

Create an ISA-88c ontrol recipe of a batch production for aspirin known as acetylsalicylic acid. The physical structure consists of a reactor, a crystallizer, a centrifuge and a dryer. Educts are Acetic anhydride, Salicylic acid, and sulphuric acid as catalyst. Products are acetylsalicylic acid and acetic acid. Drying should happen at 90 °C.

ISA-88, also known as S88, is a standard for consistent terminologies and methodologies in batch control systems. It defines a hierarchical model for the organization of batch processes, including equipment, control recipes, and procedures. Below is an example of an ISA-88 compliant control recipe for the batch production of aspirin (acetylsalicylic acid).

1. Recipe Header

Control Recipe for Aspirin Production:

- Recipe ID: ASP-001

 - Recipe Name: Aspirin Production Revision: 1.0
 - Date: 2023-03-19
 - Author: ChatGPT
- 2. Formula
- Educts:
 - Acetic anhydride Salicylic acid
 - Sulfuric acid (catalyst)
 - Products:
 - Acetylsalicylic acid Acetic acid
 - 3.1 Charge Reactor

reactor.

- Transfer the specified amounts of salicylic acid and acetic anhydride into the

3. Recipe Procedure

- 3.2 Add Catalyst
- Slowly add the sulfuric acid as a catalyst to the reactor, ensuring proper mixing.
- 3.3 Reaction

the desired reaction time.

the reaction process.

- Continuously monitor and control the temperature and pressure throughout

- Heat and maintain the reactor at the specified temperature and pressure for

- 3.4 Transfer to Crystallizer - Transfer the reaction mixture to the crystallizer, allowing the acetylsalicylic acid
- 3.5 Separation - Transfer the crystallized product to the centrifuge, separating the

to crystallize.

- acetylsalicylic acid from the acetic acid and any residual educts. 3.6 Drying
- Heat and maintain the dryer at 90°C, ensuring the product is dried to the desired moisture content.
- 3.7 Packaging

- Transfer the separated acetylsalicylic acid to the dryer.

- Transfer the dried acetylsalicylic acid to the packaging area for final packaging and labeling. 4. Equipment Requirements
 - Reactor
 - Crystallizer Centrifuge
- Dryer
 - Reaction temperature: [specify temperature]

5. Process Parameters

- Reaction pressure: [specify pressure]
- Crystallization temperature: [specify temperature] Crystallization time: [specify time]
- Drying temperature: 90°C
- Please note that this is a simplified example of an ISA-88 compliant control recipe.

Drying time: [specify time]

Reaction time: [specify time]

Actual production parameters, such as temperature, pressure, and reaction times, should be determined based on specific process requirements and equipment

equipment cleaning procedures, or regulatory compliance. Write a self-contained 61131-3 structured text program for the sequential control of the reaction stage with typical parameter values.

capabilities. Additionally, this control recipe does not cover safety precautions,



PROGRAM ReactionStage



Text (ST) program for the sequential control of the reaction stage in the aspirin production process. The example assumes the use of a PLC for the control system.

The following example demonstrates a simplified IEC 61131-3 compliant Structured

Copy code



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```
VAR
    start_reaction: BOOL := FALSE;
    reaction_complete: BOOL := FALSE;
    reaction_time: TIME := T#30m; // 30 minutes, adjust as needed
    reaction_start_time: TIME;
    reaction_temperature: REAL := 90.0; // 90°C, adjust as needed
    reaction_pressure: REAL := 1.0; // 1 bar, adjust as needed
    current_time: TIME;
    current_temperature: REAL;
    current_pressure: REAL;
END_VAR
METHOD RunReaction()
    start_reaction := TRUE;
    reaction_start_time := CURRENT_TIME;
    WHILE NOT reaction_complete DO
        current_time := CURRENT_TIME;
        current_temperature := GetReactorTemperature();
        current_pressure := GetReactorPressure();
        IF (current_temperature < reaction_temperature) THEN</pre>
            HeatReactor();
        ELSIF (current_temperature > reaction_temperature) THEN
            CoolReactor();
        END_IF;
        IF (current_pressure < reaction_pressure) THEN</pre>
            IncreaseReactorPressure();
        ELSIF (current_pressure > reaction_pressure) THEN
            DecreaseReactorPressure();
        END_IF;
        IF (current_time - reaction_start_time) >= reaction_time THEN
            reaction_complete := TRUE;
        END_IF;
    END_WHILE;
    StopHeatingAndCooling();
    StopPressureControl();
    TransferToCrystallizer();
END_METHOD
// Placeholder methods for process control, replace with actual control fur
METHOD GetReactorTemperature(): REAL
    // Read temperature from sensor and return the value
    RETURN 0.0;
END_METHOD
METHOD GetReactorPressure(): REAL
    // Read pressure from sensor and return the value
    RETURN 0.0;
END_METHOD
METHOD HeatReactor()
    // Activate heating element or control valve for temperature increase
END_METHOD
METHOD CoolReactor()
    // Activate cooling system or control valve for temperature decrease
END_METHOD
METHOD IncreaseReactorPressure()
    // Activate pressure control valve to increase pressure
END_METHOD
METHOD DecreaseReactorPressure()
    // Activate pressure control valve to decrease pressure
END_METHOD
METHOD StopHeatingAndCooling()
    // Deactivate heating and cooling systems
END_METHOD
METHOD StopPressureControl()
    // Deactivate pressure control systems
END_METHOD
```

This example provides a basic framework for controlling the reaction stage in the aspirin production process using Structured Text. The actual implementation should be tailored to the specific hardware and control systems used. Additionally, safety precautions, error handling, and system interlocks should be included in the final program.

// Transfer the reaction mixture to the crystallizer

END_METHOD

METHOD TransferToCrystallizer()