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Johnson Matthey - South Site

Five Steps in a Process Plant

Martin Powell

Martin Powell FCA

- Originally qualified as a Chartered Accountant in the UK
- 18 years experience in teaching TOC; implementing and auditing TOC projects, plus building TOC Experts
- Visited over 30 countries since 1994 on his TOC journey
- Director of Goldratt Solutions Ltd and The Goldratt Centre Ltd in the UK
- Faculty member of Goldratt Schools

m.powell@goldratt.co.uk

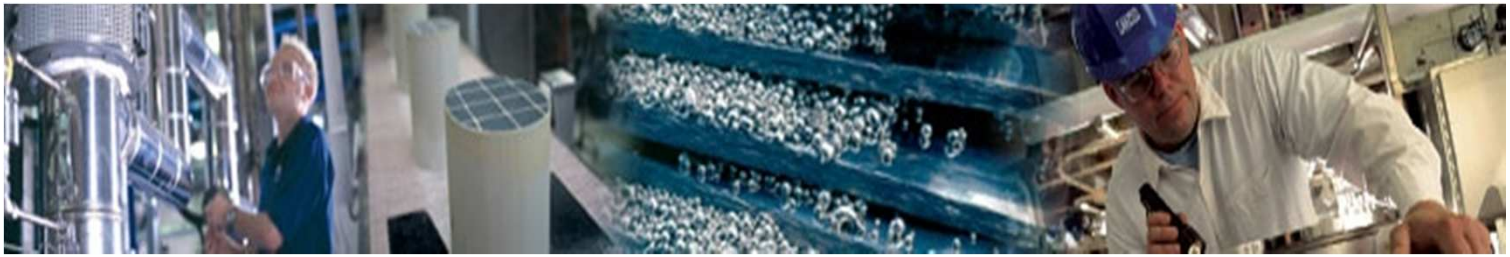
Mobile: +44 796872 8891

Office: +44 1234 834510

Skype: martinpowell

Johnson Matthey

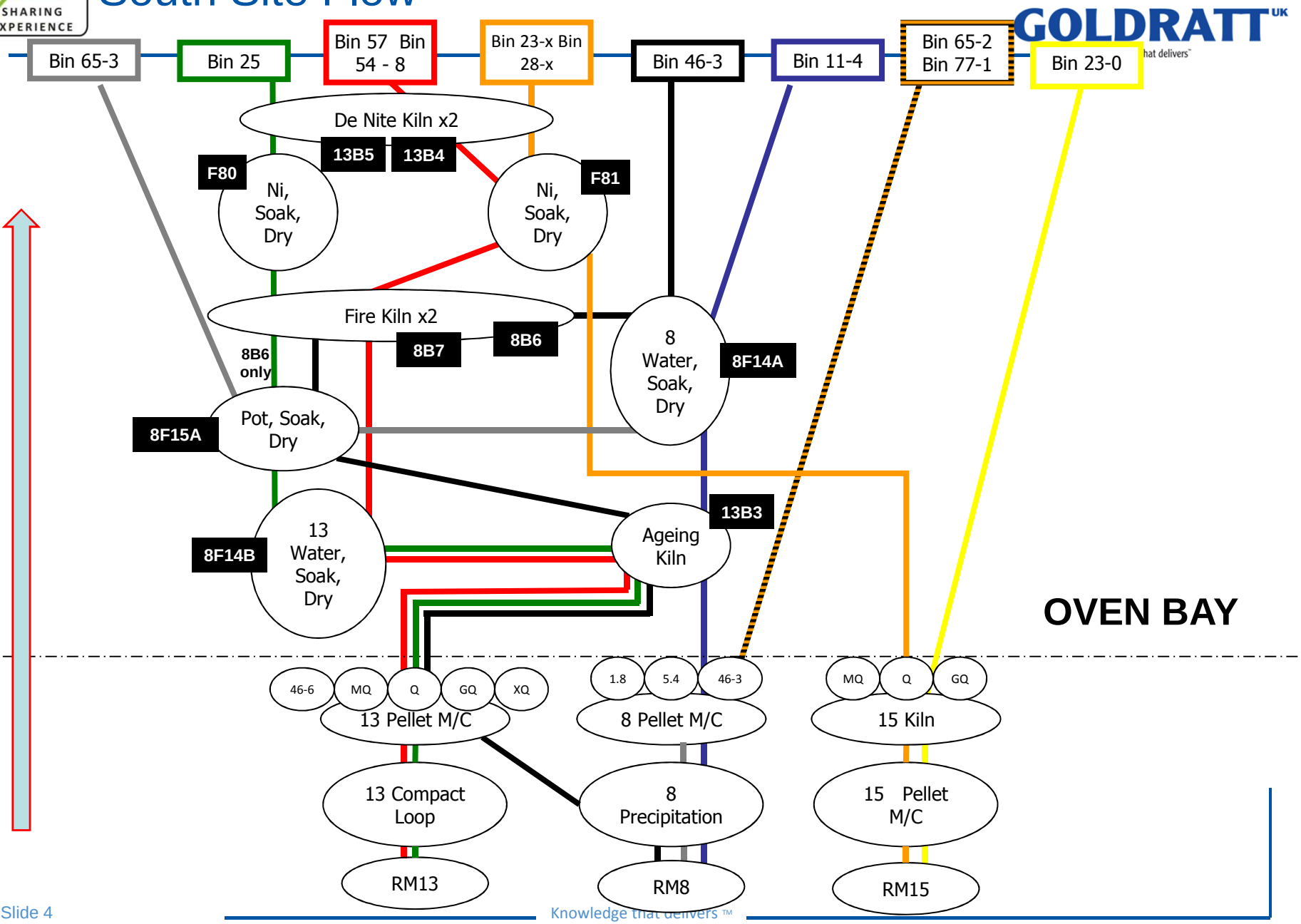
Johnson Matthey's principal activities are the manufacture of autocatalysts, heavy duty diesel catalysts and pollution control systems, catalysts and components for fuel cells, catalysts and technologies for chemical processes, fine chemicals, chemical catalysts and active pharmaceutical ingredients and the marketing, refining, and fabrication of precious metals.



South Site produces catalysts

After initial analysis by us, we mutually agreed with JM a results based contract – retainer plus bonuses on levels of output performance by South Site

South Site Flow



The Problems

- Demand exceeding capacity
- Significant investment being made elsewhere – so little capital available to invest in additional capacity in the short term
- In the mid term – investment could be available if ROI is good enough
- Manufacturing under increasing pressure to increase output for a growing market and to strengthen market share
- Many initiatives but with no significant effect
- Operational Planning under the control of Commercial not Manufacturing
- Manufacturing seen as not responsive enough by Commercial

Response by Operational Planning Department

- Prioritise forecasted orders as:
  - Green – must manufacture on time
  - Yellow – must manufacture (but can be delayed)
  - Red – Do not manufacture
  - Blue – manufacture when 35 plant is commissioned
  - White - unclassified
- Ramifications
  - Yellow orders – 316 Tonnes
  - Red orders – 864 Tonnes
  - Blue orders – 168 Tonnes
  - White orders – 207 Tonnes

The 5 Focusing Steps

- 1. **IDENTIFY** the system's constraint(s)
- 2. Decide how to **EXPLOIT** (squeeze the most out of) the constraint(s)
- 3. **SUBORDINATE** everything to the above decisions
- 4. **ELEVATE** - Find/invest in additional capacity or alternatives
- 5. If at any time in a previous step a constraint has been broken go back to **Step 1**.

This is a process of on-going improvement – however it also requires the TOC thinking embedded in the people for sustainability

Operations – Step One: Identify the Constraint

Analysis of current utilisation of ageing and de-nite kilns
Ω 70%

BASELINE					Capacity vs Order Forecast					
			Utilisation	Available Hours	G	GY	GYR	GYRB	GYRBW	Capacity
		No. of M/C	Tonnes per Batch							
	15B1	1	90%	7056	94%	112%	145%	176%	176%	-76%
	Ageing Kiln	1	70%	7560	81%	95%	133%	133%	146%	-46%
	Water Soak Dry	2	90%	15120	51%	59%	85%	85%	93%	7%
	Pot Soak Dry	1	90%	7560	23%	27%	36%	36%	39%	61%
	Fire Kiln	2	90%	15120	54%	64%	91%	91%	101%	-1%
	NI Soak Dry	1	90%	7560	61%	72%	97%	104%	112%	-12%
	De Nite Kiln	2	70%	15120	94%	112%	151%	162%	174%	-74%
	Bin	1	90%	7560	36%	41%	58%	62%	65%	35%
	De-Nite Throughput / C Hr									
	Ageing Kiln Throughput / C Hr									

Versus demand the Ageing kiln & De-nite kilns are identified as Bottlenecks

15B1 – Able to buy external capacity quickly

Step Two: Exploit the Constraint - De-nite Kilns

Increase Productivity of Kilns

- Increase quantity on trays by 7% for product “25-xx” series and “57-xx” series
- Reducing process time
  - Increase ramp rate and reduce dwell times
  - Reduce time to Unload – design and manufacture a jig and/or increase the volume of air to cool faster

– “57-GQ” product – reduce to 2 soaks only

– Operator awareness – Lost Throughput

- Ageing kiln every lost hour is £1,362
- De-nite kiln every lost hour is £2,510

Reduce Rework

- Over fired pellets, rather than putting them through 4 de-nite passes, to recover then we can make product “23-xx” from them (Note: in execution before making the decision to not convert through de-nites, check that the de-nites will not stand idle)

NB: The other action to take immediately would be to subcontract some 15B1 work to ensure this kiln is not a constraint.

All these actions can be taken by **Operations**

Step Two: Decide how to Exploit Judging Product profitability

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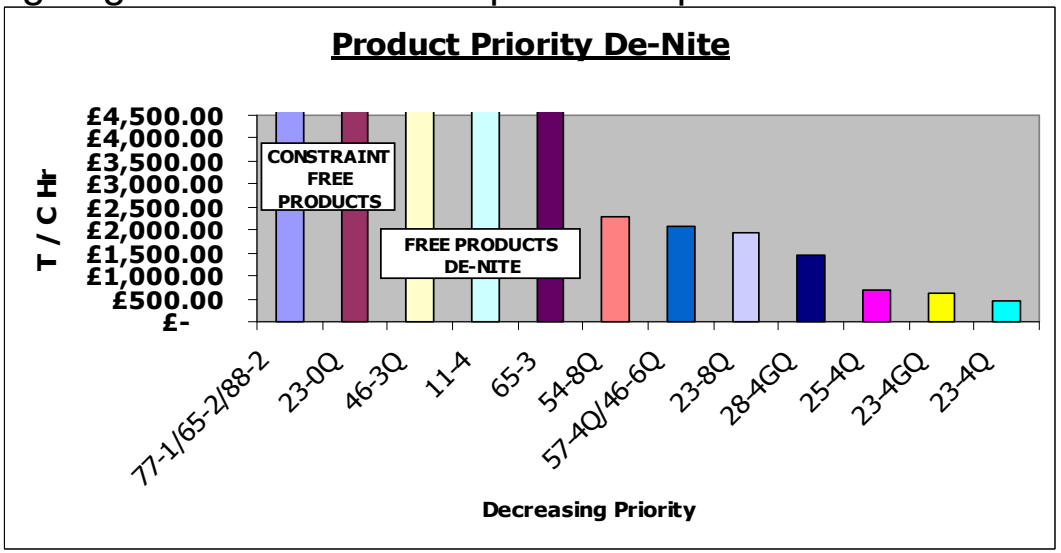
