Summary of the Invention

[0005a] According to a first aspect of the present invention, there is provided a process for producing a petroleum gas product including the steps of: charging a feedstock comprising at least two different polymer materials into a pyrolytic reactor vessel; said reactor having a screw for advancing said feedstock through said reactor; said reactor having a free volume of at least 60% based on the amount of polymer feedstock in said reactor vessel; applying heat energy to said reactor vessel and converting said feedstock to molten material and gases, in an anaerobic operation while advancing the molten material through said reactor vessel; an outer shroud that surrounds said reaction vessel; an inner wall or plurality thereof that extends between said outer shroud and said reactor vessel and defines a plurality of fluid heating channels along the horizontal length and along the exterior of said reactor vessel within said shroud for a heat exchange medium, and wherein said process has no added catalyst cracking and reforming said molten material and gases and forming said petroleum gas products in said reactor; and wherein said reactor does not rotate.

[0005b] According to a second aspect of the present invention, there is provided a reactor apparatus including: a pyrolytic reactor vessel for producing petroleum gas products from a polymer feedstock comprising at least two different polymers; said reactor having a free volume of at least 60% based upon the amount of said polymer feedstock in said reactor, said reactor having a screw for advancing said feedstock through said reactor; an outer shroud that surrounds the reactor vessel; a heat source located internal to said shroud; an inner wall or a plurality thereof that extends between said outer shroud and said pyrolytic reactor vessel and defines a plurality of heated fluid channels along the horizontal length and along the exterior of said reactor vessel within said shroud for a heated gas exchange medium, and said heat exchange medium capable of cracking and reforming said feedstock and forming petroleum gas products in said reactor.

[0006] Disclosed herein is a process for producing petroleum products that includes charging feedstock comprising mixed polymer materials into a reactor vessel of a reactor apparatus; applying heat to the reactor vessel while advancing the feedstock through the reactor apparatus in an anaerobic operation; controlling the energy input to the reactor vessel and controlling a temperature gradient within reactor vessel to produce a condensable petroleum gas product. The process for producing condensable petroleum gas products involves in situ chemical reactions that are managed to convert feedstock to solid inert residue, molten fluids and gases inside the reactor vessel and to produce condensable petroleum gas products which exit the reactor vessel.

[0007] Disclosed herein is a process for producing petroleum products that includes charging feedstock comprising mixed polymer materials into a reactor apparatus having a plurality of sequential reactor zones; applying heat energy to the reactor vessel while advancing the feedstock and products generated from the feedstock through the reactor apparatus; independently controlling the heat energy input to each of the plurality of sequential reactor zones and controlling a temperature gradient within each of the plurality of sequential reactor zones of the reactor apparatus.

CLAIMS

1. A process for producing petroleum gas products comprising the steps of:

charging a feedstock comprising at least two different polymer materials into a pyrolytic reactor vessel;

said reactor having a screw for advancing said feedstock through said reactor;

said reactor having a free volume of at least about 60% based on the amount of polymer feedstock in said reactor vessel;

applying heat energy to said reactor vessel and converting said feedstock to molten material and gases, in an anaerobic operation while advancing the molten material through said reactor vessel;

an outer shroud that surrounds said reaction vessel; an inner wall or plurality thereof that extends between said outer shroud and said reactor vessel and defines a plurality of fluid heating channels along the horizontal length and along the exterior of said reactor vessel within said shroud for a heat exchange medium, and wherein said process has no added catalyst

cracking and reforming said molten material and gases and forming said petroleum gas products in said reactor; and

wherein said reactor does not rotate.

2. The process of claim 1, wherein the process is semi-continuous or continuous process and wherein the composition of the feedstock varies during the process.

3. The process of claim 1, wherein said reactor comprises a plurality of sequential reactor zones along the horizontal axis of said reactor, controlling said heat energy and the temperature gradient both vertically and axially within said free volume of said reactor and producing said gaseous products.

