C L A I M S

1. A process for producing aromatic hydrocarbons and ethylene, comprising:
   a. contacting a lower alkane feed comprising at least one of ethane, propane and butane with an aromatic hydrocarbon conversion catalyst within an alkane-to-aromatic zone to obtain at least hydrogen and aromatic reaction products, including at least benzene;
   b. converting an oxygenate feedstock in an oxygenate-to-olefin zone to obtain olefins, including at least ethylene;

   wherein at least part of the oxygenate feedstock is obtained by providing at least part of the hydrogen obtained in step a) and a feed containing carbon monoxide and/or carbon dioxide to an oxygenate synthesis zone and synthesizing oxygenates.

2. A process according to claim 1, wherein the process is a process for preparing ethylbenzene, further comprising the step:
   c. reacting at least part of the benzene obtained in step (a) with at least part of the ethylene obtained in step (b) to obtain ethylbenzene.

3. A process according to claim 2, wherein the process is a process for preparing styrene monomer, further comprising the step:
   d. dehydrogenating at least part of the ethylbenzene obtained in step (c) to obtain styrene monomer and hydrogen; and

e. providing at least part of the hydrogen obtained in step d) to the oxygenate synthesis zone to synthesize oxygenates.

4. A process according to any one of the preceding claims, wherein methane is obtained from step (a) and at least part of the feed containing carbon monoxide and/or carbon dioxide is obtained by converting at least part of the methane to hydrogen and at least one of carbon monoxide and carbon dioxide.

5. A process according to any of the preceding claims, wherein the aromatic conversion products obtained in step (a) further include toluene and/or xylene and at least part of the toluene and/or xylene is hydrodealkylated in the presence of hydrogen to obtain further benzene and methane.

6. A process according to any of the preceding claims, comprising providing hydrogen and at least one of carbon monoxide and carbon dioxide to the oxygenate synthesis zone in a molar ratio of in the range of from 2.0 to 3.0, preferably 2.0 to 2.2.

7. A process according to any one of the preceding claims, wherein the feed containing carbon monoxide and/or carbon dioxide comprises a synthesis, preferably synthesis gas with a molar ratio of hydrogen to carbon monoxide and/or carbon dioxide of in the range of from 1.0 to 1.9, more preferably of from 1.3 to 1.8.

8. A process according to any one of the preceding claims, wherein the feed containing carbon monoxide and/or carbon dioxide comprises carbon dioxide obtained from:

i) a subsurface natural gas or oil reservoir; and/or

ii) a process for preparing ethylene oxide and optionally Mono-ethylene-glycol.

9. A process according to according to any one of the preceding claims, further comprising providing at least part of the ethylene obtained in step (b) to an ethylene oxidation zone together with a source of oxygen and performing a process for preparing ethylene oxide to obtain ethylene oxide and carbon dioxide.

10. A process according to any one of the preceding claims, comprising:

i) providing a feed comprising methane and at least one of ethane, propane and butane;

ii) separating the feed into at least a methane-comprising feed and a lower alkane feed, comprising at least one of ethane, propane and butane;

iii) providing at least part the methane-comprising feed to a process for preparing synthesis gas to obtain a synthesis gas; and

iv) contacting the lower alkane feed with an aromatic hydrocarbon conversion catalyst in an alkane-to-aromatic zone according to step (a) to obtain at least benzene and hydrogen;

v) providing at least part of the hydrogen obtained in step iv) and at least part the synthesis gas obtained in step iii) to an oxygenate synthesis zone and synthesising oxygenates; and

vi) converting at least part of the oxygenates in an oxygenate-to-olefin zone according to step (b) to obtain at least ethylene.

11. A process according to claim 10, wherein the feed comprising feed comprising methane and at least one

of ethane, propane and butane is natural gas or associated gas.

12. Use of hydrogen obtained from a process to convert lower alkanes to benzene to produce an oxygenate feed for an oxygenate-to-olefin process.

13. An integrated system for producing olefins, which system comprises:

a) an alkane-to-aromatic system having one or more inlets for a lower alkane feed comprising at least one of ethane, propane and butane and an outlet for an alkane-to-aromatic effluent comprising hydrogen and aromatic conversion products including benzene;

b) an aromatic work-up system arranged to receive at least part of the alkane-to-aromatic effluent, the work-up section comprising a separation system for separating hydrogen from the alkane-to-aromatic effluent, an outlet for conversion products and an outlet for hydrogen;

c) an oxygenate-to-olefins conversion system, having one or more inlets for receiving an oxygenate feedstock, and comprising a reaction zone for contacting the oxygenate feedstock with an oxygenate conversion catalyst under oxygenate conversion conditions, and an outlet for an oxygenate-to-olefins effluent comprising ethylene;

d) an oxygenate synthesis system having one or more inlets for a feed containing carbon monoxide and/or carbon dioxide and an inlet for hydrogen, and an outlet for an oxygenate feedstock; and

means for providing hydrogen from the outlet for hydrogen of the workup section to the hydrogen inlet of the oxygenate synthesis system.

CLAIMS

1. A process for producing aromatic hydrocarbons and ethylene, comprising:

a. separating a hydrocarbon feedstock containing methane and at least one of ethane, propane and butane into a methane comprising feed and a lower alkane feed;

b. contacting the lower alkane feed comprising at least one of ethane, propane and butane with an aromatic hydrocarbon conversion catalyst within an alkane-to-aromatic zone to obtain at least hydrogen and aromatic reaction products, including at least benzene;

c. converting the methane to synthesis gas;

d. converting an oxygenate feedstock in an oxygenate-to-olefin zone to obtain olefins, including at least ethylene; wherein at least part of the oxygenate feedstock is obtained by providing at least part of the hydrogen obtained in step a) and a feed containing carbon monoxide and/or carbon dioxide, at least part of which is obtained from step c to an oxygenate synthesis zone and synthesizing oxygenates.

2. A process according to claim 1, wherein the process is a process for preparing ethylbenzene, further comprising the step of:

reacting at least part of the benzene obtained in step (a) with at least part of the ethylene obtained in step (b) to obtain ethylbenzene.

3. A process according to claim 2, wherein the process is a process for preparing styrene monomer, further comprising the step of:

dehydrogenating at least part of the ethylbenzene obtained in step (c) to obtain styrene monomer and hydrogen; and

providing at least part of the hydrogen obtained in step d) to the oxygenate synthesis zone to synthesize oxygenates.

4. A process according to any one of the preceding claims, wherein methane is obtained from step (a) and at least part of the feed containing carbon monoxide and/or carbon dioxide is obtained by converting at least part of the methane to hydrogen and at least one of carbon monoxide and carbon dioxide.

5. A process according to any of the preceding claims, wherein the aromatic conversion products obtained in step (a) further include toluene and/or xylene and at least part of the toluene and/or xylene is hydrodealkylated in the presence of hydrogen to obtain further benzene and methane.

6. A process according to any of the preceding claims, comprising providing hydrogen and at least one of carbon monoxide and carbon dioxide to the oxygenate synthesis zone in a molar ratio of in the range of from 2.0 to 3.0, preferably 2.0 to 2.2.

7. A process according to any one of the preceding claims, wherein the feed containing carbon monoxide and/or carbon dioxide comprises a synthesis, preferably synthesis gas with a molar ratio of hydrogen to carbon monoxide and/or carbon dioxide of in the range of from 1.0 to 1.9, more preferably of from 1.3 to 1.8.

8. A process according to any one of the preceding claims, wherein the feed containing carbon monoxide and/or carbon dioxide comprises carbon dioxide obtained from:

i) a subsurface natural gas or oil reservoir; and/or

ii) a process for preparing ethylene oxide and optionally mono-ethylene-glycol .

9. A process according to any one of the preceding claims, further comprising providing at least part of the ethylene obtained in step (b) to an ethylene oxidation zone together with a source of oxygen and performing a process for preparing

ethylene oxide to obtain ethylene oxide and carbon dioxide .

10. A process according to any one of the preceding claims, comprising:

i) providing a feed comprising methane and at least one of ethane, propane and butane;

ii) separating the feed into at least a methane- comprising feed and a lower alkane feed, comprising at least one of ethane, propane and butane;

iii) providing at least part the methane-comprising feed to a process for preparing synthesis gas to obtain a synthesis gas; and

iv) contacting the lower alkane feed with an aromatic hydrocarbon conversion catalyst in an alkane-to-aromatic zone according to step (a) to obtain at least benzene and hydrogen;

v) providing at least part of the hydrogen obtained in step iv) and at least part of the synthesis gas obtained in step iii) to an oxygenate synthesis zone and synthesising oxygenates; and

vi) converting at least part of the oxygenates in an oxygenate-to-olefin zone according to step (b) to obtain at least ethylene.

11. A process according to claim 10, wherein the feed comprising feed comprising methane and at least one of ethane, propane and butane is natural gas or associated gas.

12. Use of hydrogen obtained from a process to convert lower alkanes to benzene to produce an oxygenate feed for an oxygenate-to-olefin process.

13. An integrated system for producing olefins, which system comprises:

a) an alkane-to-aromatic system having one or more inlets for a lower alkane feed comprising at least one of ethane, propane and butane and an outlet for an alkane-to-aromatic effluent comprising hydrogen and aromatic conversion products including benzene;

b) an aromatic work-up system arranged to receive at least part of the alkane-to-aromatic effluent, the work-up section comprising a separation system for separating hydrogen from the alkane-to-aromatic effluent, an outlet for conversion products and an outlet for hydrogen;

c) an oxygenate-to-olefins conversion system, having one or more inlets for receiving an oxygenate feedstock, and comprising a reaction zone for contacting the oxygenate feedstock with an oxygenate conversion catalyst under oxygenate conversion conditions, and an outlet for an oxygenate-to-olefins effluent comprising ethylene;

d) an oxygenate synthesis system having one or more inlets for a feed containing carbon monoxide and/or carbon dioxide and an inlet for hydrogen, and an outlet for an oxygenate feedstock; and

means for providing hydrogen from the outlet for hydrogen of the workup section to the hydrogen inlet of the oxygenate synthesis system.