CLAIMS

1. A process for producing one or both of phenol and cyclohexanone comprising:

(a) oxidizing at least a portion of a feed comprising cyclohexylbenzene to produce an oxidation composition comprising cyclohexyl-1-phenyl-1-hydroperoxide;

(b) cleaving at least a portion of the oxidation composition in the presence of an acid catalyst to produce a ~~single-phase~~ cleavage reaction mixture comprising the acid catalyst, phenol and cyclohexanone; and

(c) neutralizing at least a portion of the ~~single-phase~~ cleavage reaction mixture with a basic material to form a ~~single-phase~~ treated cleavage reaction mixture that is an exclusively organic matrix, wherein the neutralizing forms, from the acid catalyst and the basic material, a complexation product soluble in the exclusively organic matrix, and further~~,~~ wherein the ~~single-phase~~ treated cleavage reaction mixture contains no greater than 50 weight-parts-per-million (wppm) of the acid catalyst or no greater than 50 wppm of the basic material.

2. The process of claim 1, wherein the oxidation composition comprises at least 65 wt% cyclohexylbenzene, the wt% based upon the total weight of the oxidation composition.

3. The process of claim 1 or claim 2, wherein the oxidation composition further comprises one or more hydroperoxides selected from cyclohexyl-1-phenyl-2-hydroperoxide; cyclohexyl-1-phenyl-3-hydroperoxide; cyclohexyl-1-phenyl-4-hydroperoxide; cyclopentyl-1-methyl-2-phenyl-2-hydroperoxide; cyclopentyl-1-methyl-3-phenyl-3-hydroperoxide; cyclopentyl-1-methyl-1-phenyl-2-hydroperoxide; cyclopentyl-1-methyl-1-phenyl-3-hydroperoxide; cyclohexyl-1-phenyl-1,2-dihydroperoxide; cyclohexyl-1-phenyl-1,3-dihydroperoxide; cyclohexyl-1-phenyl-1,4-dihydroperoxide; cyclopentyl-1-methyl-2-phenyl-1,2-dihydroperoxide; cyclopentyl-1-methyl-2-phenyl-2,3-dihydroperoxide; cyclopentyl-1-methyl-2-phenyl-2,4-dihydroperoxide; and cyclopentyl-1-methyl-2-phenyl-2,5-dihydroperoxide.

4. The process of any one of the preceding claims, wherein the acid catalyst is one or more of sulfuric acid, perchloric acid, phosphoric acid, hydrochloric acid and p-toluene sulfonic acid.

5. The process of any of the preceding claims, wherein the cleavage reaction mixture comprises at least 50 wppm and no greater than 3000 wppm of the acid catalyst, based upon total weight of the cleavage reaction mixture.

6. The process of any one of the preceding claims, wherein the basic material is ~~one or more of an anionic exchange resin, an activated carbon and~~ an amine.

7. The process of any one of claims 1-5, wherein the basic material is an aliphatic amine.

8. The process of any one of claims 1-5 or claim 7, wherein the basic material is a diamine.

9. The process of any one of the preceding claims, wherein the neutralizing in (c) occurs at a temperature of at least 30°C and no greater than 200°C, and a pressure of at least 5 and no greater than 3450 kPa.

~~10. The process of claim 9, wherein the basic material is an anionic exchange resin.~~

~~11.~~10. The process of any one of the preceding claims, wherein the treated cleavage reaction mixture contains no greater than 25 wppm of the acid catalyst and no greater than 25 wppm of the basic material.

~~12.~~11. The process of any one of the preceding claims, wherein the amount of at least one of the acid catalyst or basic material in the treated cleavage reaction mixture is determined using a calibrated method.

~~13.~~12. The process of claim ~~12~~ 11, wherein the amount of acid catalyst or basic material in the treated cleavage reaction mixture is determined continually, and the process further includes: (i) continually determining a difference between the continually determined amount of acid catalyst or basic material and a target amount of acid catalyst or basic material in the treated cleavage reaction mixture; and (ii) adjusting the amount of basic material in (c) on the basis of the continually determined difference to approach the target amount of acid catalyst or basic material in the treated cleavage reaction mixture.

~~14.~~13. The process of any one of the preceding claims, wherein the ~~neutralizing of the basic material and acid catalyst in (c) forms a~~ complexation product ~~that is soluble in the treated cleavage reaction mixture,~~ is stable at a temperature of at least 185°C, and has a lower volatility than cyclohexylbenzene.

~~15.~~14. The process of any one of the preceding claims, wherein at least a portion of the treated cleavage reaction mixture is subjected to one or more fractional distillation steps to produce a bottoms material that comprises less than 5 wt% of cyclohexylbenzene, phenol and cyclohexanone combined, that wt% being based on the total weight of the bottoms material, and further contains more than 95 wt% of the complexation product contained in the at least a portion of the treated cleavage reaction mixture subjected to the fractional distillation, that wt% based upon the total weight of the at least a portion of the treated cleavage reaction mixture subjected to the fractional distillation.

~~16.~~15. Phenol produced by the process of claim 1.

~~17.~~16. Cyclohexanone produced by the process of claim 1.

~~18.~~17. At least one of a phenolic resin, bisphenol A, ε-caprolactam, an adipic acid or a plasticizer produced from the phenol of claim ~~16~~ 15.

~~19.~~18. At least one of adipic acid, a cyclohexanone resin, a cyclohexanone oxime, caprolactam or nylon produced from the cyclohexanone of claim ~~17~~ 16.

~~20.~~19. A process for producing phenol comprising:

(a) introducing oxygen to a feed comprising cyclohexylbenzene to cause an oxidation reaction to occur and produce an oxidation composition comprising cyclohexyl-1-phenyl-1-hydroperoxide;

(b) introducing an acid catalyst to at least a portion of the oxidation composition to cause a cleavage reaction to occur, and produce a ~~single-phase~~ cleavage reaction mixture comprising the acid catalyst, phenol and cyclohexanone; and

(c) introducing a basic material to at least a portion of the ~~single-phase~~ cleavage reaction mixture to cause a neutralization reaction to occur, ~~of~~ wherein a complexation product is formed from at least a portion of the basic material with at least a portion of the acid catalyst in the at least a portion of the ~~single-phase~~ cleavage reaction mixture, ~~and form~~ thereby forming a ~~single-phase~~ treated cleavage reaction mixture that is an exclusively organix matrix, wherein the complexation product is soluble in the exclusively organic matrix, and further wherein the treated cleavage reaction mixture contains no greater than 50 wppm of the acid catalyst or no greater than 50 wppm of the basic material.

~~21.~~20. A process for producing phenol comprising:

(a) oxidizing cyclohexylbenzene to produce an oxidation composition comprising cyclohexyl-1-phenyl-1-hydroperoxide;

(b) cleaving at least a portion of the cyclohexyl-1-phenyl-1-hydroperoxide in the presence of an acid catalyst to produce a ~~single-phase~~ cleavage reaction mixture comprising the acid catalyst and at least some phenol and cyclohexanone; and

(c) neutralizing at least some of the acid catalyst from the ~~single-phase~~ cleavage reaction mixture with a basic material to form a complexation product, thereby forming a ~~single-phase~~ treated cleavage reaction mixture that is an exclusively organic matrix, wherein the complexation product is soluble in the exclusively organix matrix, and further wherein the treated cleavage reaction mixture contains no greater than 50 wppm of the acid catalyst or no greater than 50 wppm of the basic material.