Claims

1. Ethylene plant, comprising an electrically-powered pyrolysis reactor (91), which electrically-powered pyrolysis reactor (91) comprises a feed inlet for a hydrocarbon feedstock-diluent mixture and an outlet for a pyrolysis reactor effluent comprising ethylene, the ethylene plant further comprising a heat exchanger (90) configured to transfer heat from the pyrolysis reactor effluent to the feed for the pyrolysis reactor, the heat exchanger (90) comprising a feed inlet and a feed outlet upstream of the pyrolysis reactor, and further a pyrolysis reactor effluent inlet and a pyrolysis reactor effluent outlet, wherein a feed passage way is present between the feed outlet of the heat exchanger and the feed inlet of the pyrolysis reactor and further a feed passage way is present between the reactor effluent outlet of the pyrolysis reactor and the cracked gas inlet of the heat exchanger.

2. Ethylene plant according to claim 1, wherein the plant further comprises a cooling section configured to further cool reactor effluent produced in the pyrolysis reactor to about ambient conditions without high pressure steam generation, which cooling section is downstream of the cracked gas outlet of the heat exchanger (90).

3. Ethylene plant according to claim 2, wherein the cooling section comprises a cooling system (60) selected from the group of quench water cooling systems configured to further cool the reactor effluent with quench water and air coolers configured to further cool the reactor effluent with air; optionally, wherein the cooling section comprises a quench oil cooling system (51) configured to further cool reactor effluent with quench oil, upstream of the quench water cooling system or air cooler.

4. Ethylene plant according to any of the preceding claims, wherein the plant comprises a humidifier (150) upstream of the feed inlet of the heat exchanger (90), which humidifier is configured to humidify the hydrocarbon feedstock, thereby providing a hydrocarbon-diluent mixture; optionally, wherein the plant comprises a compressor configured to pressurize the humidified hydrocarbon feed, which compressor is present in a humidified hydrocarbon feed passage way between an outlet for humidified hydrocarbon feed of the humidifier (150) and the feed inlet of

the heat exchanger (90) configured to transfer heat from the cracked gas from the pyrolysis reactor to the feed for the pyrolysis reactor.

5. Ethylene plant according to claim 4, wherein the plant further comprises a cooling section configured to further cool reactor effluent produced in the pyrolysis reactor to about ambient conditions without high pressure steam generation, which cooling section is downstream of the cracked gas outlet of the heat exchanger (90;

wherein the cooling section comprises a cooling system (60) selected from the group of quench water cooling systems configured to further cool the reactor effluent with quench water and air coolers configured to further cool the reactor effluent with air; and

wherein the cooling section comprises a quench oil cooling system (51) configured to further cool reactor effluent with quench oil, upstream of the quench water cooling system or air cooler;

the plant further comprising a heat exchanger (153) configured to transfer heat from the quench oil to the water for humidifying the hydrocarbon feedstock in the humidifier (150), which heat exchanger comprises a quench oil passage way and a water passage way, wherein

the quench oil passage way has an inlet for quench oil which is connected to a quench oil outlet of the quench oil cooling system (51) via a passage way configured to transfer quench oil from the quench oil cooling system (51) to said heat exchanger (153) and a quench oil outlet connected to a quench oil inlet of the quench oil cooling system (51) via a quench oil recycle passage way, and

wherein the water passage way of the heat exchanger (153) has an inlet for water to be heated in said heat exchanger (153) and an outlet for water connected to a water inlet of the humidifier (150).

6. Ethylene plant according to any of the preceding claims, wherein the plant comprises a dilution steam generator, comprising a heat pump system configured to generate the dilution steam; optionally, wherein the heat pump system has multiple heat sources, multiple sinks or both; further optionally, wherein the plant comprises a heat exchanger (30, 43) to preheat the hydrocarbon feedstock upstream of the feed inlet of the heat exchanger (90) upstream of the pyrolysis reactor (91), which heat exchanger is configured to receive heat from one

or more of quench water, quench oil, and middle oil, used to cool pyrolysis reactor effluent.

7. Ethylene plant according to claim 6, comprising a hydrocarbon feed evaporator (46) configured to receive heat from quench oil used in a quench oil cooling system (51) for evaporation of the hydrocarbon feed, which quench oil cooling system is configured to further cool pyrolysis reactor effluent with quench oil, or configured to receive condensation heat from a vaporous refrigerant (48) of the heat pump for evaporation of the hydrocarbon feed.

