We Claim:

1. A process for forming vinyl acetate, comprising the steps of:

(a) providing a reaction mixture having an initial heat capacity and comprising acetic acid, oxygen, ethylene, and optionally water;

(b) adding to the reaction mixture at least one heat capacity modifier, preferably selected from the group consisting of ethane, methane, nitrogen, water, carbon dioxide, and combinations thereof, to form an increased heat capacity reaction mixture, preferably comprising at least 1 mol% of the at least one heat capacity modifier and/or at least 1 mol% oxygen wherein the increased heat capacity reaction mixture comprises at least 1 mol% water; and

(c) contacting the acetic acid, oxygen, and ethylene over a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate and water.

2. The process of claim 1, wherein a molar ratio of the at least one heat capacity modifier to ethylene in the reaction mixture from step (b) is greater than 0.01:1.

3. The process of claim 1, wherein step (c) forms carbon dioxide wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20%.

4. A process for forming vinyl acetate, comprising the steps of:

(a) contacting acetic acid, oxygen, ethylene in the presence of water and over a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate and water, wherein step (a) is optionally conducted in a reactor and the reactor is operated at a temperature less than 300° C.;

(b) calculating a flammability limit based on water content in the reaction mixture;

(c) adjusting reaction parameters, preferably the oxygen level in the reaction mixture, based on the flammability limit.

5. The process of claim 4, further comprising the step of:

forming from the crude vinyl acetate product a derivative stream comprising acetic acid and water, wherein the derivative stream is preferably a residue of a distillation column.

6. The process of claim 5, wherein the water content in the reaction mixture is calculated based on water content of the derivative stream, which is preferably measured via an infrared analyzer.

7. The process of claim 6, wherein the derivative stream is collected in a buffer tank and the measuring is performed downstream of the buffer tank.

8. The process of claim 4, wherein the adjusting is performed directly.

9. The process of claim 4, wherein the adjusting is performed indirectly.

10. The process of claim 9, wherein the adjusting comprises adjusting a reactor temperature to adjust the oxygen level in the reaction mixture.

11. The process of claim 4, wherein step (a) forms carbon dioxide wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20% and/or vinyl acetate selectivity is greater than 65%.

12. A process for forming vinyl acetate, comprising the step of reacting acetic acid, oxygen, and ethylene in the presence of water and a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate, wherein the combined reactants comprise at least 1 mol% of at least one heat capacity modifier selected from the group consisting of ethane, methane, nitrogen, and combinations thereof, at least 1 mol% water and from 20 mol% to 70 mol% ethylene, and wherein ethylene conversion is preferably less than 50% and carbon dioxide selectivity is less than 20%.

13. The process of claim 12, further comprising the step of adding additional water to the combined reactants to form a hydrated reaction mixture, wherein the hydrated reaction mixture preferably comprises at least 0.1 mol% water and less than 85 mol% ethylene.

14. The process of claim 12, wherein the reaction forms carbon dioxide and wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20%.

15. A process for forming vinyl acetate, comprising the steps of:

(a) reacting a reaction mixture comprising acetic acid, oxygen, ethylene, and at least 1 mol% methane in the presence of water and a catalyst under conditions effective to form a crude vinyl acetate

product comprising vinyl acetate, wherein the reaction mixture comprises at least 1 mol% oxygen and from 20 mol% to 70 mol% ethylene;

(b) calculating a flammability limit of oxygen based on an amount of water in the reacting step;

(c) forming a derivative stream comprising acetic acid and water from the crude vinyl acetate stream;

(d) measuring a water content in the derivative stream via an infrared analyzer;

(e) calculating the amount of water in the reacting step based on the water content of the derivative stream;

(f) adjusting a reaction temperature to adjust an amount of oxygen in the reaction mixture based on the calculated flammability limit.

