Claims

1. A process for purifying propylene oxide, comprising
   (i) providing a stream S0 comprising propylene oxide, acetonitrile, water, and an organic compound comprising a carbonyl group -C(=O)-, wherein said organic compound comprising a carbonyl group -C(=O)- comprises one or more of acetone and propionaldehyde;
   (ii) separating propylene oxide from the stream S0 by distillation, comprising subjecting the stream S0 to distillation conditions in a distillation column, obtaining a gaseous top stream S1c which is enriched in propylene oxide compared to the stream S0, a liquid bottoms stream S1a which is enriched in acetonitrile and water compared to the stream S0, and a side stream S1b comprising propylene oxide which is enriched in the carbonyl compound compared to the stream S0;
   wherein the distillation column is operated at an absolute pressure at the top of the distillation column in the range of from 0.01 to 0.2 MPa (0.1 to 2.0 bar) and an internal reflux ratio in the range of from 2.0 to 6.0;
   wherein the distillation column exhibits at least 100 theoretical trays, the rectifying section of the distillation column consists of from 30 to 70 % of the theoretical trays and the stripping section of the distillation column consists of from 70 to 30 % of the theoretical trays.

2. The process of claim 1, wherein the distillation column is operated at an absolute pressure at the top of the distillation column in the range of from 0.02 to 0.15 MPa (0.2 to 1.5 bar) preferably in the range of from 0.03 to 0.1 MPa (0.3 to 1.0 bar), more preferably in the range of from 0.045 to 0.055 MPa (0.45 to 0.55 bar).

3. The process of claim 1 or 2, wherein the distillation column is operated at a reflux ratio in the range of from 2.5 to 5.5, preferably in the range of from 3.0 to 5.0, more preferably in the range of from 3.5 to 4.5.

4. The process of any one of claims 1 to 3, wherein the distillation column exhibits from 100 to 150, preferably from 105 to 145, more preferably from 110 to 140, more preferably from 115 to 135, more preferably from 120 to 130 theoretical trays.

5. The process of any one of claims 1 to 4, wherein the side stream S1b is removed from the rectifying section of the distillation column, preferably from the rectifying section of the distillation column at a position which is at least 1 theoretical tray above the stripping section of the distillation column, more preferred from the rectifying section of the distillation column at a position which is from 1 to 20, preferably from 2 to 19, more preferably from 3 to 18, more preferably from 4 to 17, more preferably from 5 to 16, more preferably from 5 to 15 theoretical tray above the stripping section of the distillation column.

6. The process of any one of claims 1 to 5, wherein the organic compound comprising a carbonyl group comprised in the stream S0 further comprises one or more further aldehydes, one or more further ketones, or a mixture of one or more further aldehydes and one or more further ketones, preferably one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, 2-butanon, 1-pentanal, 2-pentanon, 3-pentanon, 2-methylpentanone, more preferably one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, more preferably at least acetaldehyde.

7. The process of any one of claims 1 to 6, wherein the stream S0 is obtainable or obtained by a process comprising
   (a) providing a stream comprising propene and preferably propane, hydrogen peroxide or a source of hydrogen peroxide, water, and acetonitrile;
   (b) passing the liquid feed stream provided in (a) into an epoxidation zone comprising an epoxidation catalyst comprising a titanium zeolite, and subjecting the liquid feed stream to epoxidation reaction conditions in the epoxidation zone, obtaining a reaction mixture comprising propene and preferably propane, propylene oxide, water, acetonitrile, and the organic compound comprising a carbonyl group;
   (c) removing an effluent stream from the epoxidation zone, the effluent stream comprising propylene oxide, water, acetonitrile, propene and preferably propane, and the organic compound comprising a carbonyl group;
   (d) separating propene and preferably propane from the effluent stream by distillation, comprising subjecting the effluent stream to distillation conditions in a distillation unit, obtaining a gaseous stream which is enriched in propene and preferably propane compared to the effluent stream subjected to distillation conditions, and a liquid bottoms stream which is enriched in propylene oxide, water, acetonitrile and the organic compound comprising a carbonyl group compared to the effluent stream subjected to distillation conditions;

   wherein said liquid bottoms stream obtained according to (d) is the stream S0.

