ISA-88 Research

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Chapter 1: Introduction to ISA-88 Batch control

In this chapter the basics about what batch control is in general will be explained. In addition, this chapter will also give a basic summary of ISA-88.

1.1 Batch production

Many industries, from pharmaceuticals and food production to chemicals and paints, rely on **batch production**. This type of manufacturing involves processing a finite quantity of material through a defined sequence of steps. Unlike continuous production where materials flow constantly, batch processes involve distinct stages with clear beginnings and ends.

1.2 The challenge of consistency: Why do we need ISA-88?

Maintaining consistent quality and efficiency in batch production can be challenging. Imagine a complex recipe with multiple ingredients and processing steps. Even minor variations in these steps can lead to inconsistencies in the final product. This is where the ISA-88 standard comes in.

ISA-88 (also known as S88) is a globally recognized standard for batch control. It provides a structured framework for defining and automating batch processes. ISA-88 ensures consistency and repeatability in production by establishing clear guidelines for:

- **What** needs to be produced (the recipe)
- **How** the production should take place (the process)
- **With what** equipment the production happens (the physical plant)

1.3 Benefits of ISA-88

Implementing ISA-88 in your batch production system offers numerous benefits:

Improved Product Quality: Consistent execution of recipes minimizes errors and variations, leading to higher quality products.

Enhanced Efficiency: Optimized processes reduce production time and resource waste.

Simplified Documentation and Communication: Standardized terminology and procedures ensure clear communication between engineers, operators, and management.

Scalable Automation Solutions: The modular structure of ISA-88 facilitates the development and implementation of flexible automation systems that can adapt to new production requirements.

By adopting ISA-88, companies can achieve greater control over their batch processes, leading to improved product quality, increased efficiency, and reduced costs.

Chapter 2: The ISA-88 batch control model explained

Chapter 1 provided a general introduction to ISA-88 (S88) and its role in batch control. This chapter delves deeper into the core of the standard - the three-layer model.

2.1 The three-layer model

ISA-88 defines a three-layer model to separate the "what," "how," and "with what" of batch control. Each layer offers a distinct perspective on the process, facilitating clear communication and independent development.

- **Procedural Model (Recipe)**: This layer defines "what" needs to be produced. It specifies the desired product, its ingredients, and the overall processing steps involved. The recipe acts as the blueprint for the batch process, outlining the sequence of operations, setpoints (target values for process parameters), and expected outcomes.
- **Process Model (Execution)**: This layer focuses on "how" the production happens. It describes the control logic for each step in the recipe. This includes defining control loops, alarms, and safety interlocks. The process model translates the recipe instructions into actionable commands for the automation system.
- **Physical Model (Equipment)**: This layer represents the "with what" of the process. It describes the physical equipment involved in the batch operation, including tanks, mixers, pumps, and valves. The physical model provides a digital representation of the actual plant layout, allowing the control system to interact with the equipment.

2.2 Advantages of the three-layer-model

The separation of concerns offered by the three-layer model provides several advantages:

- **Flexibility:** Modifications can be made to one layer without affecting the others. For example, a recipe can be updated with new ingredient amounts without altering the control logic or the physical equipment.
- **Maintainability:** Each layer can be independently maintained and optimized. This simplifies troubleshooting and reduces the risk of errors.
- **Scalability:** The model can be easily adapted to accommodate new processes or plant expansions. By simply modifying the recipe and process models, the existing control system can handle new production requirements.
- **Standardization:** The ISA-88 framework promotes consistent terminology and procedures across different batch control systems, improving communication among engineers and operators.

2.3 Understanding the layers in action

Imagine a bakery using ISA-88 to produce a specific type of bread. The recipe layer would define the ingredients (flour, water, yeast, etc.) and the baking steps (mixing, proofing, baking, cooling). The process model would translate this into instructions for the control system, managing temperature control during proofing and baking. Finally, the physical model would map these instructions to the actual equipment in the bakery, such as mixers and ovens.

By separating these aspects, ISA-88 creates a modular and adaptable system for efficient and reliable batch production.

This chapter has explored the core concept of the ISA-88 batch model.

(Peter, 2018)

Chapter 3: The ISA-88 model with the Mini-FLUFFY

In the previous chapter, we learnt in detail about what the ISA-88 batch model is. Now, we will apply this knowledge to the project, the Mini-FLUFFY.

3.1 Procedural layer

In case of the Mini-FLUFFY, there isn't much of a recipe itself for a procedural layer. The only thing that is input for the system are the pallets. The recipe would consist of just the pallet and obviously the amount. For the processing steps, it would be lifting and lowering the pallet at certain stations.

3.2 Process layer

For the processing layer, we need to look into instructions the system would get. The instructions we need to give is the wait time whenever a station processes a pallet, as the rest is automatic. Going up and down is a digital signal and it is done whenever a sensor is triggered by the pallet. The only factor we control is how long it waits on the lift platform before going down and the time the pallet spends on the transfers inductive sensor.

3.3 Physical layer

In this layer, we need to map the things mentioned in the process layer to the equipment. In this case, we need to map the time to the hardware, such as the induction sensor area on the transfer and the linear actuator on the belt. How we can achieve this is with a variable for our function block that has the time it needs to wait, and then write to this variable from our HMI to control it. This way, we can adjust the time on the fly.

Sources

Peter. (2018, October 23). *ISA-88 (S88) batch control explained.* Retrieved from plcacedemy: https://www.plcacademy.com/isa-88-s88-batch-control-explained/