CLAIMS

1. An olefin oligomerization process comprising:

    a) contacting an olefin and a catalyst system comprising

    i) a transition metal complex comprising an iron compound complexed to a ligand comprising a pyridine bisimine group, and

    ii) a metal alkyl compound

    to form an olefin oligomer product in a continuous reactor, wherein the contacting is carried out at a temperature ranging from 90° C. to 150° C. with a catalyst productivity of greater than 1×10^5 g olefin oligomer product/mmol iron of the transition metal complex; and

    b) controlling, in the continuous reactor, an olefin oligomer product distribution K value in a range from 0.5 to 0.8 for the transition metal complex by adjusting an olefin oligomerization parameter selected from

    i) iron of the transition metal complex concentration in the continuous reactor,

    ii) a metal of the metal alkyl compound concentration in the continuous reactor,

    iii) a metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor of greater than 250:1, or

    iv) any combination thereof.

2. The process of claim 1, wherein the iron compound comprises a halide, nitrate, sulfate, phosphate, halate, hydrocarboxide, carboxylate, or β-dionate and the metal alkyl compound comprises an aluminoxane.

3. The process of claim 2, wherein the olefin, the transition metal complex, and the aluminoxane are simultaneously introduced into the continuous reactor.

4. The process of claim 1, wherein the olefin oligomer product distribution K value for the transition metal complex is controlled by adjusting an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-6} to 5.0×10^{-1} mole of iron per kilogram olefin oligomerization solution,

    ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-3} to 1.0×10^{3} mole of metal per kilogram olefin oligomerization solution,

    iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

    iv) any combination thereof.

5. The process of claim 1, wherein the olefin consists essentially of ethylene, the transition metal compound comprises an iron(II) halide, the metal alkyl compound comprises an alumoxane, the olefin oligomer product is produced at a temperature ranging from 95° C. to 120° C. and an ethylene partial pressure ranging from 150 psig to 2,000 psig, and wherein the olefin oligomer product distribution K value for the transition metal complex is controlled in a range from 0.55 to 0.7 by adjusting an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-5} to 1.0×10^{-2} mole of iron per kilogram olefin oligomerization solution,

    ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-2} to 1.0×10^{1} mole of metal per kilogram olefin oligomerization solution,

    iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

    iv) any combination thereof.

6. The process of claim 1 further comprising withdrawing a sample of the olefin oligomer product from the reactor prior to step b.

7. The process of claim 6 further comprising determining the olefin oligomer product distribution K value of the sample and determining the variance of the olefin oligomer product distribution K value of the sample from the range of 0.5 to 0.8.

8. An olefin oligomerization process comprising:

    a) contacting an olefin and a catalyst system comprising

    i) a transition metal complex comprising an iron compound complexed to a ligand comprising a pyridine bisimine group, and

    ii) a metal alkyl compound

    to form an olefin oligomer product in a continuous reactor, wherein the contacting is carried out at a temperature ranging from 90° C. to 150° C. with a catalyst productivity of greater than 1×10^5 g olefin oligomer product/mmol iron of the transition metal complex;

    b) selecting an olefin oligomer product distribution K value in a range from 0.5 to 0.8 for the transition metal complex from a correlation of the olefin oligomer product distribution K value with an olefin oligomerization parameter selected from

    i) an iron of the transition metal complex concentration in the continuous reactor,

    ii) a metal of the metal alkyl compound concentration in the continuous reactor,

    iii) a metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor of greater than 250:1, or

    iv) any combination thereof; and

    c) adjusting, in the continuous reactor, the selected olefin oligomerization parameter to obtain the selected olefin oligomer product distribution K value.

9. The process of claim 8, wherein the iron compound comprises a halide, nitrate, sulfate, phosphate, halate, hydrocarboxide, carboxylate, or β-dionate and the metal alkyl compound comprises an aluminoxane.

10. The process of claim 9, wherein the olefin, the transition metal complex, and the aluminoxane are simultaneously introduced into the continuous reactor.

11. The process of claim 8, wherein the selected olefin oligomer product distribution K value is obtained by adjusting an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-6} to 5.0×10^{-1} mole of iron per kilogram olefin oligomerization solution,

    ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-3} to 1.0×10^{3} mole of metal per kilogram olefin oligomerization solution,

    iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

    iv) any combination thereof.

12. The process of claim 8, wherein the olefin consists essentially of ethylene, the transition metal compound comprises an iron(II) halide, the metal alkyl compound comprises an alumoxane, the olefin oligomer product is produced at a temperature ranging from 90° C. to 120° C. and an ethylene partial pressure ranging from 150 psig to 2,000 psig, and wherein the selected olefin oligomer product distribution K value for the transition metal complex ranges from 0.55 to 0.7 and is obtained by adjusting an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-5} to 1.0×10^{-2} mole of iron per kilogram olefin oligomerization solution,

ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-2} to 1.0×10^{1} mole of metal per kilogram olefin oligomerization solution,

iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

iv) any combination thereof.

