Vertical Packaging Accumulator

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Abstract

The beverage manufacturing process is based on filling a product with a defined structure or flexible structure. If that product is pasteurized, there are different considerations that must be met, such as the filling temperature and cooling time. This cycle of filling and cooling must be fulfilled without affecting the manufacturing operation. It is common in the industry to have accumulators that help to meet the cycle, as well as to absorb time lost by micro stops in the production line. Unfortunately for products with flexible structures (such as flexible packaging), there are no practical systems that can be used in any environment. This project is to design a mechanical device to ensure that this cycle of filling and cooling will be completed without any negative effects on the manufacturing line. In addition, not only allows to meet the cycle, but to avoid quality issues on the flexible packaging material.

Introduction

This project is about the design of a device who accumulate flexible packaging product. Actually in the foods and beverage industry, is common the use of product accumulators to avoid the cost of downtime, quality issues and to improve process control variables. This project is intend to improve the way is stored flexible packaging product with mechanical devices that considers volume of accumulation instead of areas of accumulations. To go further, is suggested additional mechanisms to have a complete system of product accumulation.

Background

The Vertical Packaging Accumulator, is a mechanical accumulator that improves work space in a manner that we can use the space efficiently. The typical accumulator, is designed thinking in a “area occupied space”, while the concept is thinking on “volume used space”. That is the idea, be more efficient using volumes than areas. Where the other accumulators store one pouch, the VPA can store 28 pouches(depending on the height of the conventional accumulator conveyor).

Problem

In the process of manufacturing beverages in aluminum Pouches, a series of parameters must be met to ensure Quality and Efficiency in the operation. Currently every time the packaging area is stopped, a jam of Pouches is created in the packaging area conveyor. A requirement of the manufacturing line is that the line cannot be stopped at the same time the packaging area stops. This is because once the drink is deposited inside the Pouch, it must be some time eliminating the bacteria inside the Pouch, and then it must be cooled to preserve the color and flavor of the drink. This is caused because there is no accumulation system to store the Pouches while solving why the packaging area was stopped. Another situation is that, when stopping the packaging area, the Pouches are placed in baskets, this creates a defect in the product, which is caused by the collisions between Pouches, drilling each other. Also due to the jam, operators run to stop the conveyor to avoid further problems, as well as to reprocess the entire jammed product. This adds more tasks to the packaging operators, making the jobs in the area more tedious.

Methodology

The project is divided into three phases:
Divider of the product:
First it must control the way and where will be take the pouches. Currently the packaging area allows space to do it. The conveyor is 24 inches wide, while each pouch has only 4 inches with a pouch to pouch gap distance of 2 inches. The Figure 1 shows the conveyor and the way the pouches go through.

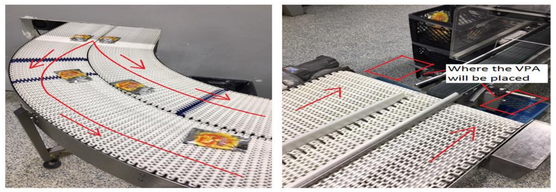

Figure 1: Redirecting the Product

Since the cycles are every 1.2 seconds, it means there is enough time to change the trajectory of the Pouch. This is the work that it will do the divider at the entrance of the conveyor, taking advantage of the side distance from Pouch to Pouch.

Storage in the accumulator
The area does not allow to have a robust or very volumetric accumulator. Therefore, it can no longer think about the horizontal, but about the vertical. This is why the height of the conveyor is used. The height of the conveyor is 28 inches. This height allows to store 84 pouches per accumulator(using 21 of the 28 inches that has the conveyor height). Each column has two pouches for every 1.5 inches of height.

Figure 2: Stacking pattern on the columns

The system will have two accumulators, one for each side of the conveyor. This allow to store 168 pouches, the equivalent of 100.8 seconds. Storage time may seems small, but it should be noted that most of the stops in packaging are resolved in less than 60 seconds.

The Pouch recovery
Since the Pouches are stored, they need to be recover while the line is in Production to absorb the stoppage time. That station will be called the “The Pouch recovery”. This station will be responsible for recovering the Pouches. This will be a robotic system that deposit the Pouches one by one on the packaging conveyor's entrance. By this way of work, the combination of the VPA with the robot system, make the project viable for the food and beverages industry. All the VPA system needs to communicate, so in the Figure 3 is the “how will work” flow chart, explaining the interaction between all the components of the system.

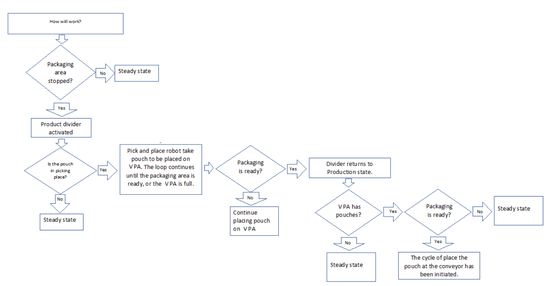

Figure 3: Flow chart of how the system will works

Results and Discussion

Divider of the product: The gap distance between pouches were helpful to design the position of the guides. The guides will be in the same orientation as the way of the pouches when the line is in Production flow configuration. When the line turns to Accumulation mode, it opens the guides and diverts the pouches in to the fixed place in the accumulator station. The Figure 4 shows the two configurations of the divider.

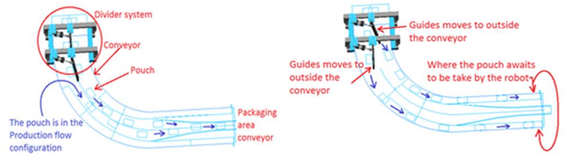

Figure 4: Two configurations of the divider

Vertical Packaging Accumulator: The VPA can store 28 pouches per column (84 per accumulator). This quantity will be transform on cycles. So, the VPA will have 14 cycles until is full. That means, when the three column are filled with 2 pouches each, the accumulator will cycle. When the VPA has completed the cycle, the elevator goes down 1.5 inches. The Figure 5 shows the VPA design.

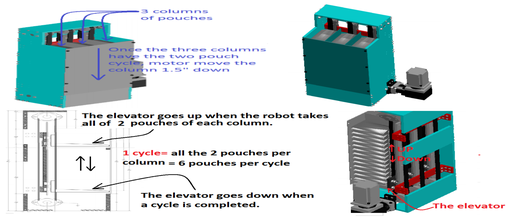

Figure 5: Final design of VPA

The accumulator receive the signals from the robot plc. The robot is communicating to the accumulator, he sends the signal to step down to continue placing product, or to step up, to emptied the accumulator.

Pouch Recovery Station: This is the area where the pouch returns to the packaging conveyor. Once the manufacturing line is ready to start, and the VPA has pouches, this station takes the pouches and put them in to the conveyor again. The system used is a group of two robots. [1]The robot is the Scara type T3-401. It is a low cost robot that complies with our application in all aspects. He has two jobs, stacking the pouch, and recover them. Once the pouch is in the picking area, the robot take the pouch and place it in to the VPA. When the VPA is full, the robots remains steady waiting for the signal to starts taking out pouches from the VPA. The Figure 6 shows the configuration of the recovery station.

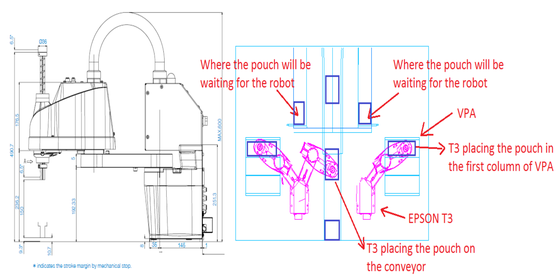

Figure 6: Recovery station layout

Conclusions

In the time spent looking for product accumulators for flexible packaging, were found buffers at most. That way of work let space to think in another way to be more efficient using less space than the buffers found. This accumulator has better use of space than any other in the industry. Where the others accumulator store one pouch, the VPA can store 28 pouches (depending on the height of the conventional accumulator conveyor). This happens because the VPA use volume to accumulate, the others accumulators use areas, so the space occupied by other accumulators would not be used for other purposes. Also, the project not only contemplate the development of the VPA, but the efficient way to divide the way of the product before get store on the VPA. This project also takes into consideration the downtime absorbed by the VPA, and the quality issues created by the lack of this accumulator. Every time the VPA is working, it stores 100.8 seconds until is full. This means the system is functional for micro stops and to comply with the filling and cooling cycle spoken before in the abstract. Also the perforations created in the package by the other packages when the operator toss them to a Basket when the line is stopped, is resolve with the VPA.

Future Work

The VPA were designed to add more columns of product, increasing its capacity. Actually each accumulator has 3 columns. The robots can be modified to use vision system to be more accurate taking the pouch without stops the pouch until the robot take it.

Acknowledgements

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References

[1] Epson Scara Robots, (2017). Robots Specifications Catalog, [online]. Available: https://epson.com/Support/Robots/SCARA-Robots/SCARA-T-Series/Epson-T3-SCARA-Robots/s/SPT_RT3-401SS#manuals