Application note

NH_3 slip measurement in the fluidized-bed catalytic cracking process

LDS 6 Analyzer

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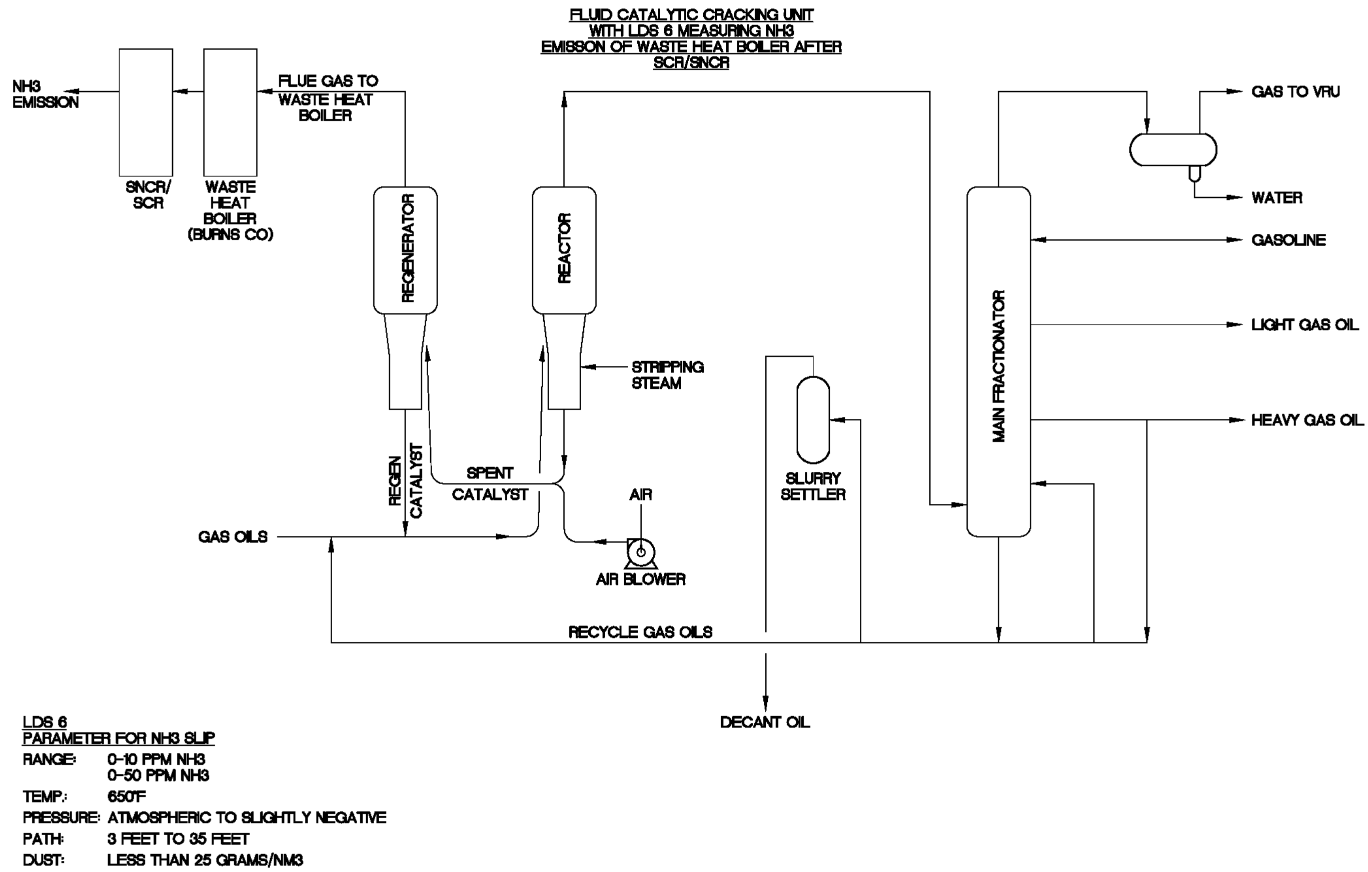
Fluidized-Bed Catalytic Cracking (FCC) is the most important and widely used refinery process for converting low value heavy oils into more valuable gasoline and lighter products. The typical FCC process will convert 75% or more of the heavy oils to gasoline and lighter products. Originally, chemical cracking was accomplished by heating the oil to super high temperatures but the catalytic process has almost completely replaced thermal cracking.

The cracking process produces carbon (coke) which remains on the catalyst particle and rapidly lowers its activity. To maintain the catalyst activity at a usable level, it is necessary to regenerate the catalyst by burning off the coke with air. As a result, the catalyst is continuously moved from reactor to regenerator and back to reactor.

The fresh feed and recycle gas oil streams are preheated by heat exchangers or a furnace and enter the unit at the base of the feed riser where they are mixed with the hot regenerated catalyst. The heat from the catalyst vaporizes the feed and brings it up to the desired temperature. The mixture of catalyst and hydrocarbon vapor travel up the riser into the reactor. Since the catalyst is a very fine particle, the mixture of catalyst and vapor behaves like a fluid.

The cracking reactions start when the feed contacts the hot catalyst in the riser and continues until the hot oil vapors are separated from the catalyst in the reactor. The catalyst leaving the reactor is called spent catalyst and contains hydrocarbons which are absorbed on the surface. These are removed by steam stripping before the catalyst leaves the reactor. The spent catalyst is separated from the hydrocarbons by a cyclone stripper with the hydrocarbons leaving the top of the reactor and the catalyst traveling down a pipe to the regenerator.

In the regenerator, coke is burned from the catalyst with air. The flue gas leaving the regenerator contains a large quantity of carbon monoxide which is burned to carbon dioxide in a CO furnace (or waste heat boiler) to recover the available heat. The combustion exhaust leaving the waste heat boiler has a large amount of NOx. The NOx must be reduced to very low levels, anywhere from 50 to 1 ppm depending upon the local environmental permit. To reduce the NOx, the combustion exhaust is directed through either a selective, non-catalytic reduction or selective catalytic reduction unit where NH_3 is injected into the process. The NH_3 reacts with NOx to ideally form $N_2 + H_2O$. However, the reaction is not always perfectly balanced and some NH_3 can slip through to the atmosphere. This NH_3 is called "NH_3 Slip." The Siemens tunable diode laser, LDS 6 is an insitu analyzer designed to measure NH_3 slip. The LDS 6 routinely measures NH_3 as low as 0-5 ppm NH_3.



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