CLAIMS

I (We) claim:

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

(1) a propylene production step wherein a hydrocarbon feedstock containing 50 % by mass or more of at least one of C_{4-12} olefin is brought into contact in a propylene production reactor with a molded catalyst A containing a first zeolite fulfilling conditions (i) through (iv) below under a condition that a partial pressure of the hydrocarbon feedstock is from 0.05 to 0.3 MPa to thereby perform a catalytic conversion reaction on the at least one of C_{4-12} olefin, resulting in a reaction mixture containing propylene and having a value obtained by dividing an amount of component [% by mass] of the C_{6-8} aromatic hydrocarbons by ~~a~~ the ~~hydrocarbon~~ partial pressure [MPa] of the hydrocarbon feedstock is 13 or less, the reaction mixture is separated into fraction C containing ~~mainly~~ hydrogen and C_{1-3} hydrocarbons and fraction D containing ~~mainly~~ at least one of C_{4+} hydrocarbon, and propylene is isolated from the fraction C:

(i) having a medium pore diameter zeolite with a pore diameter of from 5 to 6.5 Å;

(ii) containing substantially no protons;

(iii) containing at least one metal selected from the group consisting of metals in Group IB of the periodic table; and

(iv) having an SiO_2 / Al_2O_3 molar ratio of at least 800 but no more than 2,000; and

(2) an aromatic hydrocarbon production step wherein a raw material containing ~~entirely or partly~~ all or a part of the fraction D is brought into contact in an

aromatic hydrocarbon production reactor with a molded catalyst B containing a second zeolite fulfilling conditions (v) through (vii) below in a gaseous phase at 650°C or less:

(v) having a medium pore diameter zeolite with a pore diameter of from 5 to 6.5 Å;

(vi) with a primary particle diameter in a range of from 0.02 to 0.25 μm; and

(vii) containing at least one metal element selected from the group consisting of metal elements in group IB of the periodic table in the form of the corresponding cations.

2. The process according to Claim 1, wherein the hydrocarbon feedstock containing 50 % by mass or more of at least one of C_{4-12} olefin which is used in the propylene production step contains 2.5 % by mass or less of at least one of C_{3-12} diolefin compound.

3. The process according to Claim 1, wherein the first zeolite contains silver.

4. The process according to Claim 1, wherein the first zeolite is an MFI zeolite.

5. The process according to Claim 1, wherein, in the propylene production step, 10 % by mass to 95 % by mass of the fraction D is recycled back to the propylene production reactor and used as part of the hydrocarbon feedstock.

6. The process according to Claim 1, wherein the fraction C is separated into fraction C_1 containing ~~mainly~~ hydrogen and hydrocarbons of 1-2 carbon atoms and fraction C_2 containing ~~mainly~~ hydrocarbons of 3 carbon atoms, and at least part of the fraction C_1 is recycled back to the propylene production reactor and used as part of the hydrocarbon feedstock.

7. The process according to Claim 1, wherein the propylene production reactor is an adiabatic fixed-bed reactor.

8. The process according to Claim 1, wherein a reaction temperature for the propylene production step is from 500°C to 580°C, and a weight hourly space velocity of the hydrocarbon feedstock based on a weight of the molded catalyst A is from 2 hr^{-1} to 20 hr^{-1}.

9. The process according to Claim 1, wherein the molded catalyst B contains at least one selected from the group consisting of the metals belonging to groups IB, IIB, IIIB and VIII in the periodic table and compounds of these.

10. The process according to Claim 1, wherein the second zeolite contains silver.

11. The process according to Claim 1, wherein the second zeolite is an MFI zeolite.

12. The process according to Claim 1, wherein the aromatic hydrocarbon production reactor is an adiabatic fixed-bed reactor.

13. The process according to Claim 1, wherein the fraction C is separated into fraction C_1 containing ~~mainly~~ hydrogen and hydrocarbons of 1-2 carbon atoms and fraction C_2 containing ~~mainly~~ hydrocarbons of 3 carbon atoms, and at least part of the fraction C_1 is used as part of the hydrocarbon feedstock in the aromatic hydrocarbon production step.

