in the continuous reaction, a titanium zeolite of framework structure type MWW is employed as epoxidation catalyst and a liquid feed stream to be fed into the epoxidation reactor is provided which comprises propene, hydrogen peroxide, acetonitrile, water, and at least one dissolved potassium salt.

Therefore, the present disclosure relates to a continuous process for the preparation of propylene oxide, comprising

(i) providing a liquid feed stream comprising propene, hydrogen peroxide, acetonitrile, water, optionally propane, and at least one dissolved potassium salt;

(ii) passing the feed stream provided in (i) into an epoxidation reactor comprising a catalyst comprising a titanium zeolite of structure type MWW, and subjecting the feed

stream to epoxidation reaction conditions in the epoxidation reactor, obtaining a reaction mixture comprising propylene oxide, acetonitrile, water, the at least one potassium salt, optionally propene, and optionally propane;

(iii) removing an effluent stream from the epoxidation reactor, the effluent stream comprising propylene oxide, acetonitrile, water, at least a portion of the at least one potassium salt, optionally propene, and optionally propane.

In an aspect, there is provided a continuous process for the preparation of propylene oxide, the process comprising

(i) providing a liquid feed stream comprising propene, hydrogen peroxide, acetonitrile, water, optionally propane, and at least one dissolved potassium salt;

(ii) passing the feed stream provided in (i) into an epoxidation reactor comprising a catalyst comprising a titanium zeolite of structure MWW, and subjecting the feed stream to epoxidation reaction conditions in the epoxidation reactor, obtaining a reaction mixture comprising propylene oxide, acetonitrile, water, the at least one potassium salt, optionally propene, and optionally propane; and

(iii) removing an effluent stream from the epoxidation reactor, the effluent stream comprising propylene oxide, acetonitrile, water, at least a portion of the at least one potassium salt, optionally propene, and optionally propane,

wherein at least one dissolved potassium salt is an organic potassium salt.

Further, the present disclosure relates to a catalytic system comprising a catalyst comprising a titanium zeolite of structure type MWW optionally comprising zinc, and at least one potassium salt, wherein the at least one potassium salt is selected from the group consisting of at least one inorganic potassium salt, at least one organic potassium salt, and combinations of at least one inorganic potassium salt and at least one organic potassium salt.

Step (i)

Surprisingly, it was found that the presence of at least one dissolved potassium salt in the liquid feed stream provided in (i) allows for an excellent epoxidation performance of the epoxidation catalyst employed in (ii) which comprises the titanium zeolite of framework structure type MWW, in contrast to the prior art which recommends ammonium dihydrogen phosphate as additive. Yet further, it was surprisingly found that while the corresponding potassium salt, potassium dihydrogen phosphate, is by far the better additive, the epoxidation characteristics in terms of hydrogen peroxide conversion and propylene oxide selectivty can still be improved if organic potassium salts are used as additives.

Regarding the chemical nature of the at least one potassium salt is concerned, no specific restrictions exist. Preferably, the at least one potassium salt is selected from the group consisting of at least one inorganic potassium salt, at least one organic potassium salt, and combinations of at least one inorganic potassium salt and at least one organic potassium salt.

Preferred inorganic potassium salts include, but are not restricted to, potassium halides such as potassium chloride or potassium bromide, potassium nitrate, potassium sulfate, potassium hydrogen sulfate, potassium hydroxide, potassium perchlorate, potassium salts comprising phosphorus such as potassium dihydrogen phosphate or dipotassium hydrogen phosphate or potassium phosphate or potassium pyrophosphates such as monobasic potassium pyrophosphate or dibasic potassium pyrophosphate or tribasic potassium pyrophosphate or tetrabasic potassium pyrophosphate, or potassium etidronates such as monobasic

Claims

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

2. The process of claim 1, wherein the at least one dissolved potassium salt further comprises at least one inorganic potassium salt.

3. The process of claim 1, wherein the at least one organic potassium salt is selected from the group consisting of a potassium salt of an aliphatic saturated monocarboxylic acid, potassium carbonate and potassium hydrogen carbonate.

4. The process of claim 2, wherein the at least one inorganic potassium salt is selected from the group consisting of potassium hydroxide, a potassium halide, potassium nitrate, potassium sulfate, potassium hydrogen sulfate, and potassium perchlorate.

5. The process of claim 1, wherein the at least one organic potassium salt comprises potassium formate, potassium acetate, or a mixture thereof.

6. The process of claim 1, wherein a concentration of the at least one dissolved potassium salt in the liquid feed stream provided in (i) is at least 10 % of the solubility limit of the at least one organic potassium salt in the liquid feed stream provided in (i).

7. The process of claim 1, wherein in (i), a molar ratio of potassium comprised in the at least one dissolved potassium salt relative to hydrogen peroxide comprised in the liquid feed stream is from $5x10^{-6}$:1 to $1000x10^{-6}$:1.

8. The process of claim 2, wherein in (i), a molar ratio of potassium relative to hydrogen peroxide in the liquid feed stream is from $5x10^{-6}$:1 to $1000x10^{-6}$:1.

9. The process of claim 1, wherein the liquid feed stream provided in (i) comprises
acetonitrile in an amount of from 60 to 75 weight-% based on a total weight of the liquid feed stream;
hydrogen peroxide in an amount of from 6 to 10 weight-% based on the total weight of the liquid feed stream;
water in a molar ratio of water relative to acetonitrile of at most 1:4;
propene with a molar ratio of propene relative to hydrogen peroxide comprised in the liquid feed stream in a range of from 1:1 to 1.5:1; and
optionally propane with a molar ratio of propane relative to a sum of propene and propane in a range of from 0.0001:1 to 0.15:1;
wherein at least 95 weight-% of the liquid feed stream provided in (i) consists of propene,

hydrogen peroxide, acetonitrile, water, the at least one dissolved potassium salt, and optionally propane.

10. The process of claim 1, wherein an amount of ammonium $NH4^+$ in the liquid feed stream of (i) is at most 2 weight-ppm.

11. The process of claim 1, wherein a molar ratio of sodium relative to hydrogen peroxide in the liquid feed stream of (i) is from $1x10^{-6}$:1 to $250x10^{-6}$:1.

12. The process of claim 1, wherein the titanium zeolite of framework structure MWW comprises titanium, calculated as elemental titanium, in an amount of from 0.1 to 5 weight-%

based on a total weight of the titanium zeolite of framework structure MWW.

13. The process of claim 1, wherein the titanium zeolite of framework structure MWW comprises zinc, calculated as elemental zinc, in an amount of from 0.1 to 5 weight-% based on a total weight of the titanium zeolite of framework structure MWW.

14. The process of claim 1, wherein the epoxidation reaction according to (ii) has a propylene oxide selectivity of at least 95 %, wherein the propylene oxide selectivity is defined as a molar amount of propylene oxide comprised in the effluent stream removed in (iii) relative to a molar amount of hydrogen peroxide comprised in the liquid feed stream provided in (i).

15. The process of claim 1, wherein the effluent stream removed (iii) comprises propene, optionally propane, and optionally oxygen, the process further comprising

(iv) separating propene, optionally together with propane and oxygen, from the effluent stream, obtaining a stream S01 enriched in propylene oxide, acetonitrile, and water; and

(v) separating propylene oxide from S01, obtaining a stream comprising propylene oxide and depleted of acetonitrile and water.