13. An olefin oligomerization process comprising:

a) correlating an olefin oligomer product distribution K value for oligomerizing an olefin in a continuous reactor in the presence of a catalyst system comprising

1) an iron compound complexed to a ligand comprising a pyridine bisimine group, and

2) a metal alkyl compound

to an olefin oligomerization parameter selected from

i) an iron of the transition metal complex concentration in the continuous reactor,

ii) a metal of the metal alkyl compound concentration in the continuous reactor,

iii) a metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor of greater than 250:1, or

iv) any combination thereof;

b) selecting an olefin oligomerization reactor K value; and

c) oligomerizing the olefin in the continuous reactor to form an olefin oligomer product at the selected olefin oligomer product distribution K value by setting, in the continuous reactor, the selected olefin oligomerization parameters necessary to achieve the selected olefin oligomer distribution K value, wherein the oligomerizing is carried out at a temperature ranging from 100° C. to 150° C. with a catalyst productivity of greater than 1×10^{5} g olefin oligomer product/mmol iron of the transition metal complex.

14. The process of claim 13, wherein the iron compound comprises a halide, nitrate, sulfate, phosphate, halate, hydrocarboxide, carboxylate, or β-dionate and the metal alkyl compound comprises an aluminoxane.

15. The process of claim 14, wherein the olefin, the transition metal complex, and the aluminoxane are simultaneously introduced into the continuous reactor.

16. The process of claim 13, wherein the selected olefin oligomer product distribution K value ranges from 0.5 to 0.8 and the olefin is oligomerized at an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-6} to 5.0×10^{-1} mole of iron per kilogram olefin oligomerization solution,

    ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-3} to 1.0×10^{3} mole of metal per kilogram olefin oligomerization solution,

    iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

    iv) any combination thereof.

17. The process of claim 13, wherein the olefin consists essentially of ethylene, the transition metal compound comprises an iron(II) halide, the metal alkyl compound comprises an alumoxane, the olefin oligomer product is produced at a temperature ranging from 100° C. to 120° C. and an ethylene partial pressure ranging from 150 psig to 2,000 psig, and wherein the selected olefin oligomer product distribution K value for the transition metal complex ranges from 0.55 to 0.7 and the olefin is oligomerized at an olefin oligomerization parameter selected from

    i) the iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-5} to 1.0×10^{-2} mole of iron per kilogram olefin oligomerization solution,

ii) the metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-2} to 1.0×10^{1} mole of metal per kilogram olefin oligomerization solution,

iii) the metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

iv) any combination thereof.

18. An oligomerization process comprising a) contacting an olefin and a catalyst system comprising i) a transition metal complex comprising an iron compound complexed to a ligand comprising a pyridine bisimine group, and ii) a metal alkyl compound, and b) forming an olefin oligomer product in a continuous reactor at a temperature ranging from 100° C. to 150° C. wherein the olefin oligomer product distribution K value is adjusted in the continuous reactor and wherein the process has a catalyst productivity of greater than 1×10^{5} g olefin oligomer product/mmol iron of the transition metal complex, wherein the olefin is oligomerized at an olefin oligomerization parameter selected from

i) an iron of the transition metal complex concentration in the continuous reactor ranges from 1.0×10^{-6} to 5.0×10^{-1} mole of iron per kilogram olefin oligomerization solution,

ii) a metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-3} to 1.0×10^{-1} mole of metal per kilogram olefin oligomerization solution,

iii) a metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

iv) any combination thereof.

19. The process of claim 18, wherein the iron compound comprises a halide, nitrate, sulfate, phosphate, halate, hydrocarboxide, carboxylate, or β-dionate and the metal alkyl compound comprises an aluminoxane.

20. The process of claim 18, wherein the olefin oligomer product is produced at a temperature ranging from 100° C. to 120° C.

21. The process of claim 19, wherein the olefin, the transition metal complex, and the aluminoxane are simultaneously introduced into the continuous reactor.

22. The process of claim 18, wherein the olefin consists essentially of ethylene, the transition metal compound comprises an iron(II) halide, the metal alkyl compound comprises an alumoxane, the olefin oligomer product is produced at an ethylene partial pressure ranging from 150 psig to 2,000 psig, and

    wherein the olefin is oligomerized at an olefin oligomerization parameter selected from

    i) an iron of the transition metal complex concentration from 1.0×10^{-5} to 1.0×10^{-2} mole of iron per kilogram olefin oligomerization solution,

    ii) a metal of the metal alkyl compound concentration in the continuous reactor ranges from 5.0×10^{-2} to 1.0×10^{1} mole of metal per kilogram olefin oligomerization solution,

    iii) a metal of the metal alkyl to iron of the transition metal complex molar ratio in the continuous reactor ranges from greater than 250:1 to 100,000:1, or

    iv) any combination thereof.