14. A process for producing propylene and aromatic hydrocarbons, comprising:

(1) a propylene production step wherein a hydrocarbon feedstock containing 50 % by mass or more of at least one of C_{4-12} olefin is brought into contact in a propylene production reactor with a molded catalyst A containing a first zeolite fulfilling conditions (i) through (iv) below under a condition that a partial pressure of the hydrocarbon feedstock is from 0.05 to 0.3 MPa to thereby perform a catalytic conversion reaction on the at least one of C_{4-12} olefin, resulting in a reaction mixture containing propylene and having a value obtained by dividing an amount of component [% by mass] of the C_{6-8} aromatic hydrocarbons by ~~a~~ the ~~hydrocarbon~~ partial pressure [MPa] of the hydrocarbon feedstock is 13 or less, the reaction mixture is separated into fraction E containing ~~mainly~~ hydrogen and C_{1-2} hydrocarbons and fraction F containing ~~mainly~~ at least one of C_{3+} hydrocarbon, the fraction F is separated into fraction F_1 containing ~~mainly~~ C_3 hydrocarbons and fraction F_2 containing ~~mainly~~ at least one of C_{4+} hydrocarbon, and propylene is isolated from the fraction F_1:

(i) having a medium pore diameter zeolite with a pore diameter of from 5 Å to 6.5 Å;

(ii) containing effectively no protons;

(iii) containing at least one metal selected from the group consisting of the metals in Group IB of the periodic table; and

(iv) having an SiO_2 / Al_2O_3 mole ratio of at least 800 but no more than 2,000; and

(2) an aromatic hydrocarbon production step wherein a raw material containing ~~entirely or partly~~ all or a part of the fraction F_2 is brought into contact in an aromatic hydrocarbon production reactor with a molded catalyst B containing a second zeolite fulfilling conditions (v) through (vii) below in a gaseous phase at 650°C or less:

(v) having a medium pore diameter zeolite with a pore diameter of from 5 Å to 6.5 Å;

(vi) with a primary particle diameter in the range of from 0.02 μm to 0.25 μm; and

(vii) containing at least one metal element selected from the group consisting of metal elements in group IB of the periodic table in the form of the corresponding cations.

15. The process according to Claim 14, wherein the hydrocarbon feedstock containing 50 % by mass or more of at least one of C_{4-12} olefin which is used in the propylene production process contains 2.5 % by mass or less of at least one of C_{3-12} diolefin compound.

22. The process according to Claim 14, wherein molded the catalyst B contains at least one selected from the group consisting of metals belonging to groups IB, IIB, IIIB and VIII in the periodic table and compounds of these.

23. The process according to Claim 14, wherein the second zeolite contains silver.

24. The process according to Claim 14, wherein the second zeolite is an MFI zeolite.

25. The process according to Claim 14, wherein the aromatic hydrocarbon production reactor is an adiabatic fixed-bed reactor.

26. The process according to Claim 14, wherein at least part of the fraction E is used as part of the hydrocarbon feedstock in the aromatic hydrocarbon production step.

~~27. A producing apparatus for producing propylene and aromatic hydrocarbons from a hydrocarbon feedstock, comprising:~~

~~(a) a first reactor that receives the hydrocarbon feedstock and produces a reaction mixture containing propylene;~~

~~(b) a separator that receives the reaction mixture and is connected to the first reactor; and~~

~~(c) a second reactor connected to the separator, wherein the aromatic hydrocarbons are produced.~~

28. The producing apparatus according to Claim 27, wherein the separator has a conduit for directly conducting a part of a separated product obtained from the separator to the first reactor and second reactor.

29. The producing apparatus according to Claim 27, wherein a part of a fraction obtained in the separator is recycled and contained in the first reactor.

30. The producing apparatus according to Claim 27, wherein a fraction that is obtained from the separator and contained in the first and second reactors is a fraction containing mainly at least one of C_{4+} hydrocarbon.

31. The producing apparatus according to Claim 27, wherein a part of a fraction containing mainly hydrogen and C_{1-2} hydrocarbons that is obtained from the separator is contained in the first reactor and the second reactor.

32. The producing apparatus according to Claim 27, wherein the separator is a distilling column or flash drum.