(b) contacting the cooled effluent gas with fuel oil in a wash section to wash out catalyst to obtain a cooled effluent gas essentially free of catalyst;

(c) withdrawing an oil-catalyst slurry from the wash section and circulating the oil-catalyst slurry through a filter thereby removing catalyst from the fuel oil giving filtered wash oil;

(d) returning filtered wash oil to the wash section as recirculated wash oil; and

(e) backwashing the filter thereby recovering catalyst.

[0007b] In another aspect, there is provided a system for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the system comprising:

(a) a quench tower having an inlet for receiving the effluent gas from a dehydrogenation reactor, and a wash section comprising vapor-liquid contacting elements disposed above the inlet for cooling the effluent gas and contacting it with fuel oil for washing out the catalyst;

(b) a gas outlet above the contacting elements for discharging cooled effluent gas essentially free of catalyst, and a liquid holdup zone below the inlet for collecting the fuel oil from the contacting elements;

(c) at least one filter operable in filtration and backwashing modes, the filter comprising a multi-bed system comprising multiple beds, each bed comprising a fixed filtration medium; and

(d) a filtration loop for circulating fuel oil from the liquid holdup zone through the filter and returning filtered fuel oil to the top of the wash section.

[0007c] In another aspect, there is provided a method for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the method comprising:

(a) cooling fluidized-bed propane dehydrogenation reactor effluent gas to produce a cooled effluent gas;

(b) contacting the cooled effluent gas contacting the effluent gas with a recirculated wash oil in a direct contact inline device prior to entering a flash zone of a quench tower to yield a process gas by removing a net amount of recirculated wash oil and combining it with an oil-catalyst slurry and the catalyst as a concentrated bottom oil-catalyst slurry;

(c) contacting the process gas from flash zone with a fuel oil in a wash section of quench tower to wash out remaining catalyst to obtain a cooled effluent gas essentially free of catalyst;

(d) withdrawing an oil-catalyst slurry from the wash section and cooling the oil-catalyst slurry through an oil heat exchanger to yield the recirculated wash oil;

(d) returning a portion of the recirculated wash oil to the wash section of quench tower.

[0007d] In another aspect, there is provided a system for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the system comprising:

(a) a direct contact inline device for receiving the effluent gas from a dehydrogenation reactor and contacting the effluent gas with a recirculated wash oil;

(b) a quench tower comprising:

(i) a flash zone with an inlet for receiving the effluent gas and recirculated wash oil from the direct contact inline device;

(ii) vapor-liquid contacting elements disposed above the flash zone for cooling the effluent gas and washing out the catalyst;

(iii) an oil-catalyst slurry outlet from a bottom of the vapor-liquid contacting elements;

(iv) a gas outlet above the contacting elements for discharging cooled effluent gas essentially free of catalyst;

(v) a bottom catalyst-oil slurry outlet at a bottom of flash zone; and

(c) a circulation loop for circulating the oil-catalyst slurry to the direct contact inline device and the vapor-liquid contacting elements.

[0008] There is provided, in one non-limiting example a method for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, where the method includes (a) cooling fluidized-bed propane dehydrogenation reactor effluent gas, (b) contacting the effluent gas with fuel oil in a wash section to

CLAIMS

1. A method for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the method comprising:

(a) cooling fluidized-bed propane dehydrogenation reactor effluent gas;

(b) contacting the cooled effluent gas with fuel oil in a wash section to wash out catalyst to obtain a cooled effluent gas essentially free of catalyst;

(c) withdrawing an oil-catalyst slurry from the wash section and circulating the oil-catalyst slurry through a filter thereby removing catalyst from the fuel oil giving filtered wash oil;

(d) returning filtered wash oil to the wash section as recirculated wash oil; and

(e) backwashing the filter thereby recovering catalyst.

2. The method of claim 1 where the contacting and returning steps are effected in a quench tower comprising vapor-liquid contact elements and a bottoms zone holding a fuel oil inventory.

3. The method of claim 1 further comprising cooling the recirculated wash oil before the contacting step.

4. The method of claim 1 where circulating the oil-catalyst slurry through a filter comprises continuously passing the oil-catalyst slurry through at least one first filter in a filtration mode to separate the catalyst therefrom giving filtrate while at least one second filter in parallel with the first filter is in a backwashing mode thereby removing the separated catalyst therefrom.

