

Seeking perfect line control

Thank you for signing up to the OptimumFX e-coaching newsletter. This article was originally printed in the Binstead Group publication, International Bottler and Packer and is being repeated as an introduction to our thoughts on line control.

The free e-coaching sessions will start in March Week 1 of 2007 and will come in 6 parts.

Introduction:

How would you like to increase the performance of your production lines by up to 7% with little investment?

This article discusses how production lines are frequently controlled and how we believe this control can be improved to provide as much as a 7% OEE improvement on your line.

The objective of every line control philosophy is to maximise the line OEE through minimising the effect of minor stops and optimising the speed of each machine.

If you have any comments or would like to discuss line control philosophy please call a member of our team right away as we are always delighted to help.

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What do we mean by line control?

On continuous flow production lines, typical found in FMCG environments, there are broadly 2 types of production line configuration; block and accumulation.

Block production lines operate with most machines running at the same speed. Typically block lines run with very little conveyor space between the machines (often single track). Therefore a stop on any of the blocked machines quickly or instantly causes a direct loss of OEE / performance for the line.

Machines are typically controlled through linking the PLC controls to change speeds/stop automatically for the entire line.

Accumulation production lines operate with individual machines linked with large amounts of conveyor space and generally take up a lot of factory space. Typically the machines in an accumulation line have the capability of running at variable speeds, and will normally have one machine (or one block of machines) which runs the slowest; we call this the bottleneck or 'critical' machine. The OEE / Performance of this line is determined by the amount of time that we're able to keep the critical machine running at its rated speed.

Assuming good line balance and control the accumulation minimises the impact of minor stops on all machines other than the critical machine

Machines are typically controlled by conveyor-based sensors with little direct interaction between the machines.

Line control or line philosophy is the way in which machines are stopped/started in response to changing conditions on the line. E.g. Stopping in buildback when a machine downstream stops, stopping in lack when a machine upstream stops.

This article specifically refers to accumulation production lines.

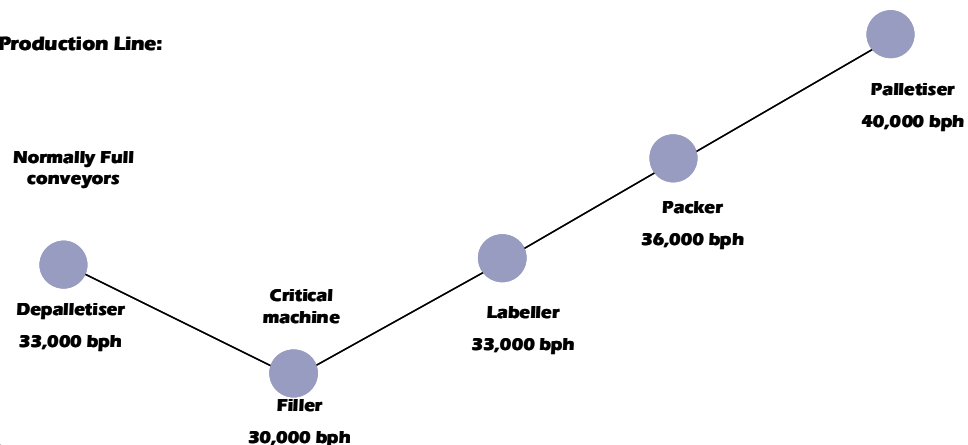
How are accumulation lines typically configured to run?

Accumulation lines are typically configured using 'V-Curve' theory.

This is a very simple theory in which you:

1. Identify the slowest machine on the line; this is the critical machine. Set the standard running speed.
2. Set the machines immediately before and after the critical machine to run (typically) 10% faster than the critical machine.
3. Set every other machine 10% faster than the one previous.
4. Machines use sensors on the infeed and outfeed to identify lack or buildback events

Example Production Line:



Advantages:

1. Setting up the line balance can quick and easy.
2. The production line uses dynamic accumulation triggers to manage flow

Disadvantages:

1. The only machine that will run at a consistent speed is your bottleneck machine, every other machine will be constantly stopping in either lack or buildback
2. When machines are constantly starting and stopping, or even changing speed, often you greatly increase inertia changes. Changes of inertia often cause; an increase in minor stop frequency, reduced machine 'operating window', increased wear on mechanical parts, increased breakdown rate and therefore maintenance costs and potentially an increase in the number of quality issues.
3. Your conveyor space may not be fully utilized

The above is a guideline to how lines can be set up with V-Curve theory. It is worth recognizing that every line is unique and that modifications to this theory may be necessary for optimum performance.

We believe that by changing your line control we can add up to 7% OEE to your production line.

In practice this old way of controlling a production line gets you quite close to achieving the objective of line control. However it is a long way from 'Perfect flow', and with technology taking huge steps, communication between PLCs is much easier, and therefore it is possible to control lines at a whole new level of precision.

What is perfect flow?

To understand the concept of perfect flow through a bottle neck it is worth considering a principle that can be imagined.

