Case Study 13

Refining Process Pilot Plant
for Murdoch University

OBJECTIVES

- To design and build a simulated alumina refining process plant
- Including batching tanks and process delivery systems.
- Ball mill simulation demonstrating realistic residence times.
- Ball mill sump and associated monitor and pumping systems.
- Two stage solids separation units.
- Random disturbance tank and header tanks
- Three reactors to simulate precipitator dynamics.
- High level S.C.A.D.A. system ensuring full computer monitoring and control over the system.

INTRODUCTION

Murdoch University, together with Alcoa World Alumina and Honeywell Limited joined forces to develop an Alumina Process Simulation Plant.

Utilising sophisticated software to simulate the alumina process, enabling in-depth teaching of instrumentation and control engineering students along with the safe training of plant operators.

Control and Thermal Engineering were chosen for the design and manufacture due to their extensive experience in process engineering and plant design.

Together with a location, a “process flow diagram” had been sketched and certain thru-puts had been designated, at which time C.T.E. became involved.

From this, Control and Thermal could then derive line and vessel sizing, agitator, valve and drive selection, construction materials.

Then designed a room layout to hide as much of the associated pipework as possible while creating a user friendly environment.

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Main Components

Batching Vessels - Conical tanks for the supply and return process streams. Fitted with agitators and associated level indicators. Also incorporating a variable speed fluid delivery system.

Ball Mill Simulator - No actual work is done in these units but solids must remain suspended in the fluid and residence times must be maintained. This then discharges to an agitated sump tank. A pump system then transferred process onto the next phase.

Solids Separation - A primary cyclone separator with the lower stream returning to the batching tanks and the upper stream onto a secondary lamella separator. The underflow then returns to the batching tanks, the upper stream onto the CSTRs.

CSTRs - The process then enters three continuously stirred tank reactors (CSTRs). They are steam jacket heated and have provision to add dye to simulate the addition of process additives. The vessels were also equipped with level, temperature and flow transmitters and controllers.

S.C.A.D.A. - The rig was fitted out with a high level Supervisory, Control And Data Acquisition system. As such, monitoring and control of the rig is driven by computer software. Assorted process scenarios may then be computer simulated via the myriad of variable pumps, control valves, bypass and overflow lines. Providing students with real-life consequences to possible process conditions

Design Criteria

Varied solids concentrations required cleaver design in order to combat a wide variety of process mediums.

Accurate control of almost every point in the system was achieved through a comprehensive S.C.A.D.A. system and as such can be monitored, controlled and logged continuously.

Large variations in process conditions were requested to give students a wide range of operating scenario. Specialized design solutions met these needs in full.

Random disturbances are applied to the system in order to stretch student thinking when computer controlling the process. This was achieved by the addition of a long conical bottomed vessel, giving a non-linear effect when acting on the system. This vessel also incorporated it's own underflow pump, control valve, level indicator and control, and flow controller.

Clever construction with consideration for safety, longevity and cost effective design solutions ensured the success of the system since it's unveiling in 1998

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