ASEPTIC EVALUATION

A CASE STUDY

www.csmius.com

ABSTRACT / INTRODUCTION

In the world of food and beverage manufacturing, there are many processes. This report is specific to an Aseptic Processing Line. Aseptic is a processing technique wherein commercially thermally sterilized liquid products are packaged into previously sterilized containers under sterile conditions to produce shelf-stable products that do not need refrigeration.

This report is an evaluation focused on the inefficiency of the liquid syrup filling and packaging of 1-liter bottles for the manufacture.

OBJECTIVE

The objective is to reach improve the overall equipment effectiveness (OEE) typically 80-85%.

In this scenario the client's hot-fill line produces 1-liter bottles of liquid syrup flavorings.

The current line has been running with an OEE at 60% - 70%.

OBSERVATION

CSMI conducted an observation, assessment and data collection for the hot fill line. Observations were focused on packaging and during the 4-day visit CSMI evaluated the efficiencies of 1-liter liquid syrup products.

The client stated the line was typically been running with an OEE of 60% - 70%.

1. **Operations** showed a fair number of damaged bottles at various handling points. Some is the process, and some may be attributed to the equipment.

2. **Maintenance** was the primary issue identified that reduced the line speed.

3. **Accumulation** was a factor on both performance and efficiency. Most of these were related to the speed of the line and throughput in conjunction with the next equipment process and the line speed.

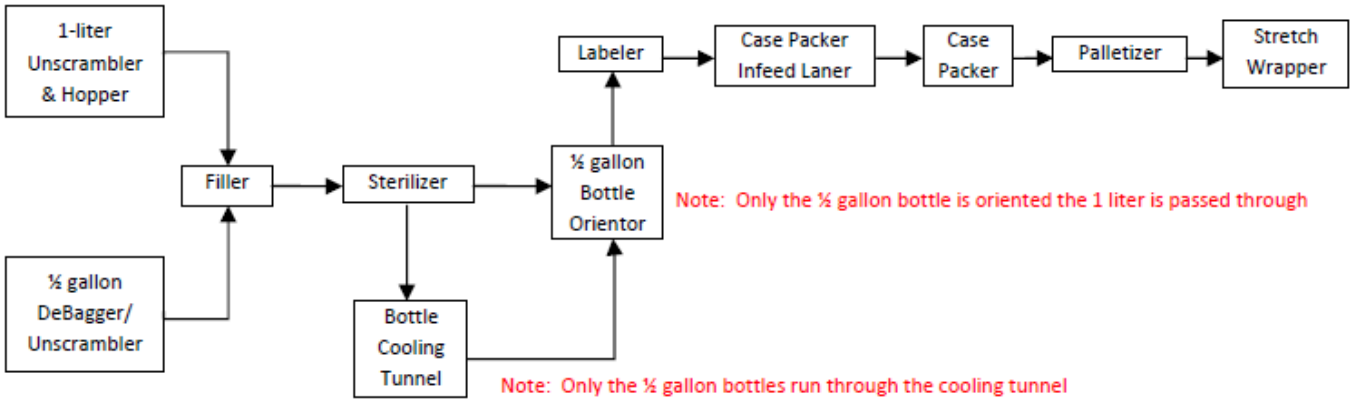
ISSUES

The evaluation revealed that the rate and yield were consistently running around 95-100+%, yet the utilization rate was pushed down to 50%

The largest sources impacting this reduction were the unscheduled downtime events. The downtime events were mechanical issues with the filler and downstream with the packaging systems. The variable viscosity of the liquids requires modified settings of the equipment speed.

The mechanical issues were unscheduled and frequent.

THE LINE



EQUIPMENT LIST

1. 1-Liter Bottle Unscrambler
2. 1-Liter Bottle Unscrambler Hopper
3. ½ Gal. De-bagger/unscrambler
4. Filler
5. Bottle Cooling Tunnel
6. ½ Gal. Bottle Orientor
7. Labeler
8. Case Packer Infeed Laner
9. Case Packer
10. Palletizer
11. Stretch Wrapper

LINE CAPACITY

1. **Batch System**
   a. Although the batch process was not observed for the ½ gallon products, both the filler and batch system operators said the time required for creating a batch from start to release can cause the **Filler** to starve for product if the line is running well.
   b. This indicates that the batching cycle efficiency needs to be reduced or additional capacity may be required.

2. **Bottle Unscrambler**
   a. The **Bottle Unscrambler** is able to keep up with the **Filler** at 160 BPM with the 1-liter bottle.

