WHAT IS CLAIMED IS:

1. An improved OXO process with converted waste oil recycle comprising:

    a. hydroformylating an olefin with synthesis gas in a reactor to produce an OXO product as well as by-product waste oil, the by-product waste oil having a lower or higher boiling temperature than said OXO product;

    b. separating OXO product from the by-product waste oil;

    c. converting separated waste oil to synthesis gas comprising evaporating the waste oil with hydrocarbon gas in an evaporator vessel to provide a mixed vapor stream of hydrocarbon gas and evaporated waste oil and directly oxidizing the mixed vapor stream to provide synthesis gas; and

    d. recycling the synthesis gas produced in step (c) to the reactor of step (a).

2. The improved OXO process according to Claim 1, wherein the hydrocarbon gas is natural gas.

3. The improved OXO process according to Claim 1, wherein the temperature in the evaporator vessel is maintained between 250°F (121°C) and 750°F (399°C).

~~4. The improved OXO process according to Claim 1, wherein the temperature in the evaporator vessel is maintained between 350°F (177°C) and 500°F (260°C).~~

~~5~~4. The improved OXO process according to Claim 1, wherein pressure in the evaporator vessel is maintained between 500 psig (3.45 MPa/g) and 1500 psig (10.34 MPa/g).

~~6. The improved OXO process according to Claim 1, wherein waste oil is injected into the evaporator vessel under a pressure of above 500 psig (3.45 MPa/g) up to about 1500 psig (10.34 MPa/g).~~

~~7~~5. The improved OXO process according to Claim 1, wherein the synthesis gas produced has a molar ratio of H_2/CO of from 1.65 to 1.85.

~~8. The improved OXO process according to Claim 1, wherein the synthesis gas produced has a molar ratio of H_2/CO of from 1.7 to 1.75.~~

~~9~~6. The improved OXO process according to Claim 1, wherein the olefin supplied to the reactor comprises a two carbon (C2) to seventeen carbon (C17) mono olefin.

~~10. The improved OXO process according to Claim 9, wherein the OXO product comprises a three carbon (C3) to eighteen carbon (C18) aldehyde or a three carbon (C3) to eighteen carbon (C18) alcohol.~~

~~11. The improved OXO process according to Claim 10, wherein the OXO product comprises propionaldehyde or butyraldehyde.~~

~~12~~7. A method of making synthesis gas from a hydrocarbon gas and a hydrocarbon liquid and/or hydrocarbon oxygenate liquid comprising:

a. feeding hydrocarbon gas at elevated temperature to an evaporator vessel;

b. concurrently with step (a), feeding a hydrocarbon liquid and/or hydrocarbon oxygenate liquid to the evaporator vessel through one or more nozzle assemblies to provide atomized liquid to the evaporator;

wherein at least 30 standard cubic feet (0.85 m^3) of hydrocarbon gas is provided to the evaporator per gallon (3.7853 l) of liquid feed;

c. evaporating the liquid with the hydrocarbon gas to provide a mixed feed stream of hydrocarbon gas and vaporized liquid to a partial oxidation unit; and
d. oxidizing the mixed feed stream by contacting the mixed feed stream with oxygen in the partial oxidation unit to produce synthesis gas.

~~13. The method according to Claim 12, wherein the liquid feed to the evaporator comprises hydrocarbon liquid and/or hydrocarbon oxygenate liquid with an average carbon chain length of from two carbons (C2) to thirty carbons (C30).~~

~~14~~8. The method according to Claim ~~12~~7, wherein the liquid feed to the evaporator comprises hydrocarbon liquid and/or hydrocarbon oxygenate liquid with an average carbon chain length of from six carbons (C6) to thirty carbons (C30).

~~15. The method according to Claim 12, wherein the liquid feed to the evaporator comprises hydrocarbon liquid and/or hydrocarbon oxygenate liquid with an average carbon chain length of from ten carbons (C10) to thirty carbons (C30).~~

~~16~~9. The method according to Claim ~~12~~7, wherein the liquid feed to the evaporator is waste oil is from an OXO aldehyde process, or OXO alcohol process.

~~17. The method according to Claim 12, wherein the synthesis gas produced has a molar ratio of H_2/CO of more than 1.65 and less than 1.85.~~

~~18. The method according to Claim 12, wherein the synthesis gas produced has a molar ratio of H_2/CO of more than 1.7 and less than 1.75.~~

~~19~~10. The method according to Claim ~~12~~7, wherein oxidizing the mixed feed stream is by way of direct oxidation without a catalyst.

~~20. The method according to Claim 12, wherein at least 50 standard cubic feet (1.42 m^3) of hydrocarbon gas is provided to the evaporator per gallon (3.7853 l) of liquid feed.~~

~~21. The method according to Claim 12, wherein from 30 standard cubic feet (0.85 m^3) to 500 standard cubic feet (14.16 m^3) of hydrocarbon gas is provided to the evaporator per gallon (3.7853 l) of liquid feed.~~

~~22~~11. The method according to Claim ~~12~~7, wherein from 50 standard cubic feet (1.42 m^3) to 200 standard cubic feet (5.66 m^3) of hydrocarbon gas is provided per gallon (3.7853 l) of liquid feed.

