Claims

1. A process for regenerating a catalyst comprising a titanium comprising zeolite of MWW framework structure as catalytically active material, the process comprising:
   (i) a stage comprising
      (a) continuously preparing propylene oxide by a process comprising, in the following order:
         (a1) introducing a feed stream comprising propene, hydrogen peroxide or a hydrogen peroxide source, and an organic solvent into a reactor comprising a catalyst comprising the titanium comprising zeolite of MWW framework structure as catalytically active material;
         (a2) subjecting the feed stream according to (a1) in the reactor to epoxidation conditions in the presence of the catalyst, obtaining a reaction mixture comprising the propylene oxide and the organic solvent; and
         (a3) removing a product stream comprising the propylene oxide and the organic solvent from the reactor;
      (b) stopping introducing the feed stream into the reactor;
      (c) washing the catalyst with a liquid aqueous system comprising at least 50 weight-% water, based on the total weight of the liquid aqueous system; and then,
   (ii) a stage comprising calcining the catalyst obtained from (c), wherein the calcining is performed at a temperature of the catalyst in the range of from 300°C to 600°C using a gas stream comprising oxygen;

   wherein the sequence of steps (a) to (c) in stage (i) is performed n times, wherein n is an integer and at least 2, such that the washing of the catalyst with a liquid aqueous system according to step (c) is followed by the continuous preparation of propylene according to step (a) at least once without an intervening calcination stage (ii).

2. The process of claim 1, wherein the organic solvent is methanol or acetonitrile.

3. The process of claim 1, wherein at least 99 weight-% of the framework structure of the titanium comprising zeolite of MWW framework structure consists of silicon, titanium, and oxygen.

4. The process of claim 1, wherein the titanium comprising zeolite of MWW framework structure comprises Zn.

5. The process of claim 1, wherein the catalyst comprising a titanium comprising zeolite of MWW framework structure is present in the reactor as a fixed-bed catalyst.

6. The process of claim 1, wherein the liquid aqueous system according to (c) comprises at least 95 weight-% water, based on the total weight of the liquid aqueous system.

7. The process of claim 1, wherein according to (c), the washing of the catalyst is carried out in the reactor comprising the catalyst in continuous mode.

8. The process of claim 7, wherein the reactor according to (a) is a tube reactor or a tube bundle reactor and the washing according to (c) is performed with the liquid aqueous system at a liquid hourly space velocity (LHSV) in the range of from 1 to 20 m/h.

9. The process of claim 1, wherein the washing according to (c) is performed at a temperature of the liquid aqueous system in the range of from 30 to 90°C.

10. The process of claim 1, wherein the washing according to (c) is performed until the total organic carbon concentration of the liquid aqueous system after having been contacted with the catalyst is at most 5% of the maximum total organic carbon concentration detected during the washing in (c).

11. The process of claim 1, wherein the sequence of steps (b) and (c) is carried out when the selectivity of the epoxidation reaction according to (a2) has decreased by 4% or less, relative to the average selectivity of the epoxidation reaction according to (a2) during the first 100 h of carrying out step (a), wherein the selectivity of the epoxidation reaction is defined as the molar amount of propylene oxide obtained in (a2) relative to the molar amount of hydrogen peroxide converted in (a2).

12. The process of claim 1, wherein n is in the range of from 2 to 7.

13. The process of claim 1, wherein the calcining according to stage (ii) is performed at a temperature of the catalyst in the range of from 350 to 550°C.

14. The process of claim 1, wherein the calcining according to stage (ii) is carried out in the reactor comprising the catalyst.

15. The process of claim 1, further comprising:
repeating stages (i) and (ii) m times, wherein m is an integer and at least 1, and wherein in each repetition of stages (i) and (ii) the integer n is the same or different.

16. The process of claim 15, wherein m is an integer from 1 to 6.

17. A continuous process for preparing propylene oxide, the process comprising:

(i') a stage comprising

(a') continuously preparing propylene oxide in a first reactor by a process comprising, in the following order:

(a1') introducing a feed stream comprising propene, hydrogen peroxide or a hydrogen peroxide source, and an organic solvent into the first reactor comprising a catalyst comprising a titanium comprising zeolite of MWW framework structure as catalytically active material;

(a2') subjecting the feed stream according to (a1') in the first reactor to epoxidation conditions in the presence of the catalyst, obtaining a reaction mixture comprising the propylene oxide and the organic solvent; and

(a3') removing a product stream comprising the propylene oxide and the organic solvent from the first reactor;

(b') stopping introducing the feed stream into the first reactor;

(c') washing the catalyst with a liquid aqueous system comprising at least 50 weight-% water, based on the total weight of the liquid aqueous system; and then

(ii') a stage comprising calcining the catalyst obtained from (c'), wherein the calcining is performed at a temperature of the catalyst in the range of from 300°C to 600°C using a gas stream comprising oxygen;

wherein the sequence of steps (a') to (c') in stage (i') performed n' times, where n' is an integer and at least 2, such that the washing of the catalyst with a liquid aqueous system according to step (c') is followed by the continuous preparation of propylene according to step (a') at least once without an intervening calcination stage (ii'); and

the process for the preparation of propylene oxide further comprising

(i") a stage comprising

(a") continuously preparing propylene oxide in a second reactor by a process comprising, in the following order:

(a1") introducing a feed stream comprising propene, hydrogen peroxide or a hydrogen peroxide source, and an organic solvent into the second reactor comprising a catalyst comprising a titanium comprising zeolite of MWW framework structure as catalytically active material;

(a2") subjecting the feed stream according to (a1") in the second reactor to epoxidation conditions in the presence of the catalyst, obtaining a reaction mixture comprising the propylene oxide and the organic solvent;

(a3") removing a product stream comprising the propylene oxide and the organic solvent from the second reactor;

(b") stopping introducing the feed stream into the second reactor; and

(c") washing the catalyst with a liquid aqueous system comprising at least 50 weight-% water, based on the total weight of the liquid aqueous system; and then

(ii") a stage comprising calcining the catalyst obtained from (c"), wherein the calcining is performed at a temperature of the catalyst in the range of from 300°C to 600°C using a gas stream comprising oxygen;

wherein the sequence of steps (a") to (c") in stage (i") is performed n" times, where n" is an integer and at least 1, such that the washing of the catalyst with a liquid aqueous system according to step (c") is followed by the continuous preparation of propylene according to step (a") at least once without an intervening calcination stage (ii"); and

wherein during at least one sequence of steps (b') and (c') in the first reactor or during at least one sequence of steps (b'), (c'), and (ii') in the first reactor, propylene oxide is prepared according to (a") in the second reactor.

18. The process of claim 17, further comprising:

repeating stages (i') and (ii') m' times, wherein m' is an integer and at least 1, and wherein in each repetition of stages (i') and (ii') the integer n' is the same or different; and/or

repeating stages (i") and (ii") m" times, wherein m" is an integer and at least 1, and wherein in each repetition of stages (i") and (ii") the integer n" is the same or different.