CLAIMS

1. A process for producing phenol and/or cyclohexanone, said process comprising:

(a) contacting cyclohexylbenzene with an oxygen-containing gas under conditions effective to produce an oxidation effluent containing cyclohexylbenzene hydroperoxide;

(b) contacting at least part of said oxidation effluent containing cyclohexylbenzene hydroperoxide with a cleavage catalyst under conditions effective to produce a cleavage effluent containing phenol and cyclohexanone,

wherein at least one of said oxidation effluent and said cleavage effluent contains at least one phenylcyclohexanol as a by-product; and

(c) contacting at least part of said at least one effluent containing said at least one phenylcyclohexanol with a dehydration catalyst comprising a molecular sieve of the MCM-22 family under conditions effective to convert at least part of said phenylcyclohexanol to phenylcyclohexene.

2. The process of claim 1, wherein said at least one phenylcyclohexanol comprises one or more of 2-phenyl-1-cyclohexanol, 3-phenyl-1-cyclohexanol, and 4-phenyl-1-cyclohexanol.

3. The process of claim 1 or claim 2, wherein said molecular sieve of the MCM-22 family comprises MCM-56.

4. The process of any one of the preceding claims, wherein said conditions in said contacting step (c) comprise a temperature of 25°C to 200°C.

5. The process of any one of ~~the preceding~~ claims 2 to 4, further comprising:

(d) contacting at least part of said phenylcyclohexene produced in said contacting step (c) with hydrogen under conditions effective to convert at least part of said phenylcyclohexene to cyclohexylbenzene and to obtain a hydrogenation effluent.

6. The process of claim 5, wherein said conditions in said contacting step (d) comprise a temperature of 80°C to 150°C.

7. The process of claim 5 or claim 6, wherein said conditions in said contacting step (d) comprise a hydrogen partial pressure of 15 kPa to 1000 kPa.

8. The process of any one of claims 5 to 7, wherein said contacting steps (c) and (d) are conducted in separate reaction zones.

9. The process of any one of claims 5 to 8, further comprising:
   (e) separating at least part of said cleavage effluent from said contacting step (b) into a first fraction containing phenol and cyclohexanone and a second fraction containing said at least one phenylcyclohexanol; and
   (f) supplying said second fraction to said contacting step (c).

10. The process of claim 9, wherein said separating step (e) is effected in a first distillation column.

11. The process of claim 10, wherein said second fraction is removed as a side stream from said first distillation column.

12. The process of claim 10 or claim 11, wherein step (d) is carried out, and at least part of said hydrogenation effluent in said contacting step (d) is fed back to said first distillation column.

13. The process of any one of claims 9 to 12, wherein said cleavage catalyst in said contacting step (b) comprises sulfuric acid and said process further comprises:
   (g) neutralizing residual sulfuric acid in said cleavage effluent with amines to produce amine salts in said cleavage effluent; and
   (h) removing amine salts produced in said cleavage effluent by said neutralizing step (g) prior to said separating step (e).

14. The process of claim 13, wherein said removing step (h) is effected in a second distillation column.

15. The process of any one of claims 5 to 14, further comprising:

(i) recycling at least part of said cyclohexylbenzene produced in said contacting step (d) to said contacting step (a).

16. The process of any one of ~~the preceding~~ claims 2 to 15, wherein said contacting step (a) is effected in the presence of a catalyst.

17. The process of any one of ~~the preceding~~ claims 2 to 16, wherein said contacting step (a) is effected in the presence of a cyclic imide catalyst.

18. The process of any one of ~~the preceding~~ claims 2 to 17, wherein said cyclohexylbenzene is produced by alkylation of benzene with cyclohexene.

19. The process of any one of ~~the preceding~~ claims 2 to 18, wherein said cyclohexylbenzene is produced by reaction of benzene with hydrogen in the presence of a hydroalkylation catalyst.

20. The process of claim 19, wherein said hydroalkylation catalyst comprises an acid alkylation component and a hydrogenating metal component.

21. The process of claim 20, wherein said acid alkylation component comprises a molecular sieve.

22. The process of claim 20 or claim 21, wherein said acid alkylation component comprises a molecular sieve of the MCM-22 family.

23. A process for producing phenol and/or cyclohexanone, said process comprising:

(I) contacting benzene with hydrogen in the presence of a hydroalkylation catalyst under a hydroalkylation condition effective to produce a hydroalkylation effluent comprising cyclohexylbenzene;

(II) contacting at least part of said cyclohexylbenzene in said hydroalkylation effluent with an oxygen-containing gas under conditions effective to produce an oxidation effluent containing cyclohexylbenzene hydroperoxide;

(III) contacting at least part of said oxidation effluent containing cyclohexylbenzene hydroperoxide with a cleavage catalyst under conditions effective to produce a cleavage effluent containing phenol and cyclohexanone,

wherein at least one of said oxidation effluent and said cleavage effluent contains at least one phenylcyclohexanol selected from the group consisting of 2-phenyl-1-cyclohexanol, 3-phenyl-1-cyclohexanol, and 4-phenyl-1-cyclohexanol; and

(IV) contacting at least part of said at least one effluent containing said at least one phenylcyclohexanol with a dehydration catalyst comprising a molecular sieve of the MCM-22 family under conditions effective to convert at least part of said phenylcyclohexanol to phenylcyclohexene.

24. The process of claim 23, further comprising:

(V) contacting at least part of said phenylcyclohexene produced in said contacting step (IV) with hydrogen under conditions effective to convert at least part of said phenylcyclohexene to cyclohexylbenzene.

25. The process of claim 23 or claim 24, further comprising:

(VI) separating at least part of said cleavage effluent produced in said contacting step (III) into a first fraction containing phenol and cyclohexanone and a second fraction containing said at least one by-product; and

(VII) supplying at least part of said second fraction to said contacting step (IV).