

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
 - (ii.1) subjecting the stream S0 to distillation conditions in a first distillation unit, 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;
 - (ii.2) reacting the carbonyl compound comprised in the side stream S1b with an organic compound comprising an amino group $-NH_2$ obtaining a reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group;
 - (ii.3) separating propylene oxide from the reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group in a second distillation unit, obtaining a gaseous top stream S3a which is enriched in propylene oxide and a liquid bottoms stream S3b which is enriched in the reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group;
 - (ii.4) introducing the top stream S3a which is enriched in propylene oxide propylene oxide into the first distillation unit.
2. The process of claim 1, 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
 - (ii.1) subjecting the stream S0 to distillation conditions in a first distillation unit, 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;
 - (ii.2) admixing the side stream S1b with an organic compound comprising an amino group $-NH_2$ and reacting the organic compound comprising a carbonyl

- group with the organic compound comprising an amino group, obtaining a stream S2 comprising propylene oxide and a reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group;
- (ii.3) subjecting the stream S2 to distillation conditions in a second distillation unit, obtaining a gaseous top stream S3a which is enriched in propylene oxide compared to the stream S2, and a liquid bottoms stream S3b which is enriched in the reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group compared to the stream S2;
- (ii.4) introducing the stream S3a into the first distillation unit.
3. The process of claim 1, 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
- (ii.1) subjecting the stream S0 to distillation conditions in a first distillation unit, 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;
- (ii.2) subjecting the side stream S1b to distillation conditions in a second distillation unit and adding an organic compound comprising an amino group $-NH_2$ to the second distillation unit, preferably at the top of the second distillation unit, and reacting the organic compound comprising a carbonyl group with the organic compound comprising an amino group, obtaining a reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group, and obtaining a gaseous top stream S3a which is enriched in propylene oxide compared to the stream S1b, and a liquid bottoms stream S3b which is enriched in the reaction product of the organic compound comprising a carbonyl group and the organic compound comprising an amino group compared to the stream S1b;
- (ii.3) introducing the stream S3a into the first distillation unit.
4. The process of any one of claims 1 to 3, wherein the organic compound comprising a carbonyl group $-C(=O)-$ comprised in the stream S0 further comprises one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, 2-butanone, 1-pentanal, 2-pentanone, 3-pentanone, 2-methylpentanone, preferably one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, more preferably at least acetaldehyde,

and wherein preferably the side stream S1b obtained in (ii.1) comprising propylene oxide and being enriched in the carbonyl compound compared to the stream S0 is further enriched in one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, 2-butanone, 1-pentanal, 2-pentanone, 3-pentanone, 2-methylpentanone, more preferably one or more of acetaldehyde, formaldehyde, butyraldehyde, isobutyraldehyde, more preferably at least in acetaldehyde.

5. The process of any one of claims 1 to 4, wherein at least 95 weight-%, preferably at least 98 weight-%, more preferably at least 99 weight-% of the stream S0 consist of propylene oxide, acetonitrile, water, and the organic compound comprising a carbonyl group.
6. The process of any one of claims 1 to 5, wherein the stream S0 is obtainable or obtained by a process comprising
 - (a) providing a stream comprising propene and preferably propane, 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.
7. The process of any one of claims 1 to 5, wherein providing the stream S0 according to (i) comprises
 - (a) providing a stream comprising propene and preferably propane, 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 the first distillation unit employed in (ii.1) is at least one distillation tower, preferably one distillation tower, wherein the distillation tower has preferably from 40 to 200, more preferably from 45 to 100, more preferably from 50 to 90, theoretical trays.
- 9. The process of any one of claims 1 to 8, wherein the rectifying section of the first distillation unit employed in (ii.1) consists of from 40 to 60 % of the theoretical trays and the stripping section of the distillation unit consists of from 60 to 40 % of the theoretical trays.
- 10. The process of any one of claims 1 to 9, wherein the first distillation unit employed in (ii.1) is operated at a top pressure of from 0.1 to 2.0 bar, preferably of from 0.2 to 1.0 bar, more preferably of from 0.3 to 0.8 bar.
- 11. The process of any one of claims 1 to 10, wherein the first distillation unit employed in (ii.1) is operated at a top temperature in the range of from 50 to 70 °C, preferably of from 52 to 68 °C, more preferably of from 54 to 64 °C.
- 12. The process of any one of claims 1 to 11, wherein the first distillation unit employed in (ii.1) is operated at an internal reflux ratio in the range of from 1 to 10, preferably from 2 to 8, more preferably from 3 to 6.
- 13. The process of any one of claims 1 to 12, wherein the side stream S1b obtained in (ii.1) is removed from the rectifying section of the first distillation unit.
- 14. The process of any one of claims 1 to 13, wherein the side stream S1b obtained in (ii.1) is removed from the rectifying section of the first distillation unit at a position which is at least 1 theoretical tray above the stripping section of the first distillation unit.