8. The process of any one of claims 1 to 7, wherein providing the stream S0 according to (i) comprises
   (a) providing a stream comprising propene and preferably propane, hydrogen peroxide or a source of hydrogen peroxide, water, and acetonitrile;
   (b) passing the liquid feed stream provided in (a) into an epoxidation zone comprising an epoxidation catalyst comprising a titanium zeolite, and subjecting the liquid feed stream to epoxidation reaction conditions in the epoxidation zone, obtaining a reaction mixture comprising propene and preferably propane, propylene oxide, water, acetonitrile, and the organic compound comprising a carbonyl group;
   (c) removing an effluent stream from the epoxidation zone, the effluent stream comprising propylene oxide, water, acetonitrile, propene and preferably propane, and the organic compound comprising a carbonyl group;
   (d) separating propene and preferably propane from the effluent stream by distillation, comprising subjecting the effluent stream to distillation conditions in a distillation

unit, obtaining a gaseous stream which is enriched in propene and preferably propane compared to the effluent stream subjected to distillation conditions, and a liquid bottoms stream which is enriched in propylene oxide, water, acetonitrile and the organic compound comprising a carbonyl group compared to the effluent stream subjected to distillation conditions;

wherein said liquid bottoms stream obtained according to (d) is the stream S0.

9. The process of any one of claims 1 to 8, wherein the top stream S1c obtained in (ii) contains at least 99.00 weight-%, more preferably at least 99.50 weight-%, more preferably at least 99.80 weight-%, propylene oxide based on the total weight of the stream S1c;
and/or
wherein the top stream S1c obtained in (ii) contains at the outmost 50 weight-ppm, preferably at the outmost 25 weight-ppm, more preferably at the outmost 20 weight-ppm of the organic compound comprising a carbonyl group based on the total weight of the stream S1c;
and/or
wherein the top stream S1c obtained in (ii) contains at the outmost 100 weight-ppm, preferably at the outmost 75 weight-ppm, more preferably at the outmost 50 weight-ppm water based on the total weight of the stream S1c.

10. The process of any one of claims 1 to 9, wherein bottoms stream S1a contains the organic compound comprising a carbonyl group in an amount of at most 20 weight-ppm, preferably at most 10 weight-ppm, more preferably at most 2 weight-ppm, based on the weight of S1a.

11. The process of any one of claims 1 to 10, wherein at least 95 weight-% of bottoms stream S1a consist of acetonitrile and water, wherein preferably, the weight ratio of acetonitrile relative to water in the stream S1a is greater than 1:1.

12. The process of any one of claims 1 to 11, wherein bottoms stream S1a contains at most 10 weight-ppm, preferably at most 5 weight-ppm, more preferably at most 1 weight-ppm, of the propylene oxide, based on the weight of S1a.

13. The process of any one of claims 1 to 12, wherein the side stream S1b comprises the organic compound comprising a carbonyl group in an amount of ≥ 10 weight-%, preferably ≥ 15 weight-%; based on the total weight of the side stream S1b; wherein the organic compound comprising a carbonyl group preferably comprises propionaldehyde in an amount of ≥10 weight-% based on the total weight of the side stream S1b and acetone in an amount of ≥5 weight-% based on the total weight of the side stream S1b.

14. The process of any one of claims 1 to 13, wherein at least 95 weight-%, preferably at least 98 weight-%, more preferably at least 99 weight-% of the side stream S1b consist of

propylene oxide, acetonitrile, water, and the organic compound comprising a carbonyl group.

15. The process of any one of claims 1 to 14, which is a continuous process.