second end of the first distillation unit via a first line; an isomerization reactor coupled to: a third end of the first distillation unit at a first end of the isomerization reactor; and the feed line.

[0008a] In one aspect, there is provided a process to convert a feed, comprising: introducing a feed comprising isobutylene to an oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene; introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene; and introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene; introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene; combining the second polishing column effluent with the feed comprising isobutylene; and introducing the second polishing column effluent to the oligomerization reactor.

[0008b] In another aspect, there is provided a process to convert a feed, comprising: introducing a feed comprising isobutylene to a solid oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene, the oligomerization reactor being a loop reactor or a continuous stirred tank reactor; introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene; introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene; introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene; combining the second polishing column effluent with the feed comprising isobutylene; and introducing the second polishing column effluent to the oligomerization reactor.

[0008c] In yet another aspect, there is provided a process to convert a feed, comprising: introducing a feed comprising isobutylene to a solid oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene, the oligomerization reactor being a loop reactor or a continuous stirred tank reactor;

introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene; introducing the first distillation effluent to an isomerization reactor to form an isomerized product effluent, the isomerized product effluent enriched in isobutylene; introducing the isomerized product effluent to the oligomerization reactor; introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene; introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene; combining the second polishing column effluent with the feed comprising isobutylene; and ntroducing the second polishing column effluent to the oligomerization reactor.

BRIEF DESCRIPTION OF THE FIGURES

[0009] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only exemplary embodiments and are therefore not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

[0010] FIG. **1** is a flow diagram of a method of processing C4 according to some embodiments.

[0011] FIG. **2** is a flow diagram flow diagram for a HR-PIB processing method according to some embodiments.

[0012] FIG. **3** is a C4 processing unit according to some embodiments.

[0013] FIG. **4** is a HR-PIB processing according to some embodiments.

DETAILED DESCRIPTION

[0014] The present disclosure provides a novel processing scheme to convert the normal butylenes (e.g., 1-butene and 2-butenes) in crude C4 streams to a product containing isobutylene and minimal amounts of the normal butylenes. Such a process can provide for an economically efficient production of isobutylene. Moreover, the present disclosure includes using that isobutylene formed to make polyisobutylene ("PIB") and high reactive polyisobutylene ("HR-PIB"). Furthermore, the present disclosure includes processes for the conversion of crude C4

streams at the olefin plant instead of sending the crude C4 streams to an off-site processing facility.

[0015] Advantageously, the conversion processes disclosed herein can provide a valuable use for the low-value normal butylenes, such as for the production of isobutylene. Instead of flaring the normal butylenes and/or sending the streams containing normal butylenes to off-site processors, the conversion processes disclosed herein advantageously can be performed on-site.

[0016] In addition, the present disclosure advantageously provides a process that can convert all, or nearly all, of the isobutylene to PIB, e.g., HR-PIB. The present disclosure

CLAIMS:

We claim:

1. A process to convert a feed, comprising:

introducing a feed comprising isobutylene to an oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene;

introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene; and

introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene;

introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene;

combining the second polishing column effluent with the feed comprising isobutylene; and

introducing the second polishing column effluent to the oligomerization reactor.

2. The process of claim 1, further comprising introducing the first distillation effluent to an isomerization reactor to form an isomerized product effluent, the isomerized product effluent enriched in isobutylene; and

introducing the isomerized product effluent to the oligomerization reactor.

3. The process of claim 2, further comprising purging butadiene from the isomerized product effluent.

4. The process of claim 1, further comprising:

introducing the second distillation effluent to a second distillation unit prior to the cracking reactor to form a third distillation effluent; and

introducing the third distillation effluent to the cracking reactor.

5. The process of claim 4, wherein the introducing the second distillation effluent to a second distillation unit prior to the cracking reactor forms a fourth distillation effluent, the fourth distillation effluent comprising diisobutylene.

6. The process of claim 1, further comprising introducing the cracking reactor effluent, the first polishing column effluent, or a combination thereof to a polymerization reactor to form a polymerization reactor effluent comprising a high reactive polyisobutylene.

7. The process of claim 6, further comprising introducing the polymerization reactor effluent to a debutanizer column to form a first debutanized effluent and a second debutanized effluent, the first debutanized effluent comprising the high reactive polyisobutylene and optionally oligomer byproducts, and the second debutanized effluent comprising the high purity isobutylene.

8. The process of claim 7, further comprising introducing the first debutanized effluent to a third distillation unit to form a fifth distillation effluent and a sixth distillation effluent, the fifth distillation effluent comprising the high reactive polyisobutylene.

9. The process of claim 8, further comprising combining the sixth distillation effluent with the second distillation effluent; and

introducing the sixth distillation effluent to the cracking reactor.

10. The process of claim 7, further comprising:

introducing the second debutanized effluent to the polishing column.

11. The process of claim 1, wherein:

a conversion of the feed comprising isobutylene to the high purity isobutylene is about 80% or greater, based on a total butylene content in the feed.

12. A process to convert a feed, comprising:

introducing a feed comprising isobutylene to a solid oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene, the oligomerization reactor being a loop reactor or a continuous stirred tank reactor;

introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene;

introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene;

introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene;

combining the second polishing column effluent with the feed comprising isobutylene; and

introducing the second polishing column effluent to the oligomerization reactor.

13. The process of claim 1, wherein the oligomerization catalyst is a solid oligomerization catalyst.

14. The process of claim 1, wherein the oligomerization reactor is a loop reactor or a continuous stirred tank reactor.

15. The process of claim 2, further comprising combining the isomerized product effluent enriched in isobutylene with the feed comprising isobutylene before introducing the isomerized product effluent to the oligomerization reactor.

16. The process of claim 7, further comprising combining the second debutanized effluent with the cracking reactor effluent prior to introducing the second debutanized effluent to the polishing column.

17. The process of claim 1, wherein:

the feed is raffinate-1;

the oligomerization catalyst comprises BF_3 and a support material;

conversion of the feed comprising isobutylene to the high purity isobutylene is about 90% or greater based on a total butylene content in the feed; or

combinations thereof.

18. The process of claim 17, wherein:

a concentration of BF_3 in the oligomerization catalyst is greater than 30 wt%;

the support material comprises Al_2O_3, ZrO_2, TiO_2, SnO_2, CeO_2, SiO_2, or combinations thereof; and

when the support material comprises Al_2O_3, the support material has an Al_2O_3 content between 25 wt% and 75 wt%, based on a total weight of the support material.

19. A process to convert a feed, comprising:

introducing a feed comprising isobutylene to a solid oligomerization catalyst in an oligomerization reactor to form a first reactor effluent comprising one or more oligomers of isobutylene, the oligomerization reactor being a loop reactor or a continuous stirred tank reactor;

introducing the first reactor effluent to a first distillation unit to form a first distillation effluent and a second distillation effluent, the second distillation effluent comprising the one or more oligomers of isobutylene;

introducing the first distillation effluent to an isomerization reactor to form an isomerized product effluent, the isomerized product effluent enriched in isobutylene;

introducing the isomerized product effluent to the oligomerization reactor;

introducing the second distillation effluent to a cracking reactor to form a cracking reactor effluent, the cracking reactor effluent comprising a high purity isobutylene;

introducing the cracking reactor effluent to a polishing column to form a first polishing column effluent and a second polishing column effluent, the first polishing column effluent comprising the high purity isobutylene;

combining the second polishing column effluent with the feed comprising isobutylene; and

introducing the second polishing column effluent to the oligomerization reactor.