~~23~~12. The method according to Claim ~~12~~7, wherein from 75 standard cubic feet (2.12 m^3) to 150 standard cubic feet (4.25 m^3) of hydrocarbon gas is provided per gallon (3.7853 l) of liquid feed.

~~24. The method according to Claim 12, wherein the hydrocarbon gas is natural gas.~~

~~25~~13. The method according to Claim ~~12~~7, wherein the evaporator is fed liquid through one or more nozzle assemblies in a downward direction and the hydrocarbon gas is fed upwardly countercurrent to the liquid feed and wherein further the mixed feed stream of hydrocarbon gas and vaporized liquid is withdrawn from the evaporator at an upper portion thereof.

~~26~~14. The method according to Claim ~~25~~13, wherein the upward superficial velocity of the gas in the evaporator is less than 3 ft/sec (0.91 m/sec).

~~27. The method according to Claim 25, wherein the upward superficial velocity of the gas in the evaporator is less than 2 ft/sec (0.61 m/sec).~~

~~28. The method according to Claim 25, wherein the upward superficial velocity of the gas in the evaporator is less than 1.5 ft/sec (0.46 m/sec).~~

~~29~~15. The method according to Claim ~~25~~13, wherein the upward superficial velocity of the gas in the evaporator is less than 1 ft/sec (0.31 m/sec).

~~30~~16. The method according to Claim ~~25~~13, wherein the upward superficial velocity of the gas in the evaporator is less than 0.5 ft/sec (0.15 m/sec).

~~31. The method according to Claim 25, wherein the upward superficial velocity of the gas in the evaporator is from 0.1 ft/sec (0.03 m/sec) up to 3 ft/sec (0.91 m/sec).~~

~~32~~17. Apparatus for production of synthesis gas comprising:

a. an evaporation unit with a heated hydrocarbon gas feed, a liquid feed for liquid hydrocarbons and/or liquid hydrocarbon oxygenates as well as an evaporator vessel coupled to the gas feed and liquid feed, the evaporator vessel also being coupled to an output of the evaporation unit,

wherein the evaporation vessel has an upper portion and a lower portion and includes:

(i) one or more nozzle assemblies disposed in its upper portion configured to feed liquid downwardly into the evaporation vessel;

(ii) a gas distributor disposed in its lower portion configured to feed heated hydrocarbon gas into the evaporation vessel; and

wherein further the evaporation vessel is coupled to the output of the evaporation unit at the upper portion of the evaporation vessel and is configured and adapted to operate at feed rates, pressures and temperatures to evaporate liquid hydrocarbons and/or liquid hydrocarbon oxygenates and provide a mixed vapor stream of hydrocarbon gas and evaporated liquid hydrocarbon and/or hydrocarbon oxygenate to the output of the evaporation unit while maintaining an upward superficial gas velocity in the evaporation vessel of less than 3 ft/sec (0.91 m/sec) in the evaporation vessel; and

b. a partial oxidation unit coupled to the output of the evaporator unit adapted to receive the mixed vapor feed of hydrocarbon gas and evaporated liquid from the evaporator unit; the partial oxidation unit being provided with an oxygen injector which provides oxygen to the mixed vapor feed and converts it to synthesis gas.

~~33~~18. Apparatus according to Claim ~~21~~17, wherein the evaporator vessel is provided with a liquid recycle system which transports liquid from the lower portion of the evaporator vessel to the upper portion of the evaporator vessel.

~~34. Apparatus according to Claim 33, wherein the waste oil recycle system includes a heater and a purge.~~

~~35~~19. Apparatus according to Claim ~~32~~17, wherein the partial oxidation unit is a non-catalytic partial oxidation unit.

~~36. Apparatus according to Claim 35, wherein the non-catalytic partial oxidation unit includes an annular burner for oxidizing mixed vapor feed of hydrocarbon gas and evaporated liquid.~~

~~37. Apparatus according to Claim 32, wherein the evaporator vessel is equipped with at least 2 nozzle assembles disposed in its upper portion configured to feed liquid downwardly into the evaporation unit.~~

~~38. Apparatus according to Claim 32, wherein the evaporator vessel is equipped with at least 4 nozzle assembles disposed in its upper portion configured to feed liquid downwardly into the evaporation unit.~~

~~39~~20. Apparatus according to Claim ~~32~~17, wherein the gas distributor is configured to feed gas upwardly into the evaporation vessel.

~~40~~21. Apparatus according to Claim ~~32~~17, wherein the evaporator vessel is provided with a mist eliminator.

~~41. Apparatus according to Claim 32, operated at a superficial gas velocity in the evaporator of less than 2ft/sec (0.61 m/sec) and a ratio of gas/liquid feed of at least 30 ft^3 (0.85 m^3) hydrocarbon gas per gallon (3.7853 l) of liquid~~.