An Oxygen Based Approach the Claus Process – Al Center

Hydrogen sulfide is a byproduct of natural gas processing and petroleum refining. The hydrogen sulfide is converted to liquid sulfur via the Claus Process. In the Claus Process, the hydrogen sulfide in burned in air to produce a mix of sulfur dioxide and hydrogen sulfide.

$$2H_2S + SO_2 \longrightarrow 3S + 2H_2O$$

The initial reaction occurs in a combustion chamber where some of the hydrogen sulfide is combusted in air to produce the correct molecular mixture. The reaction mass is cooled and liquid sulfur precipitates from the reaction mass and is removed. The remaining reaction mass is reheated and passed over a catalyst bed where approximately 60% of the remaining hydrogen sulfide is converted to sulfur. The reaction mass is cooled, liquid sulfur condenses and is removed. This catalytic step is repeated a second time until the reaction mass now contains about 3% of the sulfur fed to the process.

At this point the gas stream is so dilute in sulfur that the partial pressure of the sulfur precludes any further removal by condensation. At this point the reaction mass is fed to another process called the SCOT Process which removes the remaining 2+% sulfur. The SCOT Process is approximately equal in capital cost to the Claus Process.

Full details of the Claus Process including reactor kinetics may be found in Chapter 22 of the GPSA Handbook.

A possible alternative to the SCOT Process would be to feed the Claus Process with an oxygen rich stream which would exclude the diluent nitrogen from the gas stream and potentially allow recovery of sulfur to 99.5%.

Another alternative is to burn sulfur in oxygen and mix the resultant hot sulfur dioxide stream with hydrogen sulfide in a modified form of the Claus Process. The reduced amount of nitrogen diluent and less water produced by combustion both are favorable attributes of this approach.

The objective of the project to determine the viability of one of these concepts. The project should be started this September and should be completed no later than April 15 of the following year. This project is best done by a team of two people.

Deliverables include a design basis memorandum, an execution schedule, a complete mass and energy balance, a fully instrumented Process Flow Diagram, a layout plan for the equipment and a cost estimate developed by using the FACT cost estimating method.