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## **Question 74: Please discuss how yield data can be used to identify hardware issues. What hardware issues can you address to fix dry gas and benzene production?**

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There are several examples of how yield data can be used to identify hardware issues in the FCCU. For example, a decrease in cat to oil and/or catalyst circulation (which leads to a decrease in overall conversion and liquid yield) can be the result of a high regenerator dense bed temperature at constant process conditions. Several mechanical/hardware issues can contribute to higher regenerator temperatures. For example, higher regenerator bed temperatures can be the result of inefficient catalyst stripping and/or internal stripper damage. Entrained hydrocarbons are not sufficiently stripped and are burned in the regenerator causing an increase in bed temperature. Another mathematical check to this would be the H<sub>2</sub> on coke calculation. Higher regenerator bed temperatures can also be caused by poor feed atomization and feed nozzle damage. The gas oil is not properly atomized and is “stuck” to the catalyst, causing a higher regenerator bed temperature as it is burned. This also causes a decrease in liquid yield and increased dry gas make. Another example of where yield data can be used to identify hardware issues is in the reactor. A decrease in gasoline yield and an increase in dry gas make could indicate an issue with reactor cyclones. If there is a hole in the reactor cyclones or reactor cyclone performance has decreased, catalyst can be trapped in the disengaging section of the reactor and re-react with the vapors, causing an “overcracking” of gasoline which leads to an increased dry gas make and lower gasoline yield.

Though not truly yield data, increased regenerator emissions (NO<sub>x</sub>, SO<sub>x</sub>) can be indicative of regenerator air grid pluggage or damage. This leads to poor air and catalyst distribution in the regenerator and decreased catalyst additive performance.

Here is a brief list of hardware issues to address to minimize dry gas make:

#### 1.Catalyst stripper

a.Stripping steam nozzles plugged?

b.Stripper internal damaged or stripper upgrades needed because of higher catalyst flux rate limited?

#### 2.Feed nozzles

a.Feed nozzles plugged, or feed not properly atomized because of feed nozzle design and limitations?

#### 3.Reactor Cyclones

a.Holes in the cyclones or cyclones not designed for increased loading

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b. "Overcracking" in the dilute phase causing an increase in dry gas.

Benzene production in FCC gasoline is influenced by catalyst choice, contact time and reaction severity. To reduce benzene, one could shorten the contact time in the riser and reactor dilute phase. Changing the feed location in the riser would shorten riser contact time and minimizing reactor dilute phase cracking would also reduce the benzene in CAT gasoline.

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