5. The method of claim 4 further comprising returning filtrate from the first filter to the fuel oil inventory.

6. The method of claim 4 where the backwashing of the at least one filter further comprises periodically alternating the at least one first and the at least one second filters between the filtration and backwashing modes.

7. The method of claim 4 where the backwashing includes at least once pulsing compressed gas through the second filter for catalyst removal.

8. The method of claim 2 where the fuel oil is a portion of the fuel oil from the fuel oil inventory.

9. The method of claim 1 where the filter is a multi-bed system comprising multiple beds each bed comprising a fixed filtration medium, where in the method the circulating the oil-catalyst slurry through the multi-bed system further comprises:

(a) circulating the oil-catalyst slurry through at least a first bed thereby loading the first bed with catalyst,

(b) switching circulating the oil-catalyst slurry through at least a second bed while regenerating the at least first bed and recovering the catalyst.

10. The method of claim 9 where the fixed filtration medium is a sintered metal filter.

11. The method of claim 9 where the filter is a continuous filtration system comprising a drum filter having an inside surface, where in the method of circulating the oil-catalyst slurry through the continuous filtration system comprises:

(a) continuously removing catalyst from the inside surface; and

(b) continuously removing concentrated oil-catalyst slurry and routing it to a reactor generator.

12. The method of claim 1 wherein the method contacting the effluent gas with fuel oil occurs in a direct contact inline device prior to entering a flash zone, followed by removing a net amount of fuel oil and a majority of the catalyst as a concentrated bottom oil-catalyst slurry.

13. The method of claim 1 further comprising introducing at least a portion of the slurry from the circulating step into a catalyst regenerator for combustion to regenerate and heat the catalyst.

14. A system for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the system comprising:

(a) a quench tower having an inlet for receiving the effluent gas from a dehydrogenation reactor, and a wash section comprising vapor-liquid contacting elements disposed above the inlet for cooling the effluent gas and contacting it with fuel oil for washing out the catalyst;

(b) a gas outlet above the contacting elements for discharging cooled effluent gas essentially free of catalyst, and a liquid holdup zone below the inlet for collecting the fuel oil from the contacting elements;

(c) at least one filter operable in filtration and backwashing modes the filter comprising a multi-bed system comprising multiple beds, each bed comprising a fixed filtration medium; and

(d) a filtration loop for circulating fuel oil from the liquid holdup zone through the filter and returning filtered fuel oil to the top of the wash section.

15. The system of claim 14 further comprising a direct contact inline device that receives and mixes the fluidized-bed propane dehydrogenation reactor effluent and the filtered fuel oil from the filtration loop prior to injecting them into a flash zone.

16. A method for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the method comprising:

(a) cooling fluidized-bed propane dehydrogenation reactor effluent gas to produce a cooled effluent gas;

(b) contacting the cooled effluent gas contacting the effluent gas with a recirculated wash oil in a direct contact inline device prior to entering a flash zone of a quench tower to yield a process gas by removing a net amount of recirculated wash oil and combining it with an oil-catalyst slurry and the catalyst as a concentrated bottom oil-catalyst slurry;

(c) contacting the process gas from flash zone with a fuel oil in a wash section of quench tower to wash out remaining catalyst to obtain a cooled effluent gas essentially free of catalyst;

(d) withdrawing an oil-catalyst slurry from the wash section and cooling the oil-catalyst slurry through an oil heat exchanger to yield the recirculated wash oil;

(d) returning a portion of the recirculated wash oil to the wash section of quench tower.

17. A system for recovering catalyst from a fluidized-bed propane dehydrogenation reactor effluent gas, the system comprising:

(a) a direct contact inline device for receiving the effluent gas from a dehydrogenation reactor and contacting the effluent gas with a recirculated wash oil;

(b) a quench tower comprising:

(i) a flash zone with an inlet for receiving the effluent gas and recirculated wash oil from the direct contact inline device;

(ii) vapor-liquid contacting elements disposed above the flash zone for cooling the effluent gas and washing out the catalyst;

(iii) an oil-catalyst slurry outlet from a bottom of the vapor-liquid contacting elements;

(iv) a gas outlet above the contacting elements for discharging cooled effluent gas essentially free of catalyst;

(v) a bottom catalyst-oil slurry outlet at a bottom of flash zone; and

(c) a circulation loop for circulating the oil-catalyst slurry to the direct contact inline device and the vapor-liquid contacting elements.