4. The process of claim 3, wherein said temperature gradient ranges from about 90°C to about 350°C.

5. The process of claim 3, wherein the gas product obtained from the process ranges from 50% to 98% of the feedstock by weight; wherein the temperature gradient is the temperature differential between the temperature of the bottom surface of the reactor vessel and the temperature of the petroleum gas products along the top portion of the reactor vessel and ranges from 50°C to 450°C.

6. The process of claim 3, wherein the plurality of the reactor zones includes a first reactor zone and a second reactor zone and heat energy is applied to the first reactor zone of the reactor vessel by a first heat source and heat energy is applied to the second reactor zone by a second heat source.

7. The process of claim 3, wherein the temperature gradient within each of the plurality of reactor zones is controlled by conveying exhaust gas in a first fluid channel along a first reactor zone of the reactor apparatus, and conveying an exhaust gas in a second fluid channel along a second reactor zone of the reactor apparatus.

8. The process of claim 6, comprising collecting said petroleum gas products, and wherein the gaseous products collected comprise at least about 50% by weight condensable hydrocarbons based on the weight of gaseous products, and wherein said free volume of said reactor is at least about 80%.

9. The process of claim 8, wherein the condensable hydrocarbons produced comprises from about 10% to about 60% by weight of each of a naphtha, a distillate and a fuel oil based on the weight of gaseous product, and wherein said free volume of said reactor is at least about 80%.

10. The process of claim 6, wherein the composition of said polymer feedstock material varies from about 10 to about 70% polyethylene, from about 10% to about 70% polypropylene, from about 10% to about 30% polystyrene and from about 0% to about 30% other commonly

use polymeric materials comprising polyvinyl chloride, polyester, polycarbonate, polymethyl methacrylate, and nylon, and wherein said free volume of said reactor is at least about 80%.

11. A reactor apparatus comprising:

a pyrolytic reactor vessel for producing petroleum gas products from a polymer feedstock comprising at least two different polymers; said reactor having a free volume of at least about 60% based upon the amount of said polymer feedstock in said reactor, said reactor having a screw for advancing said feedstock through said reactor;

an outer shroud that surrounds the reactor vessel; a heat source located internal to said shroud;

an inner wall or a plurality thereof that extends between said outer shroud and said pyrolytic reactor vessel and defines a plurality of heated fluid channels along the horizontal length and along the exterior of said reactor vessel within said shroud for a heated gas exchange medium, and

said heat exchange medium capable of cracking and reforming said feedstock and forming petroleum gas products in said reactor.

12. The reactor apparatus of claim 11, wherein said reactor is capable of being heated through said shroud fluid channels whereby said feedstock is heated; and

said reactor having at least one product conduit for exiting said petroleum gas products through said reactor and said shroud; and wherein said reactor apparatus is non-rotatable.

13. The reactor apparatus of claim 12, comprising a plurality of said inner walls that extend between said outer shroud and the reactor vessel.

14. The reactor apparatus of claim 13, wherein each said heated fluid channel contains a channel vent; and

wherein said polymer feed stock comprises polyethylene, polypropylene, polyester, acrylonitrile-butadiene-styrene (ABS) copolymers, polyamide, polyether, polycarbonate, poly(oxide), poly(sulfide), polyarylate, polyetherketone, polyetherimide, polysulfone, polyurethane, polyvinyl alcohol, or polymers produced by polymerization of monomers

comprising dienes, olefins, styrenes, acrylates, acrylonitriles, methacrylates, methacrylonitriles, polymers of diacids and diamines, lactams, vinyl halides, or vinyl esters, and block copolymers thereof, and any combination thereof.

15. The reactor apparatus of claim 14, wherein said at least one heated fluid channel vent comprises a flow control valve; and

wherein said free volume of said reactor is at least about 80%.

16. The reactor apparatus of claim 12, including a plurality of heat sources, at least one heat source being located in said fluid channel.

17. The reactor apparatus of claim 12, comprising temperature sensors in said product conduit.

18. The reactor apparatus of claim 13, wherein said plurality of said fluid heating channels form a plurality of reaction zones in said pyrolytic reactor.