CLAIMS

1. A method to convert a contaminated crude oil (2) comprising sulfur and metals, with or without presence of added feed steams, to a fuel having a sulfur content limit characterized in that the crude is fractionated into three liquid fractions F1 (10), F2 (20), and F3 (30, 40) and at least a portion of fraction F2 (60) and a portion fraction F3 are hydrotreated (70) wherein fractionating (100, 200) and hydrotreating (300, 400) conditions are adjusted such that

a. overhead partial condensation of condensable entrained light gases (4) occurs during fractionation (100) without added stabilization steps to remove butanes and other lighter components to form a portion of fraction F1 (8, 10),

b. each fraction of crude is determined by its wt.% sulfur content such that sulfur content of fraction F1 (10) is less than that of fraction F2 (20) which is less than fraction F3 (30),

c. substantially all metals are concentrated in fraction F3 (30);

d. yield cut of fraction F1 (10) is maximized based on sulfur content of a combination product stream made by combining in a combination zone (600) flows of (i) a portion of fraction F2 (20) which is hydrotreated (300) to reduce sulfur content to less than 25 ppmwt to form stream S2 (60) and (ii) portions of fraction F3 (40, 80) which are hydrotreated (400) to reduce sulfur content to less than 0.12 to 0.18 wt.% to form stream S3 (70) and (iii) untreated fraction F1 having a sulfur content less than 0.25 wt.% to form stream S1 (10) where the final sulfur content limit of the combination (600) of streams S1 (10), S2 (20) and S3 (30) does not exceed total sulfur content limit of said fuel.

2. A method in accordance with Claim 1 wherein, prior to hydrotreating any portion of fraction F3, substantially all of fraction F3 is subjected to vacuum distillation at reduced hydrocarbon partial pressures, either with or without presence of added steam, to form:

a. at least one vacuum gas oil effluent stream (40) having a sulfur content, % mass of crude, in the range of about 0.1 wt.% to 5 wt.% prior to subsequent treating, which stream is directed to hydrotreating (400) and hydrotreated in a different zone than fraction F2 hydrotreater (300) and under more intense hydrotreating conditions than fraction F2 to form

at least a portion of stream S3 (70) which has a sulfur content in the range of 0.12 wt.% to 0.18 wt.% and contains less than 1 ppmwt metals; and

b. a vacuum residue effluent stream (50) which does not substantially boil at said reduced hydrocarbon partial pressures which residue is directed to solvent deasphalting (500) and mixed with one or more solvents to form a solution in a manner that enables precipitation out of said solution asphaltenes and other residue heavy components to form:

(i) a highly contaminated pitch stream (90) that contains the majority of metals of the original contaminated crude oil feed; and

(ii) a deasphalted oil (80) that forms a portion of stream S3 (70) and is either

(A) combined with a non-hydrotreated portion of fraction F3 and such combination is hydrotreated to form at least a portion of stream S3 or

(B) hydrotreated and combined with a separately hydrotreated portion of fraction F3 to form at least a portion of stream S3.

3. A method in accordance with Claim 1 comprising

a. measuring the sulfur content of fraction F1 and without further treatment, directing fraction F1 continuously to said combination zone,

b. measuring the sulfur content of fraction F2 and directing fraction F2 to a hydrotreating zone and adjusting hydrotreating conditions for fraction F2 to produce treated stream S2 having a sulfur content of less than 10 ppmwt and directing treated stream S2 continuously in all or in part to said combination zone,

c. measuring the sulfur content of fraction F3 and directing fraction F3 to a separation zone to separate fraction F3 by one or more process steps into two or more portions,

(i) first portion which is to be hydrotreated which are directed to a hydrotreating zone and adjusting hydrotreating conditions for such portions to produce treated stream S3 having a sulfur content of less than 0.18 wt.% and directing treated stream S3 continuously to said combination zone and

(ii) second portions which are not hydrotreated.

d. continuously combining steams S1, S2, and S3 in said combination zone, wherein

(i) flow rate of each stream to the combination zone is determined by its respective sulfur content and related contribution to overall final sulfur content limit of the combination, taking in consideration flow rate of each of the other two streams and their respective sulfur content; and

(ii) yield cut of untreated fraction F1 is maximized in a manner whereby the final sulfur content limit of the combination zone is not exceeded;

4. A method in accordance with Claim 1 wherein the crude comprises contaminants containing asphaltenes and crude feed rate and fractionation conditions are adjusted such that substantially all such asphaltenes are concentrated in last portion of fraction F3 which is not hydrotreated.

5. A method in accordance with Claim 2 wherein said pitch stream is used as feed to a gasification unit, boiler, or asphalt production.