3. **Filler**
   a. Per the **Filler** manufacturer's specification the **Filler** is rated at 160 BPM for the 1-Liter bottle and 100 BPM for the ½ gallon. But with some products, the speed of the **Filler** must be lowered to prevent underfilling of the bottles due to the viscosity of the product.
   b. It was observed that the Starbucks Classic product 1-liter runs at 160 BPM, However, the filler seed for the Starbucks Vanilla 1-liter had to be reduced to 150 BPM due to the viscosity of the product.
   c. This is a gravity type **Filler** from the bowl through the filling valve and the fill rate is affected by the viscosity of the product. (This should be in conjunction with the statement in a.)
      i. A full product line should be evaluated to determine the matrix of product viscosities for the high and low-speed filler rates.
   d. Due to the reduced speed of the **Case Packer** (due to maintenance) the **Filler** frequently starts and stops due to bottles backing up.

LINE CAPACITY CONT'D.

4. **Bottle Orientor**
   a. The **Bottle Orientor** is not used with the 1-liter bottle to orient the bottles; this is done at the infeed screw of the Labeler. The **Bottle Orientor** is designed to pull a gap between the ½ gallon bottles to allow room to turn and orient the bottle correctly for the labeler. The gap created, as the 1-liter bottle passes through the **Bottle Orientor,** causes low backpressure creating bottle jams and falling bottles.
      i. To prevent the 1-liter bottles from jamming and falling at the **Labeler** infeed screw, the gap between bottles needs to be at a minimum to maintain backpressure at the **Labeler** infeed screw.
   b. The plant personnel indicated the ½ gallon bottle does not work efficiently on the **Bottle Orientor** and this impacts the line's performance. The equipment manufacturer has worked on this equipment numerous times and has been unsuccessful in correcting the problems.
      i. The equipment manufacturer is recommending installing an upgrade to this unit. They will provide this at no cost (except shipping charges) and they believe it will improve the performance of the ½ gallon bottle size.
      ii. The plant is working on scheduling of these upgrades.

5. **Labeler**
   a. **Labeler** was set to run at 24% due to the reduced speed of the **Case Packer**.
   b. At 24% the **Labeler** averaged 155 BPM.
   c. Normal operating speed of the **Labeler** is run at 28%, during testing when the labeler was at 30% the average throughput was186 BPM.
   d. The orientation of the 1-liter bottle is made at the infeed of the **Labeler** with the use of a UHMW strip mounted to the conveyor at the infeed screw to align the base of the bottle correctly. This method is very effective but requires constant bottle backpressure to push the bottles into the **Labeler** infeed screw. If the backpressure is to low the bottles can either fall or jam at the infeed to the **Labeler.**

LINE OPERATIONS

1. There are a high number of crushed bottles feeding into the **Filler**.
    a. The majority of the damage to the bottles occurs due to the handling of the bagged bottles.
    b. Some contributing damage to the bottles may be from the operator over filling the **Unscramble Hopper.**
    c. Additionally, some damage can be occurring from in the **Unscramble** itself.

2. The new Amcor 1-Liter bottles are stacked on a pallet in layers with corrugated slip sheets between each layer. The previous bottle supplier furnished the bottles in layered bags.
    a. The manual transfer of the Amcor bottles to the **Unscrambler Hopper** is currently inefficient.
        i. It causes additional damage to the bottles
        ii. It requires additional resources
        iii. It starves the **Filler**
        iv. It contributes to an increase in scrap loss due to spillage from lower layers

LINE MAINTENANCE

1. The **Case Packer,** to keep up with the filler speed of 160 BPM, should operate at 40 CPM for (4) bottles/case, 27 CPM for (6) bottles/case, and 14 CPM for (12) bottles/case.

2. **Case Packer** was running at 20 CPM due to timing issues as a result of wear to the flight bar chains.
   a. The plant has replacement chains but has not been able to schedule a 3-day window (as recommended by the manufacturer) for the installation of the new chains due to production requirements.
   b. During capacity testing the **Case Packer** speed had been raised to 30 CPM and the **Labeler** speed was raised as well to 30%.
   c. At the higher speed the wear to the flight chain caused bottles to fall at the transfer into the flight chain section of the **Case Packer**.
   d. Due to the high number of fallen bottles at 30% the **Case Packer** speed was lowered slightly to 28 CPM to reduce the number of falling bottles(the **Labeler** speed remained at 30%

3. The new Amcor bottle was getting crushed in the **Filler** due to the top load pressure of several filling valve springs. (The springs have been replaced with a lighter spring to alleviate this issue).