15. The process of any one of claims 1 to 14, wherein the side stream S1b obtained in (ii.1) is removed from the rectifying section of the first distillation unit at a position which is from 1 to 15, preferably from 1 to 12, more preferably from 1 to 10, theoretical tray above the stripping section of the first distillation unit.
16. The process of any one of claims 1 to 15, wherein the organic compound comprising an amino group $-NH_2$ comprises one or more of $R-NH_2$, wherein R is a substituted or unsubstituted, branched or unbranched C1-C5-alkyl, preferably selected from the group consisting of ethyl amine, *n*-propyl amine, *iso*-propyl amine, *n*-butyl amine, *iso*-butyl amine, ethanol amine; R_1-NH_2 , wherein R_1 is a C6-C10-aryl group with at least one further substituent R_2 selected from the group consisting of hydrogen, $-CH_3$, $-NO_2$ positioned at the aryl group, preferably selected from the group consisting of aniline, toluidine, *ortho*-nitroaniline, *alpha*-naphthylamine, *beta*-naphthylamine; $NH_2-R_3-NH_2$, wherein R_3 is selected from the group consisting of C2-C3-alkylene groups or phenyl, preferably selected from the group consisting of 1,2-diamino ethane, 1,2-diamino propane, 1,3-diamino propane, 1,2-diamino benzene, 1,3-diamino benzene, 1,4-diamino benzene; N-C1-C6-aminales; carbonic acid amides, preferably selected from the group consisting of acetamide, propanamide, *iso*-butyramide, benzene sulfonamide, *para*-toluenesulfonamide; amide of the mono-methylester of methylphosphonic acid; amides of carbonic acids, preferably selected from the group consisting of urea, N-C1-C6-alkyl urea, N,N'-C1-C6-dialkyl urea; amino acids, preferably selected from the group consisting of glycine, alanine, norvaline, methionine, valine, lysine; anthranilic acid; nitriles of *alpha*-amino carbonic acids, preferably *alpha*-amino-propionitrile; cyanamide; hydroxylamine; O-methylhydroxylamine; hydroxylamine-O-sufonic acid; hydrazine; hydrazine monohydrate; monoC1-C4-alkyl hydrazines, preferably selected from the group consisting of methyl hydrazine, ethyl hydrazine, propyl hydrazine, butyl hydrazine, *iso*-propyl hydrazine; aryl hydrazines, preferably selected from the group consisting of phenylhydrazine, 2,4-dinitrophenylhydrazine; dialkyl hydrazines, preferably N,N-dimethyl hydrazine; hydrazides, preferably selected from the group consisting of semi carbazide, acethydrazide, benzoic acid hydrazide, *iso*-butanoic acid hydrazide; and hydrazides of thiocarbonic acids of the formula $R_4(S=O)_2-NH-NH_2$ wherein R_4 is selected from the group consisting of C6-C10-aryl and C1-C6-alkyl; wherein the organic compound comprising an amino group $-NH_2$ preferably comprises hydrazine, more preferably hydrazine.
17. The process of any one of claims 1 to 2 or 4 to 16, wherein the reacting of the organic compound comprising a carbonyl group with the organic compound comprising an amino group in (ii.2) is done in one or more reactors, preferably in one reactor, more preferably in a tube reactor.
18. The process of any one of claims 1 to 17, wherein the second distillation unit employed in (ii.3) is at least one distillation tower, preferably one distillation tower, wherein the

distillation tower has preferably at least 5, more preferably from 5 to 25, more preferably from 8 to 20, theoretical trays.

19. The process of any one of claims 1 to 18, wherein the gaseous top stream S3a obtained in (ii.3) is introduced into the first distillation unit in (ii.4) in the rectifying section of the first distillation unit at a position which is at least 1 theoretical tray above the stripping section of the first distillation unit, preferably at a position which is from 1 to 15, preferably from 1 to 12, more preferably from 1 to 10, theoretical tray above the stripping section of the first distillation unit.
20. The process of any one of claims 1 to 19, wherein the gaseous top stream S3a obtained in (ii.3) is introduced into the first distillation unit in (ii.4) in the rectifying section of the first distillation unit at a position which is 0 to 3 theoretical trays, preferably 0 theoretical trays above the theoretical tray where the side stream S1b obtained in (ii.1) is removed from the rectifying section of the first distillation.
21. The process of any one of claims 1 to 20, which is a continuous process.