8. Ethylene plant according to claim 7, wherein the hydrocarbon feed evaporator (44) is configured to receive at least part of the heat for the evaporation of the hydrocarbon feed from middle oil used in a quench oil cooling system (52), which middle oil cooling system is configured to further cool pyrolysis reactor effluent with middle oil.

9. Ethylene plant according to any of the preceding claims, wherein the plant comprises an electric power connection configured to provide electricity to the electrically-powered pyrolysis reactor, which electric power connection is a connection to an electric power system to produce electric power from a renewable source.

10. Process for producing a pyrolysis reactor effluent comprising ethylene from a hydrocarbon feed using an ethylene plant according to any of the preceding claims, comprising feeding a hydrocarbon feedstock-steam mixture to the electrically-powered pyrolysis reactor (91), cracking the hydrocarbon feedstock in the presence of steam in the electrically-powered pyrolysis reactor (91) of said ethylene plant to produce the pyrolysis reactor effluent comprising ethylene, feeding the pyrolysis reactor effluent to the heat-changer (90) configured to transfer heat from the pyrolysis reactor effluent to the hydrocarbon feedstock-steam mixture, prior to the cracking of the hydrocarbon feedstock and transferring heat from the pyrolysis reactor effluent to the hydrocarbon feedstock-steam mixture in said heat exchanger (90), thereby cooling the pyrolysis reactor effluent to a temperature at the heat-exchanger (90) pyrolysis reactor effluent outlet below 500 °C, preferably to a temperature in the range of 350 °C - 450 °C more preferably to a temperature in the range of 325 °C - 425 °C.

11. Process according to claim 10, wherein a gaseous hydrocarbon feedstock is used as hydrocarbon feed and wherein the gaseous hydrocarbon feed stock is humidified in a humidifier (150) upstream of the feed inlet of the heat exchanger (90), thereby providing a hydrocarbon-diluent mixture.

12. Process according to claim 10, wherein a liquid hydrocarbon feedstock is used as hydrocarbon feed, wherein the ethylene plant comprises a cooling section comprising a quench water cooling system (60), provided with a quench water cooling circuit (65) and a primary fractionator (50), the primary fractionator comprising a quench oil cooling system (51), provided with a quench oil cooling circuit (55) and a middle oil section (52), provided with a middle oil cooling circuit (57), which cooling circuits are used to preheat and evaporate liquid hydrocarbon feedstock, mixing the evaporated hydrocarbon feedstock with dilution steam and feeding the resultant mixture to the heat exchanger (90).

13. Process according to any of claims 10 to 12, wherein a mixture of a liquid feedstock and a gaseous hydrocarbon feed stock is used as hydrocarbon feed.

14. Process according to any of claims 10 to 13, comprising

feeding the hydrocarbon-steam mixture to the heat exchanger (90), configured to transfer heat from the pyrolysis reactor effluent to the feed for the pyrolysis reactor, at a temperature above the water dewpoint of the hydrocarbon-steam mixture,

heating up the hydrocarbon-steam mixture with waste heat from the pyrolysis reactor effluent in said heat exchanger (90) to a suitable inlet temperature for the electrically-powered pyrolysis reactor (91),

feeding the heated-up hydrocarbon-steam mixture from said heat exchanger (90) to the electrically heated pyrolysis reactor (91), which pyrolysis reactor further heats the heated-up hydrocarbon-steam mixture to a pyrolysis reaction temperature and which pyrolysis reactor provides the heat of reaction for the conversion of the hydrocarbon feed to the cracking product, thereby providing the cracking product; optionally, wherein the inlet temperature for the electrically-powered pyrolysis reactor (91) is in a range of 650 °C-730 °C for a gaseous hydrocarbon feedstock or in a range of 570 °C-650 °C for a liquid hydrocarbon feedstock.

15. Process according to any of claims 10 to 14, wherein heat of a refrigeration circuit of the ethylene plant is used for at least one purpose selected from dilution steam generation, feedstock preheating, and evaporation of liquid feedstock, preferably for generating dilution steam, preheating liquid feedstock and evaporating liquid feedstock.