

CLAIMS:

1. A fixed bed processing system, comprising:
a reactor vessel having a reactor inlet and a reactor outlet;
at least one fixed bed of catalyst particles within the reactor vessel;
one or more temperature-sensor structures within the reactor vessel;
a detector in fluid communication with the reactor outlet,
wherein the one or more temperature-sensor structures comprise temperature-sensor particles, a temperature-coating, or any combination thereof,
wherein the one or more temperature-sensor structures are composed of a material that undergoes a structural change at a threshold temperature, and
wherein the one or more temperature-sensor structures have a first rate of introducing a detectable substance into the reactor at a temperature below the threshold temperature and a second rate of introducing the detectable substance at a temperature above the threshold temperature, the second introduction rate being at least 5 times the first introduction rate.
2. The system of claim 1, wherein the one or more temperature-sensor structures comprise temperature-sensor particles.
3. The system of claim 1, wherein the one or more temperature-sensor structures are distributed randomly within the catalyst bed.
4. The system of claim 2, wherein the temperature-sensor particles further comprise a catalyst.
5. The system of claim 1, wherein the one or more temperature-sensor structures are composed of a material, the detectable substance being directly or indirectly formed from the material.
6. The system of claim 1, wherein the reactor vessel further comprises an interior wall with a coating, the coating comprising at least one of the one or more temperature-sensor structures.
7. The system of claim 6, wherein the one or more temperature-sensor structures comprise temperature-sensor particles.
8. The system of claim 1, wherein the detector comprises a spectroscopic detector, a radiation detector, a chromatographic detector, or a combination thereof.
9. The system of claim 1, wherein the one or more temperature-sensor structures comprise at least a first temperature-sensor structure having a first threshold temperature and a second temperature-sensor structure having a second threshold temperature.
10. A method for processing a feed in a fixed bed reactor, comprising:

exposing a hydrocarbon-like feed to a catalyst in a fixed catalyst bed in a reactor under fixed bed processing conditions to form a reactor effluent, the fixed bed processing conditions comprising an average catalyst bed temperature for the fixed catalyst bed, the reactor further comprising one or more temperature-sensor structures, the one or more temperature-sensor structures having a threshold temperature and comprising temperature-sensor particles, or a temperature-sensor coating, or any combination thereof; and

detecting a detectable substance in the reactor effluent, the detectable substance being introduced into the reactor effluent by at least one of the one or more temperature-sensor structures,

wherein:

a) when the detectable substance is detectable prior to exposing a temperature-sensor structure to a threshold temperature, the amount of detectable substance detected in the reactor effluent is at least 1% greater than an average amount detected in the reactor effluent at the average catalyst bed temperature; or

b) when the detectable substance is not detectable prior to exposing a temperature-sensor structure to a threshold temperature, the amount of detectable substance in the reactor effluent is greater than the detection limit for the detectable substance.

11. The method of claim 10, wherein the amount of detectable substance detected in the reactor effluent is at least 10 times greater than the average amount detected at the average catalyst bed temperature.

12. The method of claim 10, wherein the one or more temperature-sensor structures have a first rate of introducing the detectable substance into the reactor at a temperature below the threshold temperature and a second rate of introducing the detectable substance at a temperature above the threshold temperature, the second introduction rate being at least 5 times the first introduction rate.

13. The method of claim 10, wherein the average bed temperature is at least 20°C lower than the threshold temperature.

14. The method of claim 10, wherein the hydrocarbon-like feed comprises a petroleum feed, a renewable feed, a refinery feed, a chemicals feed, or a combination thereof.

15. The method of claim 10, wherein the one or more temperature-sensor structures comprise temperature-sensor particles.

16. The method of claim 15, wherein the temperature-sensor particles are distributed randomly in the catalyst bed.

17. The method of claim 10, wherein the one or more temperature-sensor structures comprise at least a first temperature-sensor structure having a first threshold temperature and a second temperature-sensor structure having a second threshold temperature.

18. The method of claim 17, wherein the first temperature-sensor structure introduces a first detectable substance into the reactor, the second temperature-sensor structure introduces a second detectable substance into the reactor, and the first detectable substance is different from the second detectable substance.

19. The method of claim 10, wherein the reactor comprises a coating on an interior surface, the coating being at least one of the one or more temperature-sensor structures, the coating comprising one or more temperature-sensor particles, or a combination thereof.

20. The method of claim 10, wherein, when the detectable substance is not detectable prior to exposing a temperature-sensor structure to a threshold temperature, the amount of detectable substance detected in the reactor effluent is 1 ppb to 1000 ppm by weight.