CLAIMS:

1. A method for pyrolyzing a mixed polyolefin feed, comprising:

exposing a feedstock comprising a mixture of polyolefins comprising two or more types of monomers to polyolefin pyrolysis conditions to form a pyrolysis effluent, the polyolefin pyrolysis conditions comprising:

heating the feedstock at a rate of 100°C per second or more to form a heated reaction mixture having a temperature of 500°C to 900°C, and

cooling the heated reaction mixture to a temperature of less than 500°C to form the pyrolysis effluent, the heated reaction mixture being at a temperature of 500°C or more for 0.1 seconds to 5.0 seconds;

performing an initial separation on the pyrolysis effluent to form at least a pyrolysis product fraction and a fraction comprising solid particles;

performing steam cracking on a steam cracker feed to form a steam cracker reactor effluent, wherein the steam cracker feed comprises whole and partial crudes, naphtha boiling feeds, distillate boiling range feeds, atmospheric resid boiling range feeds, vacuum resid boiling range fees, or combinations thereof, and is separate from the mixed polyolefin feed;

passing at least a portion of the steam cracker reactor effluent into a primary fractionator to form at least a first fractionator product and one or more additional fractionator products having a higher boiling range than the first fractionator product;

passing at least a portion of the first fractionator product and at least a portion of the pyrolysis product fraction into a process gas compressor to form a compressed olefin product fraction, a volume of the pyrolysis product fraction comprising 0.1 vol% to 20 vol% of a combined volume in the process gas compressor of the at least a portion of the first fractionator product and the pyrolysis product fraction; and

separating at least a first product stream comprising ethylene and a second product stream comprising propylene from the compressed olefin product fraction.

2. The method of claim 1, wherein the feedstock comprises 0.1 wt% or more of polyvinyl chloride, polyvinylidene chloride, polyamide, polystyrene, polyethylene terephthalate, ethylene vinyl acetate, or a combination thereof.

3. The method of any preceding claim, wherein the feedstock comprises 0.1 wt% to 35 wt% polystyrene.

4. The method of any preceding claim, i) wherein the feedstock comprises 0.1 wt% to 10 wt% polyvinyl chloride, polyvinylidine chloride, or a combination thereof; ii) wherein the feedstock comprises 0.1 wt% to 1.0 wt% polyamide; or iii) a combination of i) and ii).

5. The method of claim 4, the method further comprising:

separating the pyrolysis product fraction to form a lower boiling fraction and a higher boiling fraction; and

passing the lower boiling fraction into a contaminant removal stage to form the at least a portion of the pyrolysis product fraction, the at least a portion of the pyrolysis product fraction comprising a lower chlorine content than the lower boiling fraction.

6. The method of claim 5, wherein the lower boiling fraction is a vapor and the contaminant removal stage includes a water wash for chlorine removal and a supplemental quench tower for cooling the lower boiling fraction and chlorine removal can be achieved based on control of the pH of the water used in the quench tower.

7. The method of any preceding claim, wherein the feedstock comprises 0.1 wt% to 10 wt% ethylene vinyl acetate, or wherein the feedstock comprises 0.1 wt% to 10 wt% polyethylene terephthalate, or a combination thereof.

8. The method of any preceding claim, a) wherein the first product stream comprises ethylene derived from exposing the feedstock comprising a mixture of polyolefins to the polyolefin pyrolysis conditions; b) wherein the second product stream comprises propylene derived from exposing the feedstock comprising a mixture of polyolefins to the polyolefin pyrolysis conditions; or c) a combination of a) and b).

9. The method of any preceding claim, wherein the one or more additional fractionator products comprise a naphtha boiling range product, the method further comprising:

passing at least a portion of the naphtha boiling range product into a silicon removal stage to form a modified naphtha boiling range product.

10. The method of any preceding claim, wherein the heated reaction mixture further comprises heat transfer particles, the polyolefin pyrolysis conditions further comprising exposing the feedstock to the heat transfer particles.

11. The method of claim 10, wherein the heat transfer particles comprise calcium oxide, at least a portion of the calcium oxide being converted to calcium chloride under the polyolefin pyrolysis conditions.

12. The method of claim 11, wherein the fraction comprising the solid particles comprises heat transfer particles and calcium chloride, the polyolefin pyrolysis conditions further comprising:

recycling a first portion of the fraction comprising the solid particles to the pyrolysis reactor; and

purging a second portion of the fraction comprising the solid particles.

13. The method of claim 1, wherein the heated reaction mixture further comprises 10 wt% or more of steam.

14. The method of any preceding claim, further comprising:

exposing the compressed olefin product fraction to a water wash, a caustic wash, an amine wash, or a combination thereof, to form a washed compressed olefin product fraction, and

passing the washed, compressed olefin product fraction into a contaminant removal stage to form a reduced-contaminant product fraction,

wherein separating at least a first product stream comprising ethylene and a second product stream comprising propylene from the compressed olefin product fraction comprises separating the at least a first product stream and a second product stream from the reduced-contaminant product fraction.

15. An integrated system for performing polyolefin pyrolysis and steam cracking, comprising:

a polyolefin processing stage for forming a polyolefin feedstock;

a pyrolysis reactor comprising a pyrolysis inlet and a pyrolysis outlet, the pyrolysis inlet being in fluid communication with the polyolefin processing stage;

a first separation stage comprising a first separation stage inlet, a first vapor outlet and a first solids outlet, the first separation stage inlet being in fluid communication with the pyrolysis outlet;

a pyrolysis quench stage in fluid communication with the first vapor outlet;

a second separation stage comprising a second separation stage inlet, a second light outlet, and a second heavy outlet, the second separation stage inlet being in fluid communication with the pyrolysis quench stage;

a steam cracking reactor comprising a reactor outlet;

a primary fractionator comprising one or more fractionator inlets and a plurality of fractionator outlets, the one or more fractionator inlets being in fluid communication with the reactor outlet and the second heavy outlet;

at least one quench tower comprising one or more quench tower inlets and one or more quench tower outlets, the at least one quench tower inlet being in fluid communication with at least one fractionator outlet and the second heavy outlet;

a process gas compressor comprising a compressor inlet and a compressor outlet, the compressor inlet being in fluid communication with the one or more quench tower outlets; and

a plurality of olefin separation stages comprising at least an ethylene outlet and a propylene outlet, the plurality of olefin separation stages being in fluid communication with the compressor outlet.