Beverage Filling Line

Description

A high-speed rotary filling machine for beverages (water, juice, soda). Includes rinsing, filling, and capping stations with integrated quality control systems.

Tags

Create tags for the following parameters. Choose a fitting name and hierarchical structure for the tags.

- Machine Name: The name of the machine - "FluidFill Express #2"
- Machine Serial Number: A unique identifier of the production machine - "FFE2000-2023-002"
- Plant: The plant where the machine is located - "Dortmund Beverage Center"
- Production Segment: The production segment where the machine is located - "Non-Alcoholic Beverages"
- Production Line: The production line where the machine is located - "Juice Filling Line 3"
- Production Order: The name / number of the current production order. Is empty if there is no active order - "PO-2024-JUICE-5567"
- Article: The name / number of the article that is being produced. Is empty if there is no active order - "ART-JUICE-APPLE-1L"
- Quantity: The # of bottles that need to be produced to fulfill the order - "25,000 bottles"
- Target Fill Volume: The target fill volume based on the current article - "1000.0 ml"
- Actual Fill Volume: The actual fill volume of the last measured bottle - "999.2 ml"
- Target Line Speed: The target production speed based on the current article - "450 BPM"
- Actual Line Speed: The actual production speed (bottles per minute) - "448 BPM"
- Target Product Temperature: The target product temperature for optimal filling - "6.5 °C"
- Actual Product Temperature: The actual product temperature - "6.3 °C"
- Target CO2 Pressure: The target CO2 pressure for carbonated beverages - "3.8 bar"
- Actual CO2 Pressure: The actual CO2 pressure in the system - "3.75 bar"
- Target Cap Torque: The target cap application torque - "22.0 Nm"
- Actual Cap Torque: The actual cap application torque of the last bottle - "21.8 Nm"
- Target Cycle Time: The target cycle time per bottle - "2.67 seconds"
- Actual Cycle Time: The actual cycle time of the completed bottle - "2.68 seconds"
- Fill Accuracy Deviation: The deviation from target fill volume - "-0.8 ml"
- Product Level Tank: The product level in the main supply tank - "67.3%"
- Cleaning Cycle Status: The status of the cleaning cycle - "Normal Production" (Normal Production/CIP Active/SIP Active/Sanitizing)
- Quality Check Weight: The result of the weight quality check - "Pass" (Pass/Fail/Not Tested)
- Quality Check Level: The result of the fill level quality check - "Pass" (Pass/Fail/Not Tested)
- Machine Status: The current operational status of the machine. The options are: (Stopped/Starting/Running/Stopping/Error/Maintenance/Cleaning) - "Running"
- Current Station: The current active filling station - "Station 12" (Station 1-16)
- Good Bottles: The total number of good bottles produced since machine startup - "1,247,589 bottles"
- Bad Bottles Volume: The number of bottles rejected due to volume deviation since startup - "2,847 bottles"

- Bad Bottles Weight: The number of bottles rejected due to weight deviation since startup - "1,923 bottles"
- Bad Bottles Cap: The number of bottles rejected due to cap issues since startup - "1,156 bottles"
- Bad Bottles Other: The number of bottles rejected due to other defects since startup - "734 bottles"
- Total Bad Bottles: The total number of rejected bottles since startup - "6,660 bottles"
- Total Bottles: The total number of bottles processed since startup - "1,254,249 bottles"
- Good Bottles Order: The number of good bottles produced for the current production order - "12,847 bottles"
- Bad Bottles Order: The number of rejected bottles for the current production order - "153 bottles"
- Total Bottles Order: The total number of bottles processed for the current production order - "13,000 bottles"
- Production Order Progress: The completion percentage of the current production order - "52.0%"
- Current Lot Number: The current production lot number - "LOT-2024-APPLE-0456"
- Expiration Date: The calculated expiration date for the current production - "2026-09-23"

Alarms

If any single parameter deviates by more than 3% from the target value for 3 cycles in a row, an alarm should be triggered that contains (i) the parameter in question (ii) the values of the last three cycles that were out of order. The machine status is also changed to "Error".

If any single parameter deviates by more than 8% from the target value for a single cycle, an alarm should be triggered that contains (i) the parameter in question (ii) the values of the last three cycles that were out of order. The machine status is also changed to "Error".

Special beverage industry alarms:

- Fill volume deviation alarm: If fill volume deviates more than ±1% from target
- Product temperature alarm: If product temperature exceeds ±2°C from target
- CO2 pressure alarm: If CO2 pressure deviates more than ±0.2 bar from target
- Product level low alarm: If tank level drops below 15%
- Cap torque alarm: If cap torque is outside ±10% of target range
- Quality control alarm: If more than 0.5% of bottles fail quality checks

Methods

Implement methods for the following features:

- Start the machine: Machine state changes from stopped to starting. Once the machine is done starting up, the status changes to running
- Stop the machine: Machine state changes from running, error or maintenance to stopping. Once the machine is done stopping, the status changes to stopped
- Load production order: Allows to enter all the required information for a production order. That includes the order number, the article, the target quantity as well as all the target values. This method also resets the counters for good / bad / total bottles for the order
- Enter maintenance mode: Machine status changes from its current state to Maintenance

- Start CIP cycle: Initiates Clean-in-Place cycle with automated cleaning sequence
- Start SIP cycle: Initiates Sterilize-in-Place cycle for sterile products
- Reset counters: Allows to reset the counters for total good bottles, total bad bottles and total bottles
- Change product: Initiates product changeover sequence with line purging
- Adjust fill volume: Fine-tuning of fill volume within validated ranges
- Generate lot number: Creates new lot number for traceability
- Emergency stop: Immediate shutdown of all filling operations for safety