the partial pressure of the alkane or paraffin. The catalyst fines contained in the reactor effluent stream cannot easily be separated from quench water, leading to excessive fouling in the equipment and consequential high maintenance costs. Thus, there is also a need for improved recovery of catalyst fines found in the effluent stream from the dehydrogenation reactor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The FIGURE 1 is a schematic illustration of a process for catalytic paraffin dehydrogenation and catalyst recovery of the kind described herein.

SUMMARY

[0005a] In an aspect, there is provided a process for dehydrogenating paraffins, the process comprising:

contacting at least one metal oxide catalyst with a paraffin having 2-8 carbon atoms for a reaction period ranging from ~~about~~ 0.05 seconds to ~~about~~ 10 minutes in a reactor at a pressure ranging from 0.01 MPa to 0.02 MPa;

wherein the paraffin is selected from a group consisting of propane, n-butane, isobutane, and combinations thereof, and it is introduced into the reactor with an inert diluent or steam;

wherein the metal oxide catalyst is selected from a group consisting of oxides of zinc, titanium, copper, iron, manganese, aluminum, silicon, zirconium, cerium, dysprosium, erbium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, ytterbium, ~~yttrium,~~ niobium, and combinations thereof; and

wherein the metal oxide catalyst is substantially free of platinum and chromium.

[0006] There is provided, in one form, a process for dehydrogenating paraffins by contacting a metal oxide catalyst with a paraffin having 2-8 carbon atoms in a riser, fluidized bed, or fixed-bed swing reactor for a reaction period ranging from about 0.05 seconds to about 10 minutes. In one example, the metal

oxide catalyst is selected from group consisting of oxides of zinc, titanium, copper, iron, manganese, aluminum, silicon, zirconium, cerium, dysprosium, erbium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, ytterbium, yttrium, niobium, and combinations thereof, wherein the metal oxide catalyst is substantially free of platinum and chromium.

[0006a] In another aspect, there is provided a process for recovering catalyst fines from a reactor effluent stream of a catalytic paraffin dehydrogenation reaction, the process comprising:

a. contacting a metal oxide catalyst with a paraffin having 2-8 carbon atoms in a reactor at a pressure ranging from 0.01 MPa to 0.02 MPa, wherein
    i. ~~wherein~~ the paraffin is selected from a group consisting of propane, n-butane, isobutane, and combinations thereof;
    ii. ~~wherein~~ the metal oxide catalyst is selected from a group consisting of oxides of zinc, titanium, copper, iron, manganese, aluminum, silicon, zirconium, cerium, dysprosium, erbium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, ytterbium, ~~yttrium,~~ niobium, and combinations thereof; and
    iii. ~~wherein~~ the metal oxide catalyst is substantially free of platinum and chromium;
b. generating a reactor effluent stream comprising metal oxide catalyst fines after contacting with the metal oxide catalyst with the paraffin; and
c. contacting the reactor effluent stream with a wash fluid to transfer the metal oxide catalyst fines from the reactor effluent stream into the wash fluid and form a cooled catalyst effluent stream and a substantially catalyst-free product stream.

[0007] There is further provided in another form, a process for recovering catalyst fines from the reactor effluent stream of a catalytic paraffin dehydrogenation

CLAIMS

What is claimed is:

1. A process for dehydrogenating paraffins, the process comprising:

   contacting at least one metal oxide catalyst with a paraffin having 2-8 carbon atoms for a reaction period ranging from ~~about~~ 0.05 seconds to ~~about~~ 10 minutes in a reactor at a pressure ranging from 0.01 MPa to 0.02 MPa;

   wherein the paraffin is selected from a group consisting of propane, n-butane, isobutane, and combinations thereof, and it is introduced into the reactor with an inert diluent or steam;

   wherein the metal oxide catalyst is selected from a group consisting of oxides of zinc, titanium, copper, iron, manganese, aluminum, silicon, zirconium, cerium, dysprosium, erbium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, ytterbium, ~~yttrium,~~ niobium, and combinations thereof; and

   wherein the metal oxide catalyst is substantially free of platinum and chromium.

2. The process of claim 1, wherein the reactor is a riser reactor, fluidized bed reactor, or a fixed-bed swing reactor.

3. The process of claim 1, further comprising generating a reactor effluent stream comprising an olefin.

4. The process of claim 3, wherein the olefin is selected from a group consisting of propylene, ethylene, and combinations thereof.

5. The process of claim 1, wherein the reaction occurs at a temperature ranging from ~~about~~ 500 ^{o}C to ~~about~~ 800 ^{o}C.

~~6. The process of claim 1, wherein the reaction occurs at a pressure ranging from about 0.01 MPa to about 0.02 MPa.~~

~~7. The process of claim 1, wherein the paraffin is introduced to the reactor with an inert diluent or steam.~~

~~8.~~6. A process for recovering catalyst fines from a reactor effluent stream of a catalytic paraffin dehydrogenation reaction, the process comprising:

a. contacting a metal oxide catalyst with a paraffin having 2-8 carbon atoms in a reactor at a pressure ranging from 0.01 MPa to 0.02 MPa, where~~in~~

i. ~~wherein~~ the paraffin is selected from a group consisting of propane, n-butane, isobutane, and combinations thereof;

ii. ~~wherein~~ the metal oxide catalyst is selected from a group consisting of oxides of zinc, titanium, copper, iron, manganese, aluminum, silicon, zirconium, cerium, dysprosium, erbium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, ytterbium, ~~yttrium,~~ niobium, and combinations thereof; and

iii. ~~wherein~~ the metal oxide catalyst is substantially free of platinum and chromium;

b. generating a reactor effluent stream comprising metal oxide catalyst fines after contacting with the metal oxide catalyst with the paraffin; and

c. contacting the reactor effluent stream with a wash fluid to transfer the metal oxide catalyst fines from the reactor effluent stream into the wash fluid and form a cooled catalyst effluent stream and a substantially catalyst-free product stream.

~~9.~~7. The process of claim ~~8~~6, further comprising converting the cooled catalyst effluent stream into a slurry.

~~10.~~8. The process of claim ~~9~~7, further comprising directing the slurry to one or more filters to separate the metal oxide catalyst fines.

~~11.~~9. The process of claim ~~10~~8, wherein the slurry is continuously passed through a first filter in a filtration mode to separate the metal oxide catalyst fines therefrom while a second filter in parallel with the first filter is in backflushing mode to remove the separated metal oxide catalyst fines therefrom.

~~12.~~10. The process of claim ~~11~~9, wherein the filtration of the slurry comprises periodically alternating the first and the second filters between filtration and backflushing modes.

~~13.~~11. The process of claim ~~11~~9, wherein the separated metal oxide catalyst fines are accumulated in a catalyst accumulator.

~~14.~~12. The process of claim ~~8~~6, wherein the reactor effluent stream is contacted with the wash fluid in a quench tower.

~~15.~~13. The process of claim ~~14~~12, wherein the quench tower has vapor-liquid contacting elements.

~~16.~~14. The process of claim ~~14~~12, wherein the quench tower has a recirculation loop for continuously recirculating a wash oil to contacting elements.

~~17.~~15. The process of claim ~~14~~12, wherein the wash fluid comprises oil or water.