We Claim:

1. A process for forming vinyl acetate, comprising the steps of:

(a) providing a reaction mixture having an initial heat capacity and comprising acetic acid, oxygen, ethylene, and optionally water;

(b) adding to the reaction mixture at least one heat capacity modifier, preferably selected from the group consisting of ethane, methane, nitrogen, water, carbon dioxide, and combinations thereof, to form an increased heat capacity reaction mixture, preferably comprising at least 1 mol% of the at least one heat capacity modifier and/or at least 1 mol% oxygen wherein the increased heat capacity reaction mixture comprises at least 1 mol% water and from 25 mol% to 75 mol% acetic acid; and

(c) contacting the acetic acid, oxygen, and ethylene over a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate water, and from 8 mol% to 25 mol% carbon dioxide.

2. The process of claim 1, wherein a molar ratio of the at least one heat capacity modifier to ethylene in the reaction mixture from step (b) is greater than 0.01:1.

3. The process of claim 1, wherein step (c) forms carbon dioxide wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20%.

4. A process for forming vinyl acetate, comprising the steps of:

(a) contacting acetic acid, oxygen, ethylene in the presence of water and over a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate and water, wherein step (a) is optionally conducted in a reactor and the reactor is operated at a temperature less than 300° C.;

(b) forming from the crude vinyl acetate product a derivative stream comprising acetic acid and water;

(c) calculating a flammability limit based on water content in the reaction mixture;

(d) adjusting reaction parameters, preferably the oxygen level in the reaction mixture, based on the flammability limit, wherein the water content in the reaction mixture is calculated based on water content of the derivative stream.

5. The process of claim 4, further comprising the step of:

forming from the crude vinyl acetate product a derivative stream comprising acetic acid and water, wherein the derivative stream is preferably a residue of a distillation column.

6. The process of claim 5, wherein the water content in the reaction mixture is calculated based on water content of the derivative stream, which is preferably measured via an infrared analyzer.

7. The process of claim 6, wherein the derivative stream is collected in a buffer tank and the measuring is performed downstream of the buffer tank.

8. The process of claim 4, wherein the adjusting is performed directly.

9. The process of claim 4, wherein the adjusting is performed indirectly.

10. The process of claim 9, wherein the adjusting comprises adjusting a reactor temperature to adjust the oxygen level in the reaction mixture.

11. The process of claim 4, wherein step (a) forms carbon dioxide wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20% and/or vinyl acetate selectivity is greater than 65%.

12. A process for forming vinyl acetate, comprising the step of reacting from 25 mol% to 75 mol% acetic acid, oxygen, and ethylene in the presence of water and a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate and from 8 mol% to 25 mol% carbon dioxide, wherein the combined reactants comprise at least 1 mol% of at least one heat capacity modifier selected from the group consisting of ethane, methane, nitrogen, and combinations thereof, at least 1 mol% water and from 20 mol% to 70 mol% ethylene, and wherein ethylene conversion is preferably less than 50% and carbon dioxide selectivity is less than 20%.

13. The process of claim 12, further comprising the step of adding additional water to the combined reactants to form a hydrated reaction mixture, wherein the hydrated reaction mixture preferably comprises more than 1 mol% water and less than 85 mol% ethylene.

14. The process of claim 12, wherein the reaction forms carbon dioxide and wherein the crude vinyl acetate product further comprises from 1 mol% to 75 mol% carbon dioxide and/or wherein ethylene conversion is less than 50% and carbon dioxide selectivity is less than 20%.

15. A process for forming vinyl acetate, comprising the steps of:

(a) reacting a reaction mixture comprising acetic acid, oxygen, ethylene, and at least 1 mol% methane in the presence of water and a catalyst under conditions effective to form a crude vinyl acetate product comprising vinyl acetate, wherein the reaction mixture comprises at least 1 mol% oxygen and from 20 mol% to 70 mol% ethylene;

(b) calculating a flammability limit of oxygen based on an amount of water in the reacting step;

(c) forming a derivative stream comprising acetic acid and water from the crude vinyl acetate stream;

(d) measuring a water content in the derivative stream via an infrared analyzer;

(e) calculating the amount of water in the reacting step based on the water content of the derivative stream;

(f) adjusting a reaction temperature to adjust an amount of oxygen in the reaction mixture based on the calculated flammability limit.