CLAIMS

1. A reactor system comprising:

a) an acrolein-oxidizing catalyst comprising a mixed metal oxide catalyst of general formula (I):

$$MoV_aA^1_bA^2_cA^3_dO_m \qquad (I)$$

wherein:

A^1 comprises at least one element selected from the group consisting of W and Cu;

A^2 comprises at least one element selected from the group consisting of Sb, Fe, and Nb;

A^3 comprises at least one element selected from the group consisting of Y, Ti, Zr, Hf, Ta, Cr, Mn, Re, Ru, Co, Rh, Ir, Ni, Pd, Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Si, Te, Pb, P, As, Bi, Se, rare earth elements, alkaline elements, and alkaline earth elements;

a ranges from 0.01 to 1.0;

b ranges from 0.01 to 1.5;

c ranges from 0.05 to 0.2;

d ranges from 0 to 1.0;

m is dependent on the oxidation state of the other elements;

b) a finishing catalyst comprising a mixed metal oxide catalyst of general formula (II):

$$MoV_wNb_xX^1_yX^2_zO_n \qquad (II)$$

wherein:

X^1 comprises at least one element selected from the group consisting of Te and Sb;

X^2 comprises at least one an element selected from the group consisting of Y, Ti, Zr, Hf, Nb, Ta, Cr, Mn, Re, Fe, Ru, Co, Rh, Ir, Ni, Pd, Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Pb, P, As, Bi, Se, rare earth elements and alkaline earth elements;

w ranges from 0.01 to 1.0;

x ranges from 0.01 to 1.0;

y ranges from 0.01 to 1.0;

z ranges from 0 to 1.0;

n is depended on the oxidation state of the other elements;

the finishing catalyst does not contain W or Cu, and has an X-ray diffraction pattern showing an orthorhombic phase as the major crystal phase with main peaks with 2θ at 6.7°, 7.8°, 22.1°, and 27.2°; and

the acrolein-oxidizing catalyst has a different chemical composition than the finishing catalyst.

2. The reactor system according to claim 1, wherein:

w ranges from 0.1 to 0.5;

x ranges from 0.01 to 0.5;

y ranges from 0.05 to 0.3; and

z ranges from 0 to 0.2.

3. The reactor system according to claim 1 or 2, wherein the finishing catalyst comprises less than 20 wt.% based on the total weight of the acrolein-oxidizing catalyst and the finishing catalyst.

4. The reactor system according to any one of claims 1 to 3, wherein the finishing catalyst comprises less than 10 wt.% based on the total weight of the acrolein-oxidizing catalyst and the finishing catalyst.

5. A process for producing acrylic acid comprising:

a) contacting a gas stream comprising acrolein with an acrolein-oxidizing catalyst to form a product stream A, wherein at least one aldehyde byproduct is present in the product stream A;

b) contacting the product stream A with a finishing catalyst to form a product stream B comprising acrylic acid, wherein the product stream B comprises a lower weight percentage of the at least one aldehyde byproduct than product stream A;

wherein:

i) the acrolein-oxidizing catalyst comprises a mixed metal oxide catalyst of general formula (I):

$$MoV_aA^1_bA^2_cA^3_dO_m \qquad (I)$$

wherein:

A^1 comprises at least one element selected from the group consisting of W and Cu;

A^2 comprises at least one element selected from the group consisting of Sb, Fe, and Nb;

A^3 comprises at least one element selected from the group consisting of Y, Ti, Zr, Hf, Ta, Cr, Mn, Re, Ru, Co, Rh, Ir, Ni, Pd, Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Si, Te, Pb, P, As, Bi, Se, rare earth elements, alkaline elements, and alkaline earth elements;

a ranges from 0.01 to 1.0;

b ranges from 0.01 to 1.5;

c ranges from 0.05 to 0.2;

d ranges from 0 to 1.0; and

m is dependent on the oxidation state of the other elements;

ii) the finishing catalyst comprising a mixed metal oxide catalyst of general formula (I):

$$MoV_wNb_xX^1_yX^2_zO_n \qquad (II)$$

wherein:

X^1 comprises at least one element selected from the group consisting of Te and Sb;

X^2 comprises at least one an element selected from the group consisting of Y, Ti, Zr, Hf, Nb, Ta, Cr, Mn, Re, Fe, Ru, Co, Rh, Ir, Ni, Pd, Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Pb, P, As, Bi, Se, rare earth elements and alkaline earth elements;

w ranges from 0.01 to 1.0;

x ranges from 0.01 to 1.0;

y ranges from 0.01 to 1.0;

z ranges from 0 to 1.0;

n is depended on the oxidation state of the other elements;

the finishing catalyst does not contain W or Cu, and has an X-ray diffraction pattern showing an orthorhombic phase as the major crystal phase with main peaks with 2θ at 6.7°, 7.8°, 22.1°, and 27.2°; and

the acrolein-oxidizing catalyst has a different chemical composition than the finishing catalyst.

6. The process according to claim 5, wherein the acrolein-oxidizing catalyst is positioned upstream from the finishing catalyst.

7. The process according to claim 5 or 6, wherein the acrolein-oxidizing catalyst and the finishing catalyst are formed as a single catalyst bed in a reactor.

8. The process according to claim 5 or 6, wherein the finishing catalyst is present in reactor following a reactor containing the acrolein-oxidizing reactor.

9. The process according to any one of claims 5 to 7, further comprising:

prior to step a), preparing the gas stream comprising acrolein by oxidizing propylene in the presence of a propylene-oxidizing catalyst.

10. The process according to any one of claims 5 to 9, wherein the finishing catalyst comprises less than 20 wt.% based on the total weight of the acrolein-oxidizing catalyst and the finishing catalyst.