Selmo

Agitator tank analysis process

This document describes the implementation of a demo plant using the Selmo method and is divided into five main areas:

1. Structuring the system:
   The plant is called **a "plant"** and is divided into one or more hardware zones **according to its safety requirements.** The control sequences are mapped in separate sequences to ensure clear and structured process modeling.

2. Activity analysis:
   The basic position of the machine defines the initial situation for the automatic sequence, which is activated by a defined start signal. Moving components, such as cylinders or motors, are monitored by sensors in order to precisely control the process steps.

3. Technologya analysis:
   The essential technical components are explained, including **actuators, sensors, drives and operating elements** that are necessary for controlling the plant.

4. Functional analysis:
   The control of the movement sequences is described in detail. The interactions between the individual components and their monitoring by sensors and control logic are considered.

5. Process modeling in Selmo Studio:
   For implementation in Selmo Studio, it is recommended to use the preparatory tutorials in the **Selmo Knowledge Base.** In addition, tips are given on the structured modeling of the demo system in the Selmo Studio as well as on the optimal use of the Selmo functionalities.

For more information on the Selmo analysis process, visit our Knowledge Base.

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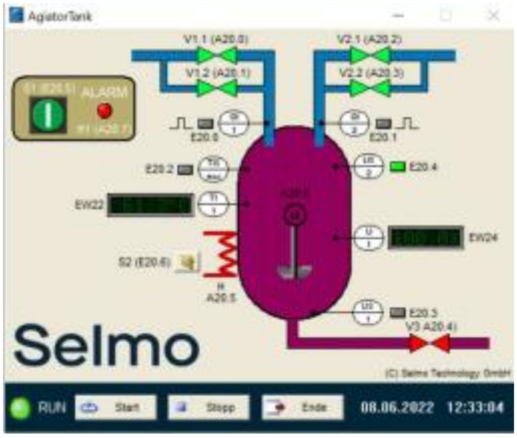
1. Structuring the system



The **structuring of the plant** is carried out according to Selmo's principles, whereby the stations and processes are divided into logical units (hardware zones and sequences).

The structure of the system is divided as follows:

> **Plant:** The entire agitator tank is called a "plant", which includes the complete plant.
>
> **Hardware zone:** The agitator tank is modeled as a hardware zone only, as the entire plant only covers one protection area. Therefore, there is no need to implement multiple independent automatic flows.
>
> **Sequence:** The flow of the agitator tank is modeled in a separate sequence.

2. Activity analysis

An essential part of the process analysis is the definition of the **home position**, which ensures that all modules are correctly positioned and ready for operation. The basic position of the plant is defined as follows:

> The agitator tank is empty, which is signaled by the activated limit switch LIS1. The inlet valves and the drain valve are closed. The heating and agitator are switched off.

The clear definition of the basic position is essential, as it forms the basis for the safe start of the system. Only when the basic position has been clearly defined can the actual **automatic process** be described and implemented.

The automatic sequence of the system is started by pressing the S1 button. After starting the drain, the coarse valve left inlet V1.1 is opened, and the liquid is quickly filled up to the specified level. Then the valve is closed and the fine valve left inlet V1.2 is opened to slowly achieve the exact dosage. At this level, this valve is also closed. We continue with the coarse and fine valve for the right inlet V2.1 and V2.2. Then the liquids are mixed with the agitator and heated via the heating coil. Heating can also be turned on manually via the S2 switch. When the temperature is reached, the container is emptied via the V3 drain valve.

The fill levels are specified together with the target temperature and the mixing times in the parameter list. The current level and temperature are also displayed there.

Due to the lack of feedback in the valves, the flow / changing fill level must be used to detect whether and how far the valves are open. This poses a possible risk, as conditions cannot be monitored directly or there may be delayed detection of errors in the system.

3. Technology analysis

Start-Button:

The start button is used to start the process. It is configured as a normally open contact, i.e. in idle mode, the voltage to the controller is interrupted and logic "0" is generated at the corresponding input. When the button is pressed, logic "1" is generated by switching the voltage forward.

Manual-Button:

With the "Turn on the heating" hand button, the heating can be switched on manually if necessary. It is configured as a normally open contact, i.e. in idle mode, the voltage to the controller is interrupted and logic "0" is generated at the corresponding input. When the button is pressed, logic "1" is generated by switching the voltage forward.

Pulse flow generator:

The flow feeder generates pulses whose frequency is proportional to the respective filling speed. One pulse corresponds to 1% of the container volume. This allows the filled quantity or the fill level of the container to be calculated.

Analog Encoder Level

The analogue level transmitter is a measuring device that measures the fill level of the container and sends an analogue value of 0-10 mA to the PLC. This corresponds to a fill level of 0-100% and is used to control the filling valve.

Analogue encoder temperature:

The Analog Transducer Temperature is a measuring device that measures the temperature of the container and sends an analog value of 0-10 mA to the PLC. This corresponds to a temperature of 0-100°C and is used to control the heating element.