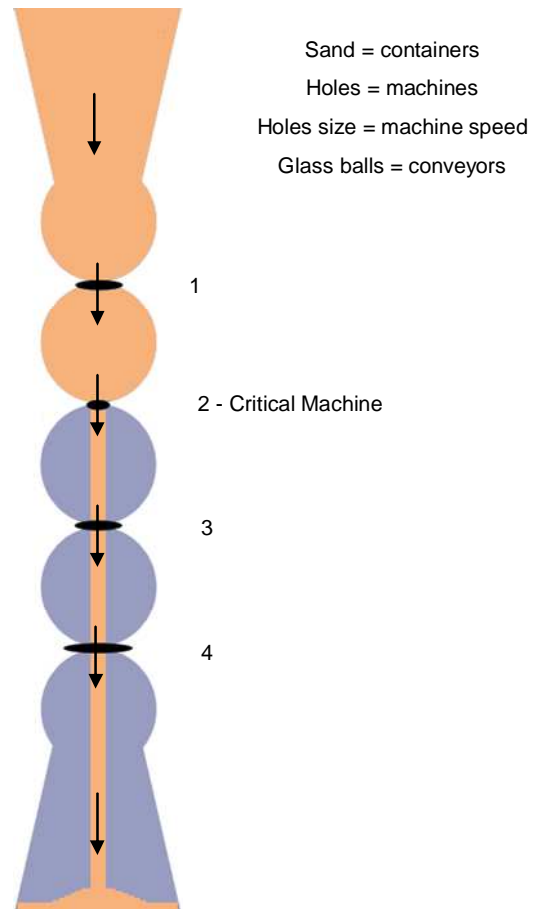
The example utilised here provides a reference that can be easily imagined and is very close to achieving perfect flow.

Imagine stacking hour glasses on top of each other, with the hole in the 2nd one down being smallest (Critical Machine) and the holes (machines) increasing in size (speed) as you move away from this one.

There would also be an infinite amount of sand at the top and an infinite amount of space the bottom (a bit like Fork Lift Trucks supplying and removing containers).

Each hole represents a machine – the hole size represents how fast that machine runs. The glass balls between each pair of holes represent the conveyors. The sand represents the containers, whether they be cans, bottles, cartons, or packs. The throughput of the this line is determined by the critical machine (size of hole number 2)

If hole three is blocked (machine stopped) the glass ball above will fill, and so long as it is unblocked (machine started) prior to the ball above it filling, the overall throughput of sand (containers) will not be affected.

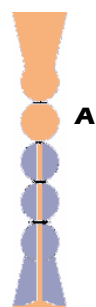


How should your production line be controlled?

Some key principles of this perfect flow that we are trying to replicate with line control:

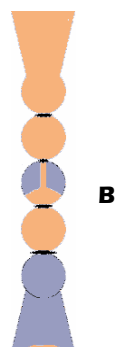
A - In normal steady state conditions:

- The glass balls (conveyors) before the critical machine are full before and after empty.
- The flow through each hole (machine) is exactly the same
- The flow through the whole system is determined by the smallest hole (critical machine)
- The single stream of sand (containers) through the holes (machines) after the smallest hole (critical machine) leaves lots of space in the event of a stoppage lower down
- Stops of flow can occur on holes (machines) other than the smallest hole (critical machine) without affecting the overall throughput.



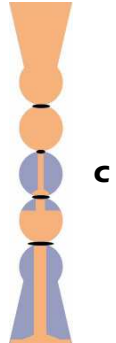
B - In a stoppage condition:

- The glass balls (conveyors) fill all the way up
- The flow through the smallest hole (critical machine) keeps consistent (design speed) until there is no more space below



C - In a recovery condition (after a stoppage clears):

- The restart of flow through all holes (machines) is almost instantaneous
- For holes (machines) below the smallest hole (critical machine) flow through is maximised until the ball above (feed conveyor) is back to its normal condition (empty)
- For holes (machines) above the smallest hole (critical machine) flow through is maximised until the ball below (discharge conveyor) is back to its normal condition (full)



So how do I do this on my lines? _

OptimumFX have developed five levels of control to optimize line control based on the model above. Whilst it may not be possible to completely replicate the model above on a production line, the five levels of control get extremely close.

The five levels of control are all steps that you can take (perhaps with the help of someone with some PLC skills) to modify your existing line control with a minimum of investment.

Now that you have logged onto our website E-Coaching letter we will email you a weekly newsletter free of charge in which we will take you through the five levels of control and how you can apply them to your lines.

If you have concerns about registering your details on a website please be assured that we value your privacy and hate receiving spam. Therefore your details will never be shared or sold to any other company and every newsletter will have an 'opt-out' option which will delete you from the database.

If you sign up during February or March you will automatically be entered in a draw to win one of 20 bottles of fine wine, and one lucky winner will get a complimentary line control audit completed at their site by our highly skilled team - full details on the website.

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