HE Process Control Simulator (Model: SE 201) has been designed to demonstrate and provide students a hands on experience on control techniques. The equipment consists of industrial grade instrumentation to exhibit a realistic working environment of standard industrial control loop. The unit will simulate a process containing three first order lags, two of which are changeable to pure integrators, plus an approximated distance velocity or transport lag. The unit consists of three main elements: the controller, the non-linear unit, and the process trainer unit.

The controller consists of Proportional (P), Integral (I), and Derivative (D) action times with fast and slow speed. The non-linear unit can be used to demonstrate some mechanical effects, e.g. limiting, deadband and backlash. It can also be used to study typical ON/OFF 2-step and 3-step controllers. The non-linear unit, placed between the process input and controller output, has five switch settings:

a) Linear
b) Limit variable (5 to 100%)
c) Deadband variable (5 to 100%)
d) Backlash variable (5 to 100%)
e) Relay simulation (2-step and 3-step control with/without overlap)

The process training unit features a heating element controlled by a thyristor and air stream circulated by a centrifugal fan along an epoxy painted galvanised steel tube. A PT-100 type temperature sensor is provided to detect the temperature at one of three points along the tube’s length. This provides a feedback signal for comparison with a second value derived from another controller.

PROCESS DESCRIPTION

SE201 is a tutor or trainer for control systems; the SE201 can run three different control circuits.
- Temperature control
- Flow control
- Cascade control (Optional)

A) Temperature Control

The temperature process consists of a fan, heating element and a manual shutter. The temperature process is slow. By slow we mean that the system's dead time and time constant is large compared to the trainer's flow control.

The temperature is measured with the sensor. The sensor is a Pt-100 element, which changes its resistance with temperature. The controller is an electronic programmable PID controller. The temperature controller has programmable alarm setting for high alarm and low alarm. We only use the high alarm in the SE201. The heater is powered from triac control. The triac is 4-20mA controlled.

If the current from the controller increases results in more power to the heating elements. The temperature control system's ability to control is dependent on the flow through the heating elements. With increase flow the cooling ability also increases. When testing the temperature control system set the reference input on the flow controller to 30% - 35%. The heating element has an internal thermostat and a fire thermostat.

If the reference level for the temperature is exceeded, the power to the heating element is switched off. At the same time a lamp on the front panel lights. The system has tripped out. When the temperature falls, the interlocking circuit is automatically reset.

B) Flow Control

Flow control is a quick control system. The control consists of the following process elements, a speed controlled fan and air pipe. The air flow is measured using flow sensor and transducer. It is the differential pressure across the sensor that is measured.

The transducers output current is a function of this differential pressure. The graph shows the relation between the output current versus the differential pressure. The controller receives the output signal from transducer, the feedback signal, and compares this with the reference signal. The output from the flow controller, is transformed in the electronic circuits to triac phase control signal. Increasing controller output will give increasing revolutions or motor speed.

C) Cascade Control

In cascade control the temperature and the flow are coupled. The flow control circuit is secondary to the temperature control circuit. Flow controller is remotely controlled by a reference signal from temperature controller. Any disturbance to the air flow will quickly be compensated by flow controller, before any noticeable disturbance to the temperature. The local controllers in the front panel cannot be used in a cascade configuration. Cascade control must be run from a PC running a process control program. (Optional)

EXPERIMENTAL CAPABILITIES

The unit shall be able to allow students to carry out work on these areas:

- Distance, velocity, transfer lag
- Open loop 2-step control
- System calibration
- Open loop proportional control
- Close loop proportional control
- P+I control
- P+I+D control
- Adjustment of 3-term controller
- Effects of limit on P control
- Effects of deadband on P control
- Non-standard control modes

SPECIFICATIONS

a) Controllers:
- Type: programmable
- Input: 4 to 20 mA
- Output: 4 to 20 mA
b) **Heating Element:**
- Power: 500 W
- Voltage: 230 VAC
- Control: Thyristor

c) **Fan:**
- Type: 100 mm canal fan
- Power: 35 W
- Voltage: 230 VAC
- Control: Thyristor

d) **Temperature Sensor:**
- Type: PT-100
- Range: 0 to 100 °C

e) **Air Flowmeter:**
- Principle: Orifice plate
- Sensor: P/I-converter, 0 to 130 Pa

f) **Interlock:**
- Temperature: Low alarm via controller
- Hi-Lo alarm from thermostat

**OPTIONAL ITEMS**

- **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

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

**REQUIREMENTS**

- Electrical: 230VAC/1-ph/50Hz

**OVERALL DIMENSIONS**

- Height: 0.44 m
- Width: 0.80 m
- Depth: 0.35 m

**MANUALS**

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

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