CONTINUOUS DISTILLATION COLUMN WITH PROCESS CONTROL

MODEL: SE 999
In an industry, distillation constitutes one of the most important and widely used unit operations. It is one of the oldest unit operation used in industry as well as studied by any chemical engineer. In spite of this, there are still many aspects of the process, which are still not fully understood. One of the important aspects that still need attention is the operation and control of the process.

In order to properly study the operation and control aspects of the process, the dynamic behavior during actual operation has to be understood. The dynamic behavior of a distillation process was known to be highly non-linear especially when involving high purity separation.

Most of the current application for distillation control is based on linear controller such as Proportional (P), Proportional-Integral-Derivative (PID) type controller. In any single distillation operation, several controllers were used in a distributed control system. The controllers were employed to maintain several important operational parameters such as level, temperature (or product composition) and pressure according to operational limits, and product and safety requirements.

This pilot scale Continuous Distillation Column (Model: SE 999) has been designed and constructed with the intention of exploring the behaviour and performance of various control strategy that can be employed on a distillation process. The pilot plant consists of the following major items:

a) One (1)-glass column (dia. 150 mm) with 15 sieve trays
b) One (1)-thermosyphon reboiler unit
c) One (1) total condenser unit
d) Three (3)-heat exchangers: one feed preheater, two product coolers
e) Five (5) hold up tanks: one reflux drum, one bottom hold up tank, one feed tank and two product tanks
f) Nine (9) centrifugal pumps and one (1) vacuum pump with necessary piping connections.

Various instrumentations consisting of measurement sensors and control valves are installed at the unit. These instrumentations includes:

a) Five (5) flow sensors
b) Twenty-one (21) temperature sensors
c) Five (5) level sensors
d) Three (3) pressure sensors
e) Six (6) control valves

All instrumentations are linked to a PC based Distributed Control System (DCS). Apart from the instrumentations above which are used for control purposes, there are other instrumentation installed for safety reason and they are:

a) Pressure relief valve for the distillation column unit
b) High pressure alarm for the distillation unit
c) Low and High Level alarm indicator for all hold up and feed tanks

The computer attached to the distillation unit serves as a data retriever/ logger for the unit and as a central controller which monitor and control the operation of all the distributed controller, set for any experimental run. The computer allows for the flexibility of changing the controller set up, thus enabling different control scheme to be tested and their performance explored.

All process input and output signals are interfaced to a distributed I/O subsystem linked to the computer. The distributed I/O subsystem receives 4 to 20 mA and mV input signals and outputs 4 to 20 mA control signals. All pumps controls and alarm monitoring are also connected.

**PROCESS DESCRIPTION**

The Pilot scale distillation column is designed and constructed with the intention of exploring the behaviour and performance of various control strategy that can be employed on a distillation process.
EXPERIMENTAL CAPABILITIES
Continuous Distillation Operations
  a) Determination of the distillation and concentration levels
  b) Determination of the number of stages in the distillation and concentration section

Process Control
  a) Cut Control to overhead
  b) Cut Control to bottoms
  c) Cut Control to overhead with feed compensation
  d) Cut Control to bottoms with feed compensation
  e) Temp Control to overhead cut
  f) Temp Control to bottoms cut
  g) Temperature Control to reflux rate
  h) Temperature Control to reboil rate
  i) DPT Control
  j) Basic Process Control for Distillation Column

SPECIFICATIONS
a) Buble Cap Distillation Column:
   Diameter : 150 mm
   Plates : 15
   Material : glass
b) Reboiler:
   Size : 0.3 m²
   Material : glass
c) Condenser:
   Size : 2.5 m²
   Material : glass
d) Relux Drum:
   Range : 15 Litres
   Material : Stainless steel
e) Feed Preheat Heat Exchanger:
   Size : 0.2 m²
   Material : glass
f) 2 Product Tank:
   Range : 75 Litres each
   Material : Stainless steel
g) Feed Tank:
   Range : 75 Litres
   Material : Stainless steel
h) Dosing Tank:
   Range : 50 Litres

OPTIONAL ITEMS
- SG
STEAM GENERATOR
36 kW electrical steam generator

- DAS
SOLDAS DATA ACQUISITION SYSTEM
i) A PC with latest Pentium Processor
ii) An electronic signal conditioning system
iii) Stand alone data acquisition modules
iv) Windows based software
   - Data Logging
   - Signal Analysis
   - Process Control
   - Real-Time Display
   - Tabulated Results
   - Graph of Experimental Results

- CAL
SOLCAL COMPUTER AIDED LEARNING SOFTWARE
i) Interactive multimedia features
ii) Graphical simulation
iii) Experiment results samples
iv) Full experiment manuals

REQUIREMENTS
Steam : 55 kg/hr at 10 barg
Electrical : 230VAC/50Hz/15Amps
              415VAC/50Hz/60Amps (for Boiler)
Water : 1.5 m3/hr @ 20 m

MANUAL
The unit is supplied with Operating and Experiment manuals in English.
SOFTWARE & E-LEARNING

Our range of teaching equipment can be complemented with our SOLDAS and SOLCAL software.

**SOLDAS** - Supervisory Control & Data Acquisition
- Data Logging
- Signal Analysis
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results

**SOLCAL** - Computer Aided Learning
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