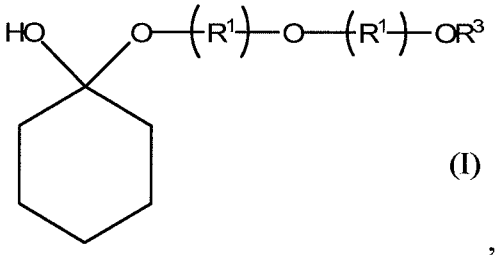
CLAIMS

1. A process for separating a mixture comprising cyclohexanone and phenol, the process comprising:

(a) continuously distilling at least a portion of the mixture in the presence of water and a solvent including at least two alcoholic hydroxyl groups attached to non-adjacent saturated carbon atoms ~~and water~~, and in the presence or absence of a hemiketal defined by the formula (I) or the formula (II):



(I)

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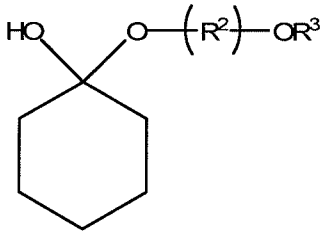

(II)

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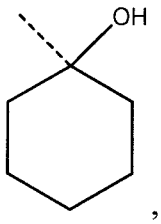
wherein R^1, the same or different at each occurrence, is independently an alkylene group having from 2 to 10 carbon atoms, R^2 is an alkylene group having from 4 to 10 carbon atoms and ~~or~~ R^3 is hydrogen or the following group:



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and in the presence or absence of an enol-ether derived from the hemiketal defined by the formula (I) or the formula (II), wherein the total concentration of the hemiketal and the enol-ether, expressed in terms of weight percentage of the total weight of the feed to the distilling step (a), is at most 0.01% ~~.~~;

wherein the distilling (a) includes at least one vapor and at least one liquid phase, and further includes a feed point, such that at least a portion of the amount of water is in the at least one liquid phase at or below the feed point.

2. The process of claim 1, wherein the total concentration of the hemiketal and the enol-ether is at most 0.005%.

3. The process of claim 1 ~~or claim 2~~, wherein water is present in an amount ~~of~~ in the range from at least 0.1 wt% to no greater than 20 wt%, based on the total weight of feed to the distilling step (a).

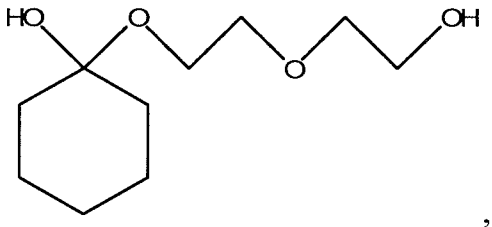
4. The process of claim 3, wherein water is present in an amount in the range from at least 1.0 wt% and no greater than 8.0 wt%.

~~5. The process of any of the preceding claims, wherein the distilling step (a) includes at least one vapor and at least one liquid phase, and said amount of water is in said at least one liquid phase.~~

~~6. The process of claim 5, wherein said distilling (a) is continuous, and includes a feed point, and at least a portion of the amount of water is in the at least one liquid phase at or below the feed point.~~

~~7.~~5. The process of ~~any of the preceding claims~~ claim 1, wherein said solvent is diethylene glycol and R^1 is an ethylene group.

~~8.~~6. The process of claim ~~7~~ 5, wherein said hemiketal is defined by the formula:



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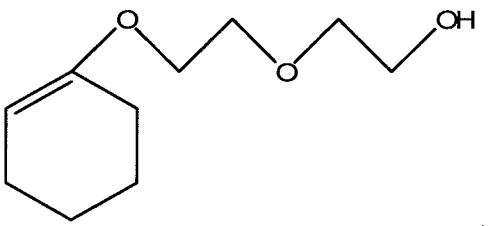
and said enol-ether thereof is defined by the formula:



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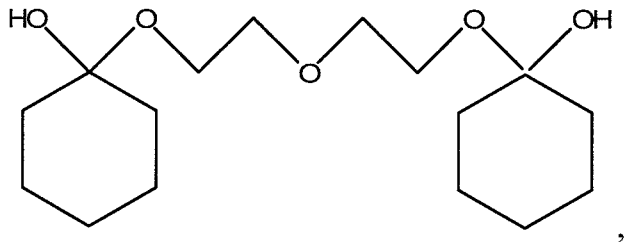
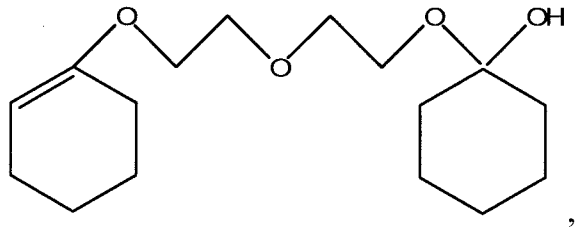
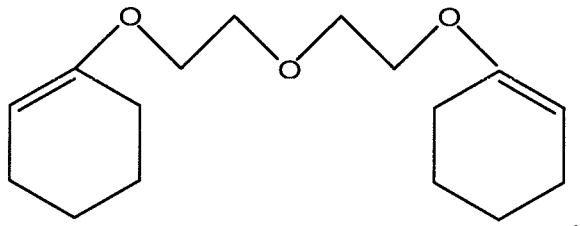
~~9.~~7. The process of claim ~~7~~ 5, wherein said hemiketal is defined by the formula:



and said enol-ether thereof is defined by the formula:

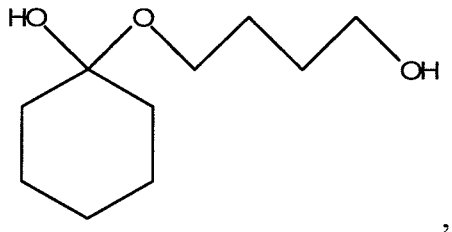


or by the formula:

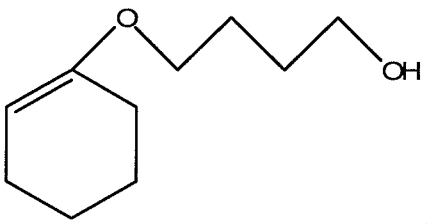


~~10.~~8. The process of ~~any of claims 1 to 5~~ claim 1, wherein said solvent is 1,4-butanediol and R^2 is an alkylene group having 4 carbon atoms.

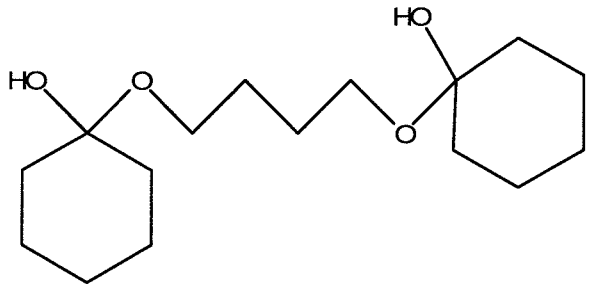
~~11.~~9. The process of claim ~~10~~ 8, wherein said hemiketal is defined by the formula:



and said enol-ether thereof is defined by the formula:



~~12.~~10. The process of claim ~~10~~ 8, wherein said hemiketal is defined by the formula



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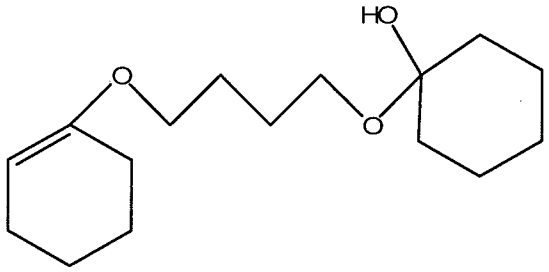
and said enol-ether thereof is defined by the formula:



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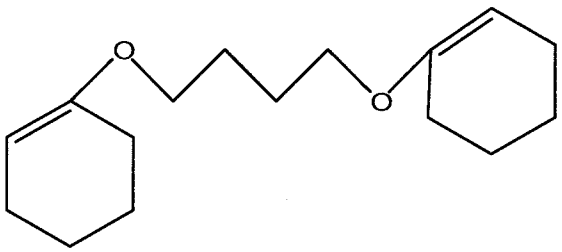
or by the formula:



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~~13.~~11. The process of ~~any of the preceding claims~~ claim 1, wherein at least a portion of the water is included into the mixture of phenol and cyclohexanone before the distilling step (a) starts.