Heating element:

The heating element is used to heat liquids or solid materials and is switched on and off directly via the individual Hxx outputs. The control is by simple on/off switching, without power control or temperature monitoring. The desired temperature control must be carried out externally via sensors or cyclic control.

Valve without monitoring:

The valve is a technical component used in conveyor systems and silos to regulate or interrupt material flows. It consists of a closable opening that releases the bulk material or stops it completely. There is no feedback on whether the valve is open or closed.

Engine:

The components are each driven by electric motors, which are optimally adapted to their speed and power via gearboxes. Drum drives are often used in which the motor is integrated directly into the drive drum to save space. These are switched on and off via the individual outputs Mxx. The motors have no speed control or operating status monitoring.

Level Indicator

Sensors are used both to detect the maximum fill level and to determine when the container is empty. These are actuated by the liquid and transmit the signal to the PLC.

Warning light:

The warning lamp is a signal lamp that is controlled by the PLC via an output.

4. Functional analysis

This is followed by the functional analysis, in which the operation of the individual components and stations as well as their control requirements are examined in detail. The aim is to define the necessary functions in order to implement the previously developed process efficiently and precisely.

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The agitator model consists of a tank with a motor-driven agitator M, in which two liquids are mixed in a predetermined ratio and then heated to a set temperature.

Filling:

The two liquids are supplied via two supply lines, each with a coarse valve (V1.1 or V2.1) and a fine valve (V1.2 or V2.2) for exact dosing. The two flow rate transmitters QI1 and QI2 generate pulses whose frequency is proportional to the respective filling speed. One pulse corresponds to just 1% of the container volume. Two limit sensors (LIS1/LIS2) and an analogue encoder (LI1) are available for measuring the fill level.

Mixing and heating

The liquid in the tank can be heated via a heater H, and a limit sensor (TISmax) and an analogue value sensor (TI) are available to measure the temperature. The heating can be switched on both programmatically and manually via the S2 button. If the temperature limit value is exceeded, the H1 alarm light is monitored. The mixing process is started by pressing the start button S1.

Empty

The outflow of the mixture is controlled by valve V3. When the temperature has reached the set point, the valve is opened until the lower limit sensor LIS1 responds and reports that the tank is empty.

Ein-/Ausgangsbelegung
Die Ein- und Ausgänge des Modells sind wie folgt belegt (die Bezeichnung Ein- bzw. Ausgang bezieht sich dabei jeweils auf die angeschlossene Steuerung):

Eingang Nr.	Boris	PLC-Variablenname		Beschreibung
1	S1	I_S1	:BOOL;	Start Taster (Schließer)
2	S2	I_ S2	:BOOL;	Handtaster Heizung einschalten (Schließer)
3	QI1	I_ QI1	:BOOL;	Impulse Durchflussmengengeber linker Zulauf
4	QI2	I_ QI2	:BOOL;	Impulse Durchflussmengengeber rechter Zulauf
5	TI1	I_ TI1	:INT;	Analogwertgeber Temperatur in Grad (100° = 27648)
6	TISmax	I_ TISmax	:BOOL;	Grenzwertgeber Temperatur
7	LI1	I_ LI1	:INT;	Analogwertgeber Füllstand in % (100% = 27648)
8	LIS1	I_ LIS1	:BOOL;	Unterer Grenzwertgeber Füllstand
9	LIS2	I_ LIS2	:BOOL;	Oberer Grenzwertgeber Füllstand

Ausgang Nr.	Boris	PLC-Variablenname		Beschreibung
1	V1.1	O_V11	:BOOL;	Grobventil linker Zulauf
2	V1.2	O_V12	:BOOL;	Feinventil linker Zulauf
3	V2.1	O_V21	:BOOL;	Grobventil rechter Zulauf
4	V2.2	O_V22	:BOOL;	Feinventil rechter Zulauf
5	V3	O_V3	:BOOL;	Ventil Ablauf
6	H	O_H	:BOOL;	Heizung einschalten
7	H1	O_H1	:BOOL;	Alarmleuchte
8	M	O_M	:BOOL;	Motor Rührwerk

5.Process Modeling in Selmo Studio

Relevant tutorials for the model are presented in the next chapter. To get an in-depth insight into the Selmo Studio, you can take the course "Sequence Logic Modelling - The New Way of PLC Programming - Start Now!". These tutorials will support you in practical application and deepen your understanding of working with the Selmo Studio.

To be able to carry out the course, all you have to do is click on the following link and book the course for free.

Link: Sequence Logic Modelling - The new way of PLC programming - Start now!

For a better overview and detailed analysis, the process model should be viewed directly in Selmo Studio, where the logic layer and the system layer are fully visible and comprehensible.

Before you move on to the practical implementation, you should also look at the instructions in the help center. This documentation will provide you with important basics and helpful tips for working in the Selmo Studio.

After reviewing the documentation, you can test the downloaded process model in real time. You can start the simulation of the plant and check the interaction between the process model and the digital twin. Use the created document as an aid to implement what you have learned independently in Selmo Studio.

Good luck with the practical application!