

CLAIMS

What is claimed is:

1. A propylene oxide separation system comprising:
 - A) a heavies distillation column configured to receive a crude propylene oxide stream and discharge:
 - a1) a heavies purge bottoms comprising at least one impurity selected from acetone, methanol, aldehydes, aldehyde derivatives, water, heavy hydrocarbons comprising C₅+, or combinations thereof, and
 - a2) a heavies distillation column overhead stream comprising a majority of the propylene oxide entering with the crude propylene oxide stream; and
 - B) a first extractive distillation column configured to receive the heavies distillation column overhead stream and a first extraction solvent stream comprising a hydrocarbon solvent, and discharge:
 - b1) a lights purge overhead comprising at least one impurity selected from acetaldehyde, methyl formate, methanol, water, C₃ hydrocarbons, C₄ hydrocarbons, or combinations thereof, and
 - b2) a rich solvent bottoms stream comprising a majority of the propylene oxide entering via the heavies distillation column overhead stream.
2. The propylene oxide separation system of claim 1, wherein the first extractive distillation column is further configured to discharge a side draw, and wherein the propylene oxide separation system further comprises a decanter configured to receive the side draw, a lean hydrocarbon solvent stream comprising the hydrocarbon solvent, and optionally water, allow formation of an aqueous phase and an organic phase, discharge an aqueous phase purge comprising water and methanol, one or more glycols, or a combination thereof, and discharge an organic phase stream comprising propylene oxide and the hydrocarbon solvent.
3. The propylene oxide separation system of claim 2 further comprising a first solvent stripper configured to receive the rich solvent bottoms stream from the first extractive distillation column, discharge a first solvent stripper overhead comprising a majority of the propylene oxide entering with the rich solvent bottoms stream, and discharge a first solvent stripper bottoms comprising lean hydrocarbon solvent.
4. The propylene oxide separation system of claim 3, wherein the first extractive distillation column is fluidly connected with the first solvent stripper, whereby at least a portion of the lean hydrocarbon solvent from the first solvent stripper bottoms can be introduced into the first extractive distillation column via the first extraction solvent stream.

5. The propylene oxide separation system of claim 3 further comprising:
 - a second extractive distillation column configured to receive the first solvent stripper overhead and a second extraction solvent stream comprising the hydrocarbon solvent, discharge an overhead propylene oxide product stream comprising a majority of the propylene oxide from the first solvent stripper overhead, and discharge a second extractive distillation column bottoms comprising rich hydrocarbon solvent; and
 - a second solvent stripper configured to receive the second extractive distillation column bottoms, discharge a hydrocarbon purge overhead stream, and discharge a second solvent stripper bottoms comprising lean hydrocarbon solvent.
6. The propylene oxide separation system of claim 5, wherein the second solvent stripper is fluidly connected with the first extractive distillation column, the decanter or both, whereby a portion of the lean hydrocarbon solvent from the second solvent stripper bottoms can be introduced into the first extractive distillation column, the decanter, or both.
7. The propylene oxide separation system of claim 5, wherein the second solvent stripper is fluidly connected with the second extractive distillation column, whereby at least a portion of the lean hydrocarbon solvent from the second solvent stripper bottoms can be introduced into the second extractive distillation column via the second extraction solvent stream.
8. The propylene oxide separation system of claim 1 comprising no non-solvent distillation column upstream of the first extractive distillation column other than the heavies distillation column.
9. The propylene oxide separation system of claim 1 further comprising:
 - a decanter configured to receive at least a portion of the lights purge overhead, a lean hydrocarbon solvent stream comprising the hydrocarbon solvent, and optionally water, allow formation of an aqueous phase and an organic phase, and discharges an aqueous phase purge comprising water and methanol, one or more glycols, or a combination thereof, and discharge an organic phase stream comprising propylene oxide and the hydrocarbon solvent back to the first extractive distillation column.
10. The propylene oxide separation system of claim 1 further comprising:
 - a decanter configured to receive at least a portion of the lights purge overhead, a lean hydrocarbon solvent stream comprising the hydrocarbon solvent, and optionally water, allow formation of an aqueous phase and an organic phase, discharge an aqueous phase purge comprising water and methanol, one or more glycols, or a combination thereof, and discharge an organic phase stream comprising propylene oxide and the hydrocarbon solvent; and
 - a solvent stripper configured to receive the organic phase stream from the decanter, discharge a hydrocarbon purge overhead stream comprising at least a portion of the

propylene oxide from the organic phase stream, and discharge a solvent stripper bottoms comprising lean hydrocarbon solvent.

11. A method comprising:

(i) subjecting a crude propylene oxide stream to non-solvent distillation in a heavies distillation column to produce a heavies purge bottoms comprising at least one impurity selected from acetone, methanol, aldehydes, aldehyde derivatives, water, heavy hydrocarbons comprising C₅+, or combinations thereof, and a heavies distillation column overhead stream comprising a majority of the propylene oxide entering in the crude propylene oxide stream;

(ii) introducing the heavies distillation column overhead stream and a first extractive distillation solvent stream comprising a hydrocarbon solvent into a first extractive distillation column to produce a lights purge overhead comprising at least one impurity selected from acetaldehyde, methyl formate, methanol, water, C₃ hydrocarbons, C₄ hydrocarbons, or combinations thereof, and a rich solvent bottoms stream comprising a majority of the propylene oxide entering via the heavies distillation column overhead stream;

(iii) introducing a side draw from the first extractive distillation column into a decanting apparatus, and therein allowing the formation of an aqueous phase purge comprising water and methanol, one or more glycols, or a combination thereof, and an organic phase stream comprising propylene oxide and the hydrocarbon solvent; and

(iv) introducing the rich solvent bottoms stream from the first extractive distillation column into a first solvent stripper to produce a first solvent stripper overhead comprising a majority of the propylene oxide entering the first solvent stripper via the rich solvent bottoms stream and a first solvent stripper bottoms comprising lean hydrocarbon solvent.

