CLAIMS

1. A process for producing cyclohexylbenzene, the process comprising:

(a) contacting benzene and hydrogen under hydroalkylation conditions effective to form a first effluent stream comprising cyclohexylbenzene, cyclohexane, methylcyclopentane, and unreacted benzene;

(b) contacting at least a portion of the first effluent stream with a dehydrogenation catalyst under dehydrogenation conditions to convert at least a portion of the cyclohexane to benzene thereby forming a second effluent stream, wherein the amount of methylcyclopentane in the second effluent stream is different by no more than 65% of the total amount of the portion of the first effluent stream, said amounts being on a weight basis;

(c) removing a methylcyclopentane-containing stream from the first effluent stream or the second effluent stream; and

(d) recycling at least a portion of the second effluent stream containing benzene to (a),

wherein the dehydrogenation catalyst comprises 0.05 wt% to 0.5 wt% of a metal selected from Group 14 of the Periodic Table of Elements; and 0.1 wt% to 2 wt% of a metal selected from palladium and platinum, the wt%s being based upon total weight of the dehydrogenation catalyst.

2. The process of claim 1, wherein the amount of methylcyclopentane in the second effluent stream is different by no more than 30% of the total amount of the portion of the first effluent stream, said amounts being on a weight basis.

3. The process of claim 1 or claim 2, wherein the amount of methylcyclopentane in the second effluent stream is different by no more than 10% of the total amount of portion of the first effluent stream, said amounts being on a weight basis.

4. The process of any one of the preceding claims, wherein the amount of methylcyclopentane in the second effluent stream is different by no more than 2% of

the total amount of the portion of the first effluent stream, said amounts being on a weight basis.

5. The process of any one of the preceding claims, wherein a cyclohexylbenzene-containing stream is recovered from said first effluent stream prior to said contacting step (b).

6. The process of claim 5, wherein the cyclohexylbenzene-containing stream is recovered from said first effluent stream by fractionation.

7. The process of any one of the preceding claims, wherein the contacting step (a) is conducted in the presence of a hydroalkylation catalyst comprising a molecular sieve of the MCM-22 family and a hydrogenation metal.

~~8. The process of any one of the preceding claims, wherein the dehydrogenation catalyst comprises 0.05 wt% to 0.5 wt% of a metal selected from Group 14 of the Periodic Table of Elements; and 0.1 wt% to 2 wt% of a metal selected from Groups 6 to 10 of the Periodic Table of Elements, the wt%s being based upon total weight of the dehydrogenation catalyst.~~

~~9.~~8. The process of claim ~~8~~ 1, wherein the metal selected from Group 14 of the Periodic Table of Elements comprises tin.

~~10. The process of claim 8 or claim 9, wherein the metal selected from Groups 6 to 10 of the Periodic Table of Elements comprises platinum and/or palladium.~~

~~11.~~9. The process of any one of the preceding claims, wherein the dehydrogenation conditions comprise a temperature between 200°C and 550°C and a pressure between 100 kPa and 7,000 kPa, gauge.

~~12.~~10. The process of any one of the preceding claims, wherein the methylcyclopentane-containing stream is removed from either the first or the second effluent stream by fractionation.

~~13.~~11. The process of any one of the preceding claims, wherein the methylcyclopentane-containing stream contains from ~~about~~ 5 wt% to ~~about~~ 50 wt% methylcyclopentane, the wt% based upon the weight of the methylcyclopentane-containing stream.

~~14.~~12. The process of any one of the preceding claims, wherein the methylcyclopentane-containing stream contains from ~~about~~ 5 wt% to ~~about~~ 50 wt% cyclohexane, the wt% based upon the weight of the methylcyclopentane-containing stream.

~~15.~~13. The process of any one of the preceding claims, wherein the methylcyclopentane-containing stream contains from ~~about~~ 10 wt% to ~~about~~ 80 wt% benzene, the wt% based upon the weight of the methylcyclopentane-containing stream.