6. A method in accordance with Claim 2 wherein said pitch stream is used as feed to a gasification unit which converts the pitch to synthesis gas consisting of CO and hydrogen, which hydrogen is directed to hydrogenation of portions of fractions F2 and F3 forming streams S2 and S3.

7. A fuel produced in accordance with the process of Claim 1 having a sulfur content limit selected at or below regulatory requirements at location of firing.

8. A fuel produced by the method of Claim 1 formed by combination of steams S1, S2 and S3 which is useful as a polished turbine fuel having a maximum 0.1 wt.% sulfur content and less than 0.1 ppmwt metals content.

9. Use of a fuel produced in accordance with the process of Claim 1 in marine or land based engines, combustion gas turbines, or fired heaters.

10. A process to produce a single product liquid fuel (600) comprising:

a. feeding a contaminated hydrocarbonaeous flowing feed (2) selected from the group consisting of one or more of crude oils, refinery residual oils, high sulfur fuel oils, biomass liquids, or hydrocarbon oil slurries containing particles of coke, coal, peat or ash to a basic separation zone which serves as a primary decontaminator,

b. separating said liquid feed in said zone into a minimum number of basic segments (10, 20, 30) based upon measurement of contaminate levels of effluent streams, not based upon measurement of hydrocarbon composition, temperature range or other non-contaminant related separation criteria,

c. adjusting operating conditions of said separation zone (100) to control separation of feed to form segments having different contaminate levels to form:

(i) a reduced contaminate level segment (100), which without substantial subsequent treatment, forms a fuel component stream (10),

(ii) a contaminated segment (20) which is treated (300) by hydrogen in the presence of catalyst to form one or more reduced contaminate level fuel component streams (60) and

(iii) a contaminate rich segment (30) which is subjected to one or more additional separation steps (200, 500) to form one or more reduced contaminate level streams (40, 80), each of which are treated (400), either separately or combined, by hydrogen in the presence of catalyst to form one or more reduced contaminate level fuel component streams (70), and

d. combining fuel component streams of c.(i) (10), c.(ii) (60) and c.(iii) (70) to form said fuel (600) in a manner wherein the amount of c.(i) (10) is maximized in relation to treated segments c.(ii) (60) and c.(iii) (70) by maximizing in c.(i) (10) a portion of what might otherwise fall within lighter kerosene range materials to minimize amount of light distillates in segment c.(ii) (60).

11. A reduction of corrosion, ash formation and emissions over firing contaminated crude by firing in marine or land based engines, combustion gas turbines, or fired heaters a fuel produced in accordance with the process of Claim 10.

12. A fractionator (100) having upper, middle and lower zones for separating crude oil feed characterized in that such fractionator does not achieve fractionation efficiency for precise target cuts based on temperature, hydrocarbon composition or other non-

contaminant related separation criteria but achieves feed separation to respective fractions F1 (10), F2 (20) and F3 (30) based on contaminate levels of target fractions F1, F2 and F3, either as one cut for each such fraction or multiple cuts combined to form each such fraction, which fractionator has, when processing the same crude for a comparative to conventional crude oil distillations processing such same crude, a higher temperature profile in the upper zone which

a. avoids excessive vapor condensation and flooding experienced in the upper sections of conventional crude oil distillation caused by sub-cooling and related pressure change upsets leading to condensation of stripping steam and excessive liquids formation in the upper zone of conventional crude oil distillations,

b. maximizes quantity of fraction F1 within said upper zone in relation to fractions F2 and F3, which fraction F1 if within conventional distillation would include materials within the range from light overhead unstabilized whole naphtha to kerosene range components or at least a portion of other light distillates, such maximization of fraction F1 would minimize quantity of light distillates in fraction F2
and enables combining all of such materials within the range from light overhead unstabilized whole naphtha to kerosene range components or at least a portion of other light distillates in fraction F1 in a single cut leading to fewer rundown systems over conventional crude oil distillation units that has multiple cuts for such materials,

c. maximizes quantity of fraction F2 within said middle zone in relation to fraction F3, which fraction F2 if within conventional distillation would include materials within the range from a portion of remaining heavier portion of light distillates and middle and heavy distillates, which maximization enables combining said remaining heavier portion of light distillates and middle and heavy distillates in fraction F2 in a single cut leading to fewer rundown systems over conventional crude oil distillation units that has multiple cuts for such materials, or

d. decreases pressure drop across the fractionator column due to reduced rundown streams, and reduced number of trays, hence decreases the feed flash zone pressure, and hence decreases the flash zone temperature, with corresponding reduction in column furnace duty which reduces energy consumption compared to conventional crude distillation.