CLAIMS

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

(a) contacting benzene with a hydrogen-containing stream in the presence of a hydroalkylation catalyst under hydroalkylation conditions effective to form a first effluent stream comprising cyclohexylbenzene, cyclohexane, and benzene; ~~and~~

(b) contacting the first effluent stream with fresh make-up hydrogen; and

~~(b)~~(c) contacting at least a portion of the cyclohexane and the fresh make-up hydrogen from the first effluent stream with a dehydrogenation catalyst in a dehydrogenation reaction zone under dehydrogenation conditions effective to convert at least some of the cyclohexane into benzene contained in a second effluent stream,

wherein at least some of the hydrogen-containing stream is supplied ~~to~~ from said dehydrogenation reaction zone before contacting said hydroalkylation catalyst in (a).

2. The process of claim 1, wherein at least ~~some of the hydrogen supplied to (a)~~ a portion of the fresh make-up hydrogen from (b) contacts said dehydrogenation catalyst in said dehydrogenation zone, ~~before contacting said hydroalkylation catalyst in (a).~~ and furthermore forms at least part of the hydrogen-containing stream in (a).

3. The process of claim 2, wherein the hydrogen-containing stream contains at least one impurity selected from carbon monoxide and an oxygenate, and at least a portion of the impurity is removed from the hydrogen-containing stream through contact with said dehydrogenation catalyst.

4. The process of claim 3, wherein at least 10 wt% of the impurity is removed from the hydrogen-containing stream.

5. The process of claim 3 or claim 4, wherein the impurity is carbon monoxide.

6. The process of claim 3 or claim 4, wherein the oxygenate is an aldehyde or a ketone.

7. The process of any one of the preceding claims, ~~and further comprising:~~

~~(c)~~ wherein contacting the first effluent stream with the fresh make-up hydrogen ~~to separate~~ separates the first effluent stream into a vapor-phase stream containing cyclohexane and benzene and a liquid-phase stream containing cyclohexylbenzene.

8. The process of claim 7, wherein at least some of the hydrogen in (c) contacts the dehydrogenation catalyst before contacting the first effluent stream.

9. The process of claim 7 or claim 8, wherein at least a portion of said first effluent stream is fed to a gas/liquid separator to recover at least a portion of the cyclohexylbenzene prior to the contacting (b).

10. The process of any one of claims 7-9, wherein at least a portion of the vapor phase stream is recycled to the contacting (a).

11. The process of any one of ~~claims 7-10~~ the preceding claims, wherein said fresh make-up hydrogen is supplied in a direction countercurrent to the first effluent stream.

12. The process of any one of ~~claims 7-11~~ the preceding claims, wherein the fresh make-up hydrogen is contacted with the first effluent stream in a stripper located downstream of the contacting step (a).

13. The process of any one of ~~claims 7-12~~ the preceding claims, wherein the contacting (a) is conducted in a plurality of series connected reaction zones and the fresh make-up hydrogen is supplied at or adjacent to the outlet of the final reaction zone.

14. The process of any one of ~~claims 7-13~~ the preceding claims, wherein the contacting (a) is conducted in three series connected reaction zones.

15. The process of any one of the preceding claims, wherein the hydroalkylation catalyst comprises at least one molecular sieve and at least one hydrogenation metal.

16. The process of claim 15, wherein the at least one molecular sieve is selected from zeolite beta, mordenite, zeolite X, zeolite Y, and a molecular sieve of the MCM-22 family.

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

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

(b) supplying fresh make-up hydrogen to the ~~process~~ first effluent stream such that said first effluent stream is a mixed gas and liquid phase stream, wherein at least a portion of the cyclohexane and benzene is in the vapor phase; and

(c) separating the first effluent stream into a vapor phase stream containing cyclohexane and benzene, and a liquid phase stream containing cyclohexylbenzene.

18. The process of claim 17, wherein at least a portion of the ~~vapor phase stream containing~~ cyclohexane and benzene is contacted with at least a portion of the fresh make-up hydrogen in the presence of a dehydrogenation catalyst under dehydrogenation conditions effective to convert at least a portion of the cyclohexane to benzene.

19. The process of claim 18, wherein the fresh make-up hydrogen ~~is~~ supplied to the ~~process such that the fresh hydrogen~~ first effluent stream contacts said dehydrogenation catalyst before contacting said hydroalkylation catalyst in (a).

20. The process of any one of claims 17-19, wherein part of the vapor phase stream is recycled to the contacting (a).

21. The process of any one of claims 17-20, wherein the hydroalkylation catalyst comprises at least one molecular sieve and at least one hydrogenation metal.

22. The process of claim 21, wherein the at least one molecular sieve is selected from zeolite beta, mordenite, zeolite X, zeolite Y, and a molecular sieve of the MCM-22 family.