~~16.~~14. The process of any one of the preceding claims, wherein the portion of the second effluent stream that is recycled to the contacting step (a) contains from ~~about~~ 0.1 wt% to ~~about~~ 5 wt% methylcyclopentane, the wt% based upon the weight of the portion of the second effluent stream.

~~17.~~15. The process of any one of the preceding claims, wherein the portion of the second effluent stream that is recycled to the contacting step (a) contains from ~~about~~ 0.1 wt% to ~~about~~ 1 wt% methylcyclopentane, the wt% based upon the weight of the portion of the second effluent stream.

~~18.~~16. The process of any one of the preceding claims, wherein the portion of the second effluent stream that is recycled to the contacting step (a) contains from ~~about~~ 0.1 wt% to ~~about~~ 10 wt% cyclohexane, the wt% based upon the weight of the portion of the second effluent stream.

~~19. A process for producing cyclohexylbenzene, the process comprising:~~

(a) contacting benzene and hydrogen in the presence of a hydroalkylation catalyst under hydroalkylation conditions effective to form a first effluent stream comprising cyclohexylbenzene, methylcyclopentane, and unreacted benzene;

(b) supplying at least a portion of said first effluent stream to a fractionation system to recover a first product stream containing cyclohexylbenzene and a second product stream containing from about 1 wt% to about 99 wt% of the methylcyclopentane contained in said first effluent stream portion and leave a benzene-containing stream containing up to 5 wt% methylcyclopentane; and

(c) recycling at least a portion of the benzene-containing stream to (a).

20. The process of claim 19, wherein the second product stream contains from about 2 wt% to about 80 wt% of the methylcyclopentane contained in said portion of the first effluent stream.

21. The process of claim 19 or claim 20, wherein the second product stream contains from about 5 wt% to about 50 wt% methylcyclopentane, the wt% based upon the total weight of the second product stream.

22. The process of any one of claims 19-21, wherein the second product stream contains from about 10 wt% to about 80 wt% benzene, the wt% based upon the total weight of the second product stream.

23. The process of any one of claims 19-22, wherein the benzene-containing stream contains from about 0.1 wt% to about 1 wt% methylcyclopentane, the wt% based upon the weight of the benzene-containing stream.

24. A process for producing cyclohexylbenzene, the process comprising:

(a) contacting dicyclohexylbenzene and benzene in the presence of a transalkylation catalyst under transalkylation conditions effective to form a transalkylation effluent stream comprising cyclohexylbenzene, methylcyclopentane, and unreacted benzene;

~~(b) supplying at least a portion of said transalkylation effluent stream to a fractionation system to recover a first product stream containing cyclohexylbenzene and a second product stream containing from about 1 wt% to about 99 wt% of the methylcyclopentane contained in said first effluent stream portion and leave a benzene-containing stream containing up to 5 wt% methylcyclopentane; and~~

~~(c) recycling at least a portion of the benzene-containing stream to (a) or to a benzene hydroalkylation process.~~

~~25.~~17. A process for producing cyclohexylbenzene, the process comprising:

(a) contacting benzene and hydrogen under hydroalkylation conditions effective to form a first effluent stream comprising cyclohexylbenzene, cyclohexane, methylcyclopentane, and unreacted benzene;

(b) contacting at least a portion of the first effluent stream with a dehydrogenation catalyst under dehydrogenation conditions sufficient to convert at least a portion of the cyclohexane in the first effluent stream portion to benzene and form a second effluent stream, wherein less than 10% of the methylcyclopentane in the second effluent stream is converted to a paraffin on a weight basis;

(c) removing a methylcyclopentane-containing stream from either the first effluent stream or the second effluent stream; and

(d) recycling at least a portion of the second effluent stream containing benzene to (a),

wherein the dehydrogenation catalyst comprises 0.05 wt% to 0.5 wt% of a metal selected from Group 14 of the Periodic Table of Elements; and 0.1 wt% to 2 wt% of a metal selected from palladium and platinum, the wt%s being based upon total weight of the dehydrogenation catalyst.