CLAIMS

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

(a) contacting cyclohexylbenzene with an oxygen-containing gas in the presence of an oxidation catalyst under oxidation conditions effective to produce an oxidation effluent comprising cyclohexylbenzene hydroperoxide at a first concentration Con1 and residual cyclohexylbenzene;

(b) concentrating at least a portion of the oxidation effluent to produce a cleavage feed comprising cyclohexylbenzene hydroperoxide at a second concentration Con2, where Con2 > Con1; ~~and~~

(c) contacting a cleavage reaction mixture formed from the cleavage feed with a solid acid catalyst in a cleavage reaction zone under conditions effective to produce a cleavage product comprising phenol and cyclohexanone~~.~~;

(d) dividing the cleavage product into a first fraction and a second fraction, each comprising phenol and cyclohexanone;

(e) supplying a polar solvent comprising water to the second fraction to form a combined recycle stream; and

(f) providing the combined recycle stream to the cleavage reaction zone.

2. The process of claim 1, wherein the concentrating step (b) comprises distillation to remove at least a portion of the cyclohexylbenzene in the oxidation effluent.

3. The process of claim 1 or claim 2, wherein Con2 – Con1 > 10 wt%.

4. The process of any preceding claim, wherein Con2 – Con1 > 20 wt%.

5. The process of claim 1 or claim 2, wherein Con1 is in a range from 10 wt% to 30 wt% and Con2 is in a range from 30 wt% to 80 wt%.

6. The process of any preceding claim, wherein Con1 is in a range from 15 wt% to 25 wt% and Con2 is in a range from 40 wt% to 60 wt%.

~~7. The process of any preceding claim, wherein the cleavage product is divided into at least a first fraction and a second fraction, and the first fraction is recycled to the cleavage reaction zone.~~

~~8.~~7. The process of claim ~~7~~ 1, wherein the weight ratio of the first fraction to the second fraction is in a range from 1 to 50.

~~9.~~8. The process of any preceding claim, wherein the solid acid catalyst comprises an acidic molecular sieve.

~~10.~~9. The process of claim ~~9~~ 8, wherein the acidic molecular sieve comprises an aluminosilicate zeolite.

~~11.~~10. The process of claim ~~9~~ 8 or claim ~~10~~ 9, wherein the acidic molecular sieve comprises at least one of zeolite beta, faujasite, ZSM-12, mordenite and an MCM-22 family molecular sieve.

~~12.~~11. The process of any preceding claims, further comprising:

~~(d)~~ (g) regenerating at least a portion of the solid acid catalyst.

~~13.~~12. A process for producing phenol and/or cyclohexanone, the process comprising:

(a) hydroalkylating benzene with hydrogen in the presence of a hydroalkylation catalyst under conditions effective to produce a hydroalkylation reaction product comprising cyclohexylbenzene;

(b) contacting at least a portion of the cyclohexylbenzene from the hydroalkylation reaction product with an oxygen-containing gas in the presence of an oxidation catalyst under oxidation conditions effective to produce an oxidation effluent comprising cyclohexylbenzene hydroperoxide at a first concentration Con1 and residual cyclohexylbenzene;

(c) concentrating at least a portion of the oxidation effluent to produce a cleavage feed comprising cyclohexylbenzene hydroperoxide at a second concentration Con2, where Con2 > Con1; ~~and~~

(d) contacting a cleavage reaction mixture formed from the cleavage feed with a solid acid catalyst in a cleavage reaction zone under conditions effective to produce a cleavage product comprising phenol and cyclohexanone.;

(e) dividing the cleavage product into a first fraction and a second fraction, each comprising phenol and cyclohexanone;

(f) supplying a polar solvent comprising water to the second fraction to form a combined recycle stream; and

(g) providing the combined recycle stream to the cleavage reaction zone.

~~14.~~13. The process of claim ~~13~~ 12, wherein the concentrating step (b) comprises distillation to remove at least a portion of the residual cyclohexylbenzene in the oxidation effluent.

~~15.~~14. The process of claim ~~13~~ 12 or claim ~~14~~ 13, wherein Con2 – Con1 > 10 wt%.

~~16.~~15. The process of any one of claims ~~13~~ 12 to ~~15~~ 14, wherein Con2 – Con1 > 20 wt%.

~~17.~~16. The process of claim ~~13~~ 12 or claim ~~14~~ 13, wherein Con1 is in a range from 10 wt% to 30 wt%, and Con2 is in a range from 30 wt% to 80 wt%.

~~18.~~17. The process of any one of claims ~~13~~ 12 to ~~17~~ 16, wherein Con1 is in a range from 15 wt% to 25 wt%, and Con2 is in a range from 40 wt% to 60 wt%.

~~19. The process of any one of claims 13 to 18, wherein the cleavage product is divided into at least a first fraction and a second fraction, and the first fraction is recycled to the cleavage reaction zone.~~

~~20.~~18. The process of claim ~~19~~ 12, wherein the weight ratio of the first fraction to the second fraction is from 1 to 50.

~~21.~~19. The process of any one of claims ~~13~~ 12 to ~~20~~ 18, wherein the solid acid catalyst comprises an acidic molecular sieve.

~~22.~~20. The process of claim ~~21~~ 19, wherein the acidic molecular sieve comprises an aluminosilicate zeolite.

~~23.~~21. The process of claim ~~21~~ 19 or claim ~~22~~ 20, wherein the acidic molecular sieve comprises at least one of zeolite beta, faujasite, ZSM-12, mordenite and an MCM-22 family molecular sieve.

~~24.~~22. The process of any one of claims ~~13~~ 12 to ~~23~~ 21, further comprising:

(e) regenerating at least a portion of the solid acid catalyst.