12. The method of claim 11 further comprising feeding a portion of the first solvent stripper bottoms comprising lean hydrocarbon solvent into the first extractive distillation column and another portion of the first solvent stripper bottoms comprising lean hydrocarbon solvent to the decanting apparatus.

13. The method of claim 11, wherein the heavies purge bottoms comprises at least 10 wt% of an amount of methanol introduced with the crude propylene oxide stream, at least 40 wt% of an amount of water introduced with the crude propylene oxide stream, or both.

14. The method of claim 11 further comprising:

(v) subjecting the first solvent stripper overhead to extractive distillation by introducing the first solvent stripper overhead and a second extractive distillation solvent stream comprising the hydrocarbon solvent into a second extractive distillation column, thus

producing a purified propylene oxide product as an overhead stream and a second extractive distillation column bottoms comprising rich hydrocarbon solvent;

(vi) introducing the second extractive distillation column bottoms comprising rich hydrocarbon solvent into a second solvent stripper to produce a light hydrocarbon overhead purge stream and a second solvent stripper bottoms comprising lean hydrocarbon solvent; and

(vii) introducing at least a portion of the second solvent stripper bottoms into the second extractive distillation column, the first extractive distillation column, the decanting apparatus, or a combination thereof.

15. The method of claim 14, wherein the heavies distillation column is operated at a pressure in the range of from 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of from 30 to 150 degrees Celsius, or both; wherein the first extractive distillation column is operated at a pressure in a range of 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of 30 to 200 degrees Celsius, or both; wherein the second extractive distillation column is operated at a pressure in the range of from 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of from 30 to 200 degrees Celsius, or both; or a combination thereof.

16. A method comprising:

(i) subjecting a crude propylene oxide stream to non-solvent distillation in a heavies distillation column to produce a heavies purge bottoms comprising at least one impurity selected from acetone, methanol, aldehydes, aldehyde derivatives, water, heavy hydrocarbons comprising C₅+, or combinations thereof, and a heavies distillation column overhead stream comprising a majority of the propylene oxide entering in the crude propylene oxide stream;

(ii) introducing the heavies distillation column overhead stream and a first extractive distillation solvent stream comprising a hydrocarbon solvent into a first extractive distillation column to produce a lights purge overhead comprising at least one impurity selected from acetaldehyde, methyl formate, methanol, water, C₃ hydrocarbons, C₄ hydrocarbons, or combinations thereof, and a rich solvent bottoms stream comprising a majority of the propylene oxide entering via the heavies distillation column overhead stream;

(iii) introducing at least a portion of the lights purge overhead from the first extractive distillation column into a decanting apparatus, and therein allowing the formation of an aqueous phase purge comprising water and methanol, one or more glycols, or a combination thereof, and an organic phase stream comprising propylene oxide and the hydrocarbon solvent; and

- (iv) introducing the rich solvent bottoms stream from the first extractive distillation column into a first solvent stripper to produce a first solvent stripper overhead comprising a majority of the propylene oxide entering the first solvent stripper via the rich solvent bottoms stream and a first solvent stripper bottoms comprising lean hydrocarbon solvent.
17. The method of claim 16 further comprising feeding a portion of the first solvent stripper bottoms comprising lean hydrocarbon solvent into the first extractive distillation column and another portion of the first solvent stripper bottoms comprising lean hydrocarbon solvent to the decanting apparatus.
18. The method of claim 16, wherein the heavies purge bottoms comprises at least 10 wt% of an amount of methanol introduced with the crude propylene oxide stream, at least 40 wt% of an amount of water introduced with the crude propylene oxide stream, or both.
19. The method of claim 16 further comprising:
- (v) subjecting the first solvent stripper overhead to extractive distillation by introducing the first solvent stripper overhead and a second extractive distillation solvent stream comprising the hydrocarbon solvent into a second extractive distillation column, thus producing a purified propylene oxide product as an overhead stream and a second extractive distillation column bottoms comprising rich hydrocarbon solvent;
- (vi) introducing the second extractive distillation column bottoms comprising rich hydrocarbon solvent into a second solvent stripper to produce a light hydrocarbon overhead purge stream and a second solvent stripper bottoms comprising lean hydrocarbon solvent; and
- (vii) introducing at least a portion of the second solvent stripper bottoms into the second extractive distillation column, the first extractive distillation column, the decanting apparatus, or a combination thereof.
20. The method of claim 19, wherein the heavies distillation column is operated at a pressure in the range of from 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of from 30 to 150 degrees Celsius, or both; wherein the first extractive distillation column is operated at a pressure in a range of 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of 30 to 200 degrees Celsius, or both; wherein the second extractive distillation column is operated at a pressure in the range of from 0 to 60 psig (0 to 414 kPa gauge), at a temperature in the range of from 30 to 200 degrees Celsius, or both; or a combination thereof.