REFRIGERATION RECOVERY FROM REACTOR FEED IN A PROPANE DEHYDROGENATION SYSTEM

TECHNICAL FIELD

[0001] The present invention relates to a process for recovering propylene from a propane dehydrogenation (PDH) process, and more particularly relates to recovering refrigeration from reactor feed in a PDH process.

BACKGROUND

[0002] Propane dehydrogenation (PDH) is a process step in the production of propylene from propane. PDH is important to the petrochemical industry because propylene is the second most important starting product in the petrochemical industry after ethylene. The purpose of a deethanizer and chilling train systems in a PDH process is to separate the cracked gas into a methane-rich tail gas product, a C2 process stream and a C3 process stream.

[0003] It would always be beneficial to improve a PDH process, such as by reducing refrigeration power requirements and/or reducing the size and cost of the compressor system. In particular, the refrigeration power required to provide process cooling in the –5 to 30°C range typically is high. Presently, the depropanizer column overhead stream is produced as a vapor product, which feed to the reactor system without recovery of refrigeration. Process cooling in the –5 to 30°C range is provided through propylene refrigeration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 is a non-limiting, schematic illustration of a portion of a PDH process as described herein.

SUMMARY

[0004a] In an aspect, there is provided a process for recovering propylene from a propane dehydrogenation process, the process comprising:

partially or fully condensing a purified propane-rich depropanizer overhead stream against a cooling medium at

a pressure to yield a liquid purified propane-rich overhead stream;

letting down the liquid purified propane-rich overhead stream in pressure; and

partially or fully vaporizing the liquid purified propane-rich overhead stream against at least one process stream to provide refrigeration to yield a partially or fully vaporized stream, wherein a vaporization pressure is based on back-pressure from a propane dehydrogenation reactor, and wherein at least a portion of the partially or fully vaporized stream is used as feed to the propane dehydrogenation reactor.

[0005] In one non-limiting example, there is provided a process for recovering propylene from a propane dehydrogenation process, where the process includes partially or fully condensing a depropanizer overhead stream

against a relatively warm cooling medium at relatively high pressure; letting down the liquid overhead stream in pressure; and partially or fully vaporizing the liquid overhead stream against at least one process stream to provide refrigeration.

[0005a] In an aspect, there is provided a system for recovering propylene from a propane dehydrogenation process, the system comprising:

a depropanizer column generating a purified propane-rich depropanizer overhead stream (7);

at least one condenser for partially or fully condensing the purified propane-rich depropanizer overhead stream against a cooling medium at a pressure to yield a liquid purified propane-rich overhead stream;

at least one device (40, 42, 44) for letting down the pressure of the liquid purified propane-rich depropanizer overhead stream (7) as determined by back-pressure of a propane dehydrogenation reactor; and

at least one chiller (20, 28, 46) for partially or fully vaporizing the liquid purified propane-rich depropanizer overhead stream (7) to yield a partially or fully vaporized stream that is directed as feed to the propane dehydrogenation reactor.

[0006] In another non-restrictive version, there is provided a system for recovering propylene from a propane dehydrogenation process, where the system includes a depropanizer column generating a depropanizer overhead stream, at least one condenser for partially or fully condensing the depropanizer overhead stream, at least one device for letting down the pressure of the depropanizer overhead stream as determined by back-pressure of a reactor, and at least one chiller for partially or fully vaporizing the depropanizer overhead stream.

DETAILED DESCRIPTION

[0007] In a typical propane dehydrogenation process, fresh propane-rich feed as well as the propane-rich recycle from a C3 Splitter passes through a

Depropanizer column to remove C4+ components. The purified propane-rich stream is recovered as a vapor overhead product that feeds directly to the reactor system without refrigeration heat recovery.

[0008] In one non-limiting embodiment, it has been discovered that the Depropanizer column overhead stream may be partially or fully condensed against a relatively warm cooling medium such as cooling water at relativelyhigh pressure. In one non-limiting embodiment, “relatively warm” is defined as between about 20°C independently to about 50°C, alternatively between about 28°C independently to about 34°C; where the term “independently” when used with reference to a range means any threshold may be used with any other threshold to give a suitable alternative range. In another non-restrictive version “relative high pressure” is defined as between about 10 barg (1101 kPa) independently to about 20 barg (2101 kPa); alternatively between about 12 barg (1301 kPa) independently to about 15 barg (1601 kPa). Other cooling media besides water may include, but not necessarily be limited to, air cooling.

CLAIMS

What is claimed is:

1. A process for recovering propylene from a propane dehydrogenation process, the process comprising:

partially or fully condensing a purified propane-rich depropanizer overhead stream against a cooling medium at a pressure to yield a liquid purified propane-rich overhead stream;

letting down the liquid purified propane-rich overhead stream in pressure; and

partially or fully vaporizing the liquid purified propane-rich overhead stream against at least one process stream to provide refrigeration to yield a partially or fully vaporized stream, wherein a vaporization pressure is based on back-pressure from a propane dehydrogenation reactor, and wherein at least a portion of the partially or fully vaporized stream is used as feed to the propane dehydrogenation reactor.

2. The process of claim 1, wherein the letting down the liquid overhead stream in pressure is based on the back-pressure from the propane dehydrogenation reactor.

3. The process of claim 1, wherein in partially or fully vaporizing the liquid purified propane-rich overhead stream against at least one process stream to provide refrigeration, the refrigeration is in the range of –10 to 30°C.

4. The process of claim 1, wherein partially or fully vaporizing the liquid purified propane-rich overhead stream against at least one process stream to provide refrigeration offsets the requirement for refrigeration provided by a propylene or propane refrigeration system in the same temperature range.

5. The process of claim 1, wherein the cooling medium is at a temperature between 20°C and 50°C and where the pressure is between 10 barg (1101 kPa) and 20 barg (2101 kPa).

6. A system for recovering propylene from a propane dehydrogenation process, the system comprising:

a depropanizer column generating a purified propane-rich depropanizer overhead stream (7);

at least one condenser for partially or fully condensing the purified propane-rich depropanizer overhead stream against a cooling medium at a pressure to yield a liquid purified propane-rich overhead stream;

at least one device (40, 42, 44) for letting down the pressure of the liquid purified propane-rich depropanizer overhead stream (7) as determined by back-pressure of a propane dehydrogenation reactor; and

at least one chiller (20, 28, 46) for partially or fully vaporizing the liquid purified propane-rich depropanizer overhead stream (7) to yield a partially or fully vaporized stream that is directed as feed to the propane dehydrogenation reactor.

7. The system of claim 6 where the device is a valve (40, 42, 44).

8. The system of claim 6, wherein refrigeration of the least one chiller is in the range of – 10ºC to 30 ºC.

9. The system of claim 6, wherein the cooling medium is at a temperature between about 20ºC and about 50ºC and where the pressure is between 10 barg (1101 kPa) and 20 barg (2101 kPa).