LINE ACCUMULATION

1. Filled Bottle Accumulation –
   a. The **Cooling Tunnel** is not used for the 1-liter bottles as are the ½ gallon bottles.
   b. There is very little bottle accumulation area on the conveyors between the **Filler** and the **Labeler** when the **Cooling Tunnel** is not used.
   c. In the event the **Case Packer** or **Labeler** goes down for any reason the **Filler** stops soon after due to bottles backing up on the conveyors resulting in lost production.

2. Line Control
   a. The conveyor control logic in the area after the **Laner** is causing bottle gaps going into the **Case Packer** infeed that the **Laner** is not able to catch up with at times, this causes the case packer to shut down shortly after starting up.
      i. When the **Case Packer** stops the bottle will back up to the **Laner** but the bottles from the **Laner** will not start up again until the bottle level in all lanes drop past a set of sensors on the conveyors after the **Laner**. Since this is right at the discharge of the **Laner** the bottle population in each lane is not always equal and this is the main contributing factor to the large gaps in the bottles.

RECOMMENDATIONS

Increase line efficiency: The following list is not ranked in any particular order of importance. It is undetermined what the historical impact each of these has independently on the line, however, by collectively addressing all the following recommendations the line efficiency should increase to 80 – 85%.

a. **Batch System** – Modify batch system to reduce process cycle time for ½ gallon products. The reduction of batch cycle time is to improve batching capacity and eliminate starvation of the **Filler** for product.
b. **Line (Preventative Maintenance)** - Schedule at least one (1) additional preventative maintenance window between the bottle changeovers. This additional maintenance window will allow the line mechanics and operators to perform routine and scheduled maintenance tasks that cannot be completed during a bottle changeover.
c. **Bottle Unscrambler** - Work with the **Bottle Unscrambler** manufacturer to increase the bottle rendering rate to minimize lost production due to starvation of the **Filler** for bottles at higher speeds.
d. **Filler Valves** - Work with the **Filler** manufacturer or third parties to develop valve design to increase the flow rate of the higher viscosity products. This will eliminate the need to reduce the **Filler** speed below 160 BPM.
e. **Cooling Tunnel -** Send 1-liter bottles thru the **Cooling Tunnel** as a pass through. This will increase the amount of bottle accumulation between the filler and **Labeler** allowing the **Filler** to run longer in the event that the **Case Packer** or **Labeler** goes down.
f. **Bottle Orientor** –
    i. Modify conveyor controls to minimize the bottle gap for 1-liter bottles to maintain backpressure on the **Labeler** infeed screw. Constant backpressure is required to reduce the bottle jams and falling bottles at the infeed.
    ii. Install equipment manufacturer upgrade (per their offer) to improve the efficiency for ½ gallon bottles.
g. **Case Packer** – Install new flight chains to eliminate falling bottles in transfer.

RECOMMENDATIONS CONT'D.

h. **Line Control** - Modify operation of the bottle conveyors, **Bottle Orientor**, **Labeler**, and **Case Packer** to have the ability to ramp up and down based on bottle population on the conveyors. This would allow the **Case Packer** and **Labeler** to maintain a constant flow of bottles as well as the ability to draw down the bottle population on the **Labeler** infeed side conveyors as needed.
    i. Modify **Laner** operation to monitor bottle population in each lane at discharge to equalize the number of bottles in each lane. This will prevent the **Case Packer** from shutting down due to lack of bottles shortly after starting up each time.

Increasing line capacity: Before evaluating the potential capacity increases to the line, the line efficiency must be addressed. The first step would be to get the line running at the rated **Filler** speeds with all products. When the line is running at its highest level (during this evaluation) the following areas will need to be addressed for increased capacity:

a. **Batch System** – Modify batch system to handle additional capacity and reduce cycle time requirements.
b. **Bottle Unscrambler** – Upgrade/replace the current 1-liter **Bottle Unscrambler**. This unit is near the maximum limit when running the **Filler** at 160 BPM.
c. **Filler Valves** - Replace/modify existing **Filler** valves to increase product flow rates.
d. **Bottle Orientor** – Replace or install second parallel unit to accommodate additional capacity. The existing unit is unable to efficiently handle the current capacity.
e. **Palletizer Infeed** (Increase Accumulation) - Install additional accumulation conveyors on **Palletizer** infeed to handle higher case volumes.

FINDINGS

The recommendations tendered herein have the potential to increase the efficiency from 60%-70% to 80% to 85%.