9 PLANT INSTRUMENTATION AND CONTROL

The basic requirement of the sulphonation plant control system is to allow production of the desired quality acids and pastes in a safe manner within the design capacity limitations of the plant.

The level and sophistication of instruments and process control systems is largely determined by local preference although in order to satisfy the basic requirement, as stated above, there is a minimum requirement for instrumentation, control and safety interlocks which are common to all sulphonation plants.

* see also Process and Instrumentation Diagrams no. 1-8, at the end of this chapter.

9.1 Minimum instrumentation and control requirements

9.1.1 Air raising

Compressors

The outlet air temperature and pressure from the compressors gives a good indication of the state of downstream process plant, where additional pressure drop may be experienced due to the entrainment of dust in the drying bed, breakdown of the catalyst or malfunction of the control valves. The gas discharge pressure and preferably also the temperature should be recorded. In addition, for safety reasons and to protect the compressor, a high-pressure switch/alarm combination should be used to stop the compressor in the event of overpressure. The sulphur pumping system must be interlocked with compressor operation, to stop the pump when no process air is available.

Pressure control system

In order for the downstream control valves which control the flow-rate of SO$_2$/air to function in their optimum range and therefore enable the SO$_2$: organic mole ratio to be maintained as constant as possible, the air discharge pressure from the compressors must be controlled. Excess air from the compressors can be vented to atmosphere automatically through a valve controlled by the pressure measured at some point downstream of the venting point. An alternative system of controlling the compressor speed can be used where energy costs justify the additional capital expenditure.

Air coolers/chilling group

The temperature of the glycol solution used to cool the process air before entering the driers must be controlled. As an additional safeguard in the event that the temperature sensor or controller malfunctions, a low-temperature alarm, using a separate independent sensor, should be fitted on the glycol feed-line to warn if the temperature approaches 0°C. The consequence of too low a glycol feed temperature to the cooling air heat exchanger is the formation of ice on the finned pipes, leading to poor heat transfer, excessive pressure drop and possibly damage to the heat exchanger or its supports. A measurement of the total air flow-rate to the plant should be made on the process air directly after the chilling group. The mass-flow of air can be determined at this point by applying the appropriate temperature and pressure compensations to the volumetric flow-rate.
Air Driers

The control of the regeneration of drying beds can be a manual or automatic operation.

For automatic regeneration after fixed periods of operation, e.g. 8 hours, electromechanical (relays) or PLC based control may be used.

For plants without heat recovery to produce steam, hot air from sulphur combustion and SO₂/SO₃ cooling can be used for regeneration of the drying beds.

Dewpoint meter

A dewpoint meter for process air, with a recorded signal, should always be fitted as standard in sulphonation plants. Regular manual checks are essential (see 5.2.2.).

9.1.2 Sulphur handling

Proportioning

Molten sulphur must be delivered to the sulphur burner at a constant, desired rate to ensure that the subsequent downstream SO₂-in-air concentration and the SO₃ organic mole ratio are kept as constant as possible.

The commonest proportioning system for sulphur is to use calibrated variable-stroke metering pumps e.g. Bran & Luebbe. Normally the stroke length is adjusted manually by the operator and no system for closed-loop control of the sulphur flow-rate using metering pumps has ever been used in sulphonation plants. Closed-loop control of variable-speed gear pumps has however been used successfully, based on the measurement of the sulphur mass flowrate using flowmeters based on the Coriolis principle. The advantage of such a system is that the actual mass flow-rate is measured and controlled continuously.

Pressure measurement

Where pressure transducers or switches are used for molten sulphur, the sensor must be fitted with an extended diaphragm to prevent blockage resulting in false recordings.

Temperature control

The pressure of the steam used for heating sulphur must be rigorously controlled. High and low-pressure alarms should be installed in the feed lines, together with temperature indication.

9.1.3 Sulphur burning and SO₃ production

Ignition system

A sulphur ignition system is used in the Ballestra design of sulphur burner. The following safeguards must be incorporated: