## CLAIMS

What is claimed is:

1. A process for producing acetic acid comprising:

contacting methanol and carbon monoxide in the presence of a liquid reaction medium comprising iodide under carbonylation conditions sufficient to form acetic acid, wherein the liquid reaction medium comprises:

a carbonylation catalyst selected from the group consisting of rhodium catalysts, iridium catalysts and palladium catalysts;

1-14 wt. % water; and

one or more additives at an additive to iodide ratio of 1:1 to 5:1, in-situ generated derivatives of the one or more additives or combinations thereof;

wherein the one or more additives comprise a compound mixture of tri-n-octylphosphine oxide (TOPO), tri-n-hexylphosphine oxide (THPO), dihexylmonooctylphosphine oxide and dioctylmonohexylphosphine oxide; and

recovering acetic acid.

2. The process of claim 1, wherein the one or more additives additionally comprises an additive package comprising at least two additive package additives, in-situ generated derivatives of the at least two additive package additives, or combinations thereof, and wherein the at least two additive package additives are independently selected from the group consisting of non-benzoyl containing pentavalent phosphine oxides, compound mixtures of at least four phosphine oxides, and pentavalent aryl or alkaryl phosphine oxides comprising one or more benzoyl groups.



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3. The process of claim 2, wherein the pentavalent aryl or alkaryl phosphine oxides comprising one or more benzoyl groups are selected from bis(2,4,6-trimethylbenzoyl) phenyl phosphine oxide (BAPO), (2,4,6-trimethylbenzoyl) diphenyl phosphine oxide (TMDPO) or combinations thereof.

4. The process of claim 2, wherein the non-benzoyl containing pentavalent phosphine oxides are selected from the group consisting of triethyl phosphine oxide, tributyl phosphine oxide, tripentyl phosphine oxide, diphenylmethyl phosphine oxide, triphenyl phosphine oxide or combinations thereof.

5. The process of claim 2, wherein the non-benzoyl containing pentavalent phosphine oxides comprise a phenyl group directly bonded to the phosphorous atom.

6. The process of claim 2, wherein the additive package comprises essentially equal concentrations of each of the at least two additive package additives.

7. The process of claim 1, wherein the reaction medium comprises 1-10 wt. % water.

8. The process of claim 1, wherein the reaction medium comprises a concentration of additive of 0.005-2.0 mol/L.

9. The process of claim 1, wherein the compound mixture comprises from 1-60 wt. % of each phosphine oxide based on the total weight of compound mixture.

10. The process of claim 1, wherein the compound mixture comprises 12-16 wt. % tri-n-octylphosphine oxide (TOPO), from 8-16 wt. % tri-n-hexylphosphine oxide (THPO), from 28-32 wt. % dihexylmonooctylphosphine oxide and from 40-44 wt. % dioctylmonohexylphosphine oxide.

11. The process of claim 1, further comprising introducing a second concentration of the one or more additives into the process downstream of a reaction zone.



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12. The process of claim 11, further comprising adjusting the second concentration in response to a downstream iodide content.

13. The process of claim 11, wherein the second concentration comprises a molar ratio of additive to iodide of 2.5:1 to 3.5:1.

14. The process of claim 1, wherein the one or more additives comprises a non-benzoyl containing pentavalent phosphine oxide and the carbonylation catalyst comprises iridium catalysts.



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