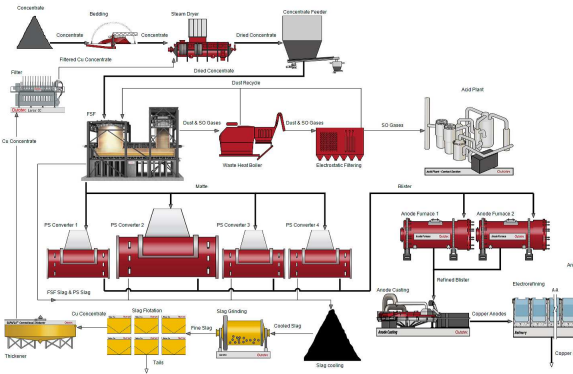


## COCOP Copper Pilot Case Scheduling

### Copper Production Process



**Scope:** From the flash smelting furnace to anode casting

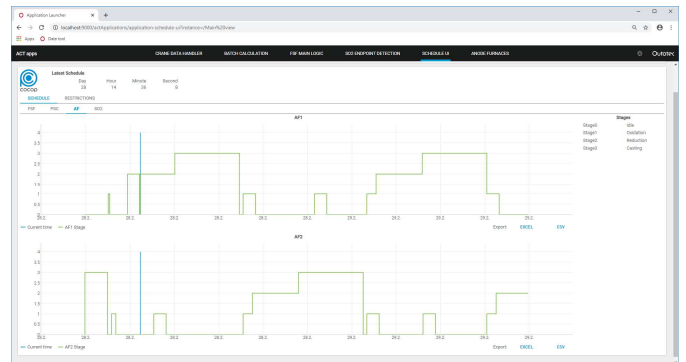
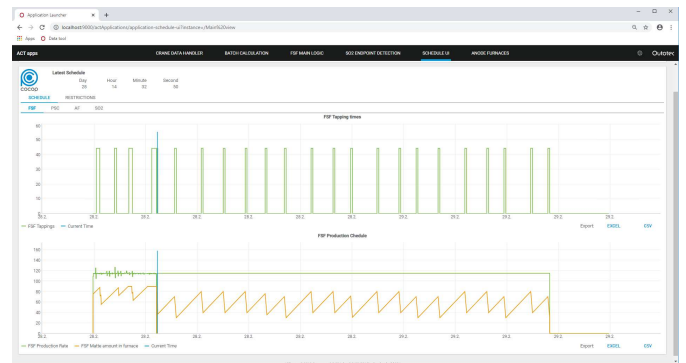
**Optimised operation** of the flash smelting furnace, Peirce-Smith converters and anode furnaces while considering the constraints imposed by the acid plant

**Overall objectives:**

- Increase the production rates in situations where abnormal operating conditions may restrict capacity
- Provide advice to operators on current and upcoming operating stages
- Increase production stability through improved planning capabilities

### Online Tests

- Tested in the real production environment with developers on-site for 2 weeks
- The current production state was incorporated by connecting the system to Outotec ACT software through the message bus
- Relevant scheduling situations occurred quite seldom. Improvements on the UI and usability are still needed



### Discrete Time Solution

- A single batch **discrete time** –MILP problem is formulated to provide an optimum schedule with **minimum copper losses**.
- The coordinator provides an optimum schedule considering the flash smelting furnace and Peirce-Smith converters only.
- The coordinator uses heuristics to solve the infeasibilities that exist among those units.
- The computational requirement is higher as compared to **continuous time approach**.

### Continuous Time Solution

- **Mixed batch-continuous** scheduling problem
- The continuous time - MILP calculation can quickly provide **optimised schedules** when process conditions change
- 24 hour horizon with approximately 1000 variables, half integers – 3500 constraints – Solved in 10 seconds
- The result can be further improved by a single batch optimisation