~~14.~~12. The process of ~~any of the preceding claims~~ claim 1, wherein the weight ratio of phenol to cyclohexanone in the mixture to be separated is at least 2.57.

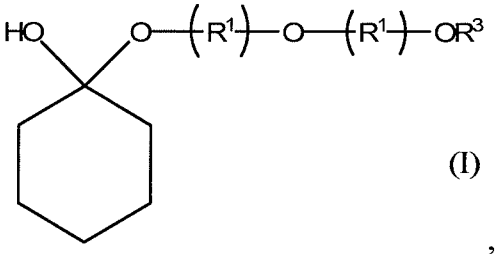
~~15.~~13. A process for making cyclohexanone and phenol, the process comprising:

(A) contacting benzene and hydrogen with a catalyst under hydroalkylation conditions to produce a first effluent comprising cyclohexylbenzene;

(B) oxidizing at least part of the cyclohexylbenzene in the first effluent to produce a second effluent comprising cyclohexylbenzene peroxide;

(C) cleaving at least part of the cyclohexylbenzene peroxide in the second effluent stream to obtain a product mixture comprising phenol and cyclohexanone;

(D) separating the product mixture by (a) continuously distilling at least a portion of the product mixture in the presence of a solvent including at least two alcoholic hydroxyl groups attached to non-adjacent saturated carbon atoms and water, and in the presence or absence of a hemiketal defined by the formula (I) or the formula (II):



(I)

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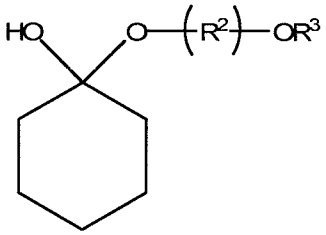

(II)

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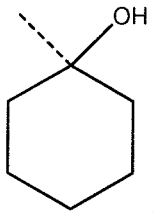
wherein R^1, the same or different at each occurrence, is independently an alkylene group having from 2 to 10 carbon atoms, R^2 is an alkylene group having from 4 to 10 carbon atoms and R^3 is hydrogen or the following group:



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and in the presence or absence of an enol-ether derived from the hemiketal defined by the formula (I) or the formula (II), wherein the total concentration of the hemiketal and enol-ether, expressed in terms of weight percentage based on the total weight of the feed to the distilling step (a), is at most 0.01%;

wherein the distilling (a) in step (D) includes at least one vapor and at least one liquid phase, and further includes a feed point, such that at least a portion of the amount of water is in the at least one liquid phase at or below the feed point.

~~16.~~14. The process of claim ~~15~~ 13, wherein the total concentration of the hemiketal and enol-ether is at most 0.005% in the distilling step (a) of the separating step (D).

~~17.~~15. The process of claim ~~15 or claim 16~~ 13, wherein water is present in an amount in the range of at least 0.1 wt% to no greater than 20 wt%, based on the total weight of the feed to the distilling step (a).

~~18.~~16. The process of claim ~~17~~ 15, wherein ~~the~~ water is present in an amount in the range from at least 1.0 wt% to no greater than 8.0 wt%.

~~19. The process of any of the preceding claims 15 to 18, wherein the distilling step (a) in the separating step (D) includes at least one vapor and at least one liquid phase, and at least a portion of said amount of water is present in said at least one liquid phase.~~

~~20. The process of claim 19, wherein the distilling step (a) in step (D) is continuous, and includes a feed point, and at least a portion of said amount of water is present in the at least one liquid phase at or below the feed point.~~

~~21.~~17. The process of claim ~~20~~ 15, wherein at least a portion of said water is introduced below a lowest feed point at a location from 1 to 10 trays above a reboiler.

~~22.~~18. The process of ~~any of claims 15 to 21~~ claim 13, wherein R^1 is an ethylene group or a 1,4-butylene group.

~~23.~~19. The process of ~~any of the preceding claims 15 to 22~~ claim 13, wherein at least a portion of said water is included into the product mixture to be separated before the distilling step (a) in (D).

~~24.~~20. The process ~~any~~ of ~~the preceding claims 15 to 23~~ claim 13, wherein the weight ratio of phenol to cyclohexanone in the product mixture to be separated is at least 2.57.