There are no translations available.

Unit description

The unit is made of SS-316 and consists of a vertical reactor (riser) with 3/8" in diameter and of a fluid bed reactor with 3" in diameter. A simplified process flowchart is given in Figure 1. In the two reactors gas catalytic reactions or gas solid reactions can take place.

a. The Riser Type Reactor

A liquid feed is introduced in the reactor inlet which is then vaporized in the riser inlet. There is also the option for introduction of a gas feed independent or simultaneously with the liquid feed. The reactor is a two phase flow reactor where the one phase is the feed vapours and the other phase is a solid phase.

The feed is injected inside the reactor and comes in contact with a catalyst (or a solid reactant) which is introduced through the slide valve SV-101. In the riser the reactions take place while at the reactor exit the mixture is introduced to the stripper vessel. In the stripper the separation and stripping of gases from the solids (catalyst or unreactand solids) occurs. The solids through the slide valve SV-401 and the lift line returns to the reactor bottom. For the case where a solid reactant is used the pilot plant has the ability for continuous addition of the consumable solid.

The reaction products, from the stripper exit, flow through a heat exchanger, for the condensation of heavier products, and are led to a stabilizer for the better separation of liquid and gaseous products. The gaseous products come through a wet test meter for the measurement of volumetric flow rate and subsequently are analyzed by GC's. The liquid products are collected and weighted in a special collection vessel. The specifications of the riser reactor are reported below.

Specification of Riser Reactor	Residence Time	>0.5 sec
Reactor Temperature	max 590°C	
Stripper Temperature	max 590°C	

Liquid Feed Rate	max 25 gr/min
Catalyst Rate	2 Kg/hr - 30 Kg/hr
Reactor Pressure	1.6 - 3.3 atm

b. The fluid bed reactor

The fluid bed can be operated independently or in relation to the other system. Catalyst or a solid reactant can be added continuously with a pneumatic system inside the bed. The fluidization gas is introduced from the base of the reactor and its flow rate is controlled by mass flow controllers. The reactor exit passes through cyclones for the removing of entrained solids. The remaining products are cooled by a heat exchanger and subsequently are measured (WTM2) and analyzed. The specifications of the fluid bed reactor is represented in below.

Specification of Fluidized Bed Reactor Bed Temperature up to 690 °C

Catalyst or Solid Mass	up 4.5 Kg
Rate of Fluidization Gas	30 Nl/min
Bed Pressure	1.6 - 3.3 atm

General characteristics of the pilot plant

Observation of the fluidization state of catalyst movement inside the unit is accomplished by monitoring the pressure in selected parts of the unit. This is done using several differential pressure transmitters.The solids flow inside the unit is controlled through two slide valves. For the case of steam demand the pilot plant is equipped by two peristaltic pumps and a special furnace for steam production. For the introduction of liquid feed a gear dosing pump is used.

The pilot plant is fully automated using a software and hardware system which will be described later. for monitoring the system on the basis of various measurements the operator uses the main screen which presents a simplified process flowchart, as well as a number of more detailed views which are parts of the process, numerical charts and virtual control panels. The operator at any time can also execute other parts of the software which provide him with screen views of trending charts of variable process values and parameters.

Applications of the Pilot Plant

a. Catalytic cracking.

The pilot plant has already been used as an integral system for the study of the catalytic cracking process. According to this process heavy petroleum fractions can be converted to more valuable products like gasoline, diesel and LPG. As liquid feed vacuum gas oil (VGO), from Hellenic Aspropyrgos Refinery, was used. In the riser reactor the VGO is vaporized when it is mixed with hot catalyst coming from the slide valve SV-101. The liquid products (gasoline,diesel,unconverted gas oil) are collected in the stabilizer bottom while the gaseous products from the stabilizer exit are analyzed by GC. Catalytic cracking produces also coke which is deposited on the catalyst. So the catalyst at the riser exit is deactivated. In order to make it again active the catalyst is led through the lift line into the fluid bed reactor for there generation. In the regenerator the coke is burn off by air and the regenerated catalyst flows through the bottom of regenerator to the riser.

b. Bio-oil upgrading.

The pilot plant is going to be operated for the upgrading of various type of biooil produced by biomass pyrolysis. The objective of this investigation is the production of gasoline and diesel from the bio-oil.

Possible Applications of the Unit Automation and process control

The process control system of the unit is based on a special industrial computer control system. This system consists of two processing units mDCS-6000 by Analog Devices and a 386 PC by Compaq. These three micro computers are cooperating in a tight network that performs all the data acquisition and control operations. This system is completed and coordinated with the FIX/DMACS software by *Intellution*. The control system collects the values of the inputs and drives the output signals as well as maintains a digital record of signals. The process pressure control valves as well as the electrical power to electrical heaters, are controlled by digital PID controllers.

The control software is capable of executing concurrently process control algorithms for the supervisory control of existent digital controllers as well as new direct acting digital controllers of novel design. The development and execution of algorithms can be carried out either on the same computer that is handling the unit either through a local area network on a different computer (PC or VAX). This flexibility of the software that acts in a multitasking environment gives the capability of executing concurrently on-line process models that interact with the real system. This capability can be exploited in a various ways such as model tuning and verification of the fundamental process modelling, selection of better operating conditions and control during operation, for the compensation of variations on feed composition, application of novel digital control algorithms, feedback on operating conditions based on the analysis of process products or the execution of the on-line process model etc.