Rebuild an Old Line

Time is tight. Equipment is dated. Floor space is at a premium. Engineers at a premier beverage brand have a long list of tasks to complete on their bottling and packaging line under tough restrictions. They need to increase OEE (Overall Equipment Effectiveness) significantly, increase throughput by 30%, and do it during a limited shut-down period. But here's the really tricky part: a newly purchased, mono block filler is squeezing floor space tighter than a Manhattan studio apartment and has to be integrated with some equipment that was bought in Reagan's first term.

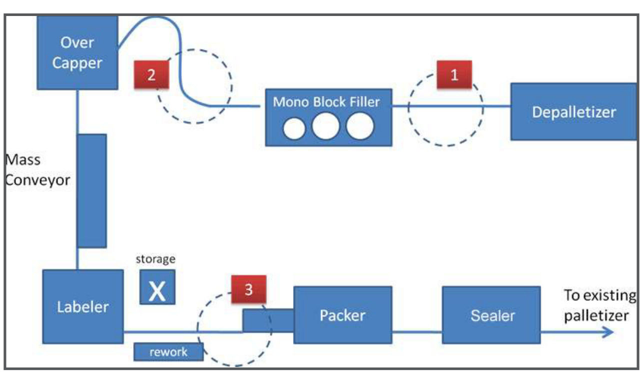
Can this jigsaw puzzle of an old line be rebuilt to get the job done?

Introduction

How do you:

- increase a beverage line's speed (BPM) from 180 to the 240 range
- raise the line's OEE about 18%
- prevent service technicians from being on site for too long
- integrate a large, high-capacity, Mono-Block Filler with quartercentury-old equipment
- accomplish it all in a space that should be 100%-200% larger

Here's a hint. You know you will have to add accumulation somewhere.



Fifteen Design Options; One Right Choice

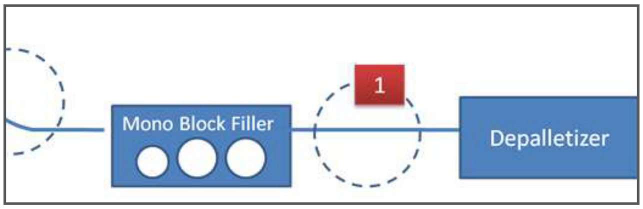
Plant engineers and their Haskell colleagues had their backs against the wall – literally.

The engineers had "run the stew" out of their existing line to build inventory to get through their busy holiday season. Now, with a very limited shutdown schedule, the team needed to reconfigure a new line to increase capacity 30% and ramp up OEE.

The company has already invested in a multi-million dollar mono block filler that could support an increase in capacity to help with the throughput demand. The good news is this hot piece of equipment could really produce. The bad part is it had to integrate with other equipment on the line that was first purchased when roller skates were in vogue. Moreover, the filler was a space hog and operators in certain sections around the existing labeler were already working shoulder-to-shoulder.

Some wild design options – including going up in the air with as much equipment as possible – were being tossed around. In fact, more than a dozen different line design options were being considered. The team knew, in order to meet their OEE targets, they had to add accumulation; the question was "where?" By the way, the accumulation system was not in the project budget. So, the team had to make sure they got the most for their money.

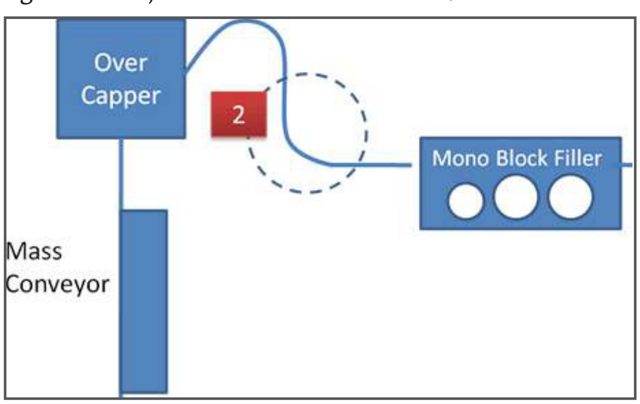
The team decided to create an Emulation – a model that interacts with the PLC program that is going to control the line. The PLC "reads" the input from this dynamic model and directs the outputs to cause actions in the model, according to the logic. This interaction allows the engineers – in fact, the entire team – to verify the logic and confirm that the line will operate as they intend it to. They also connect the HMI to the PLC to verify all the operator controls, alarms and enunciators. Prior to line startup, the entire team participated in a control system Factory Acceptance Test (FAT) in the Haskell office. The logic was completely verified, along with the interface for the operators and the code for including the additional accumulation.

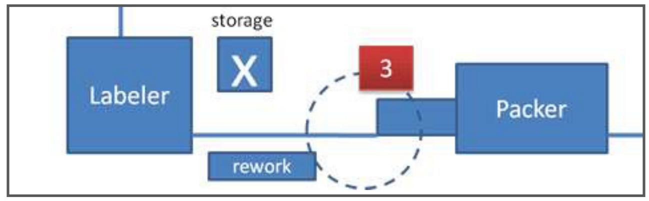


The team knew they needed to protect the filler – but from what? Add accumulation pre- or post-filler was the first question to be answered.

The speed of the depalletizer was enough to make up for any hiccups it may cause to the line. The team found that adding prefiller accumulation wouldn't offer any advantages to optimizing the line.

Post-filler accumulation would provide the most benefit. Floor space is tight and available options are limited. If the team determines that adding accumulation between the filler and the overcapper is necessary, they only have one option – one that is not preferred. But the emulation indicated this to be the right answer. Adding accumulation at this point in the line allowed the monoblock filler to empty out if a stoppage occurred downstream (a quality requirement). It also buffered the filler from overcapper downtime events as well as the longer labeler outages. The team also found this option to produce additional OEE points; making the change worth the hassle of working the accumulation into the layout. They tried every conceivable layout alternative to open up their options, but none were found. This was the right answer, so the team made it work.





Adding accumulation after the labeler was also beneficial statistically. On the flip-side, the need for full operator access around the machine, necessary storage for materials and a rework area all added to the congestion. The team believed that, while accumulation would help buffer the outages between the packer and the labeler, the congestion would increase the time that the labeler was down just because it would be even more difficult to work in that area.

Conclusion

A 500 bottle accumulator was placed between the filler and the overcapper. This proved to provide the team with a system that could achieve the OEE targets as well as meet their quality requirements. In addition, it helped to simplify the line automation programming. No more complicated algorithms that had to account for each and every circumstance.

After the location for the accumulation was determined, the team decided to model each of the three options – just to make sure. A simple flowchart simulation was created for four line configuration. The only change between the configurations was the location of 500 bottles worth of accumulation. The results were pretty dramatic. The availability for the line was increased by 3.3 points – over 2½ points better than the other options by choosing this location.

Starting Up

				No accum.	Pre-filler	Post-filler	Post-labeler
			Actual Production:	162,126	163,176	167,772	163,020
			Theoretical Production:	172,800	172,800	172,800	172,800
			Availability:	93.8%	94.4%	97.1%	94.3%
Options Selected		Machine Availability	Failures Per Shift	Bottles of Accumulation	Bottles of Accumulation	Bottles of Accumulation	Bottles of Accumulation
(#)	(Name)	(%)	(#)	(# bottles)	(# bottles)	(# bottles)	(# bottles)
1	Depal	96.00%	4.8				
2	Empty Bottle Conv	99.60%		500	1,000	500	500
3	Rinser/Filler/Capper	98.00%	7.2				
4	Full Bottle Conv/Acc	99.60%		250	250	750	250
5	Overcapper	93.00%	33.6				
6	Full Bottle Conv/Acc	99.60%		400	400	400	400
7	Labeler	92.00%	38.4				
8	Full Bottle Conv/Acc	99.60%		200	200	200	700
9	Case Packer	99.00%	1.4	6	6	6	6
			Sim. Time:	2 min.	2 min.	2 min.	2 min.

Using the emulation model to validate the controls and train their personnel before starting up the line was an essential part of ramping up the line. That short shutdown schedule turned out to be a non-factor. Stress levels were eased, and the plant was happy as they sailed past their OEE targets within 4 weeks of starting the line – **6 weeks ahead of their plan!** Not only that, new production records were being set – so much so that the line had to be stopped, waiting for new materials to arrive. The team outran all their goals – making it all worth it in the end.

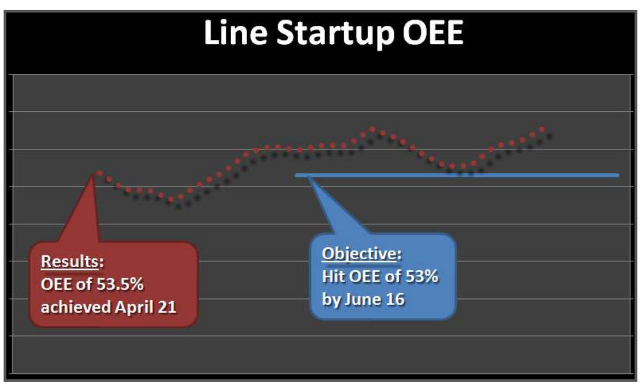


Figure 6- *The team achieved above target results and sustained them for many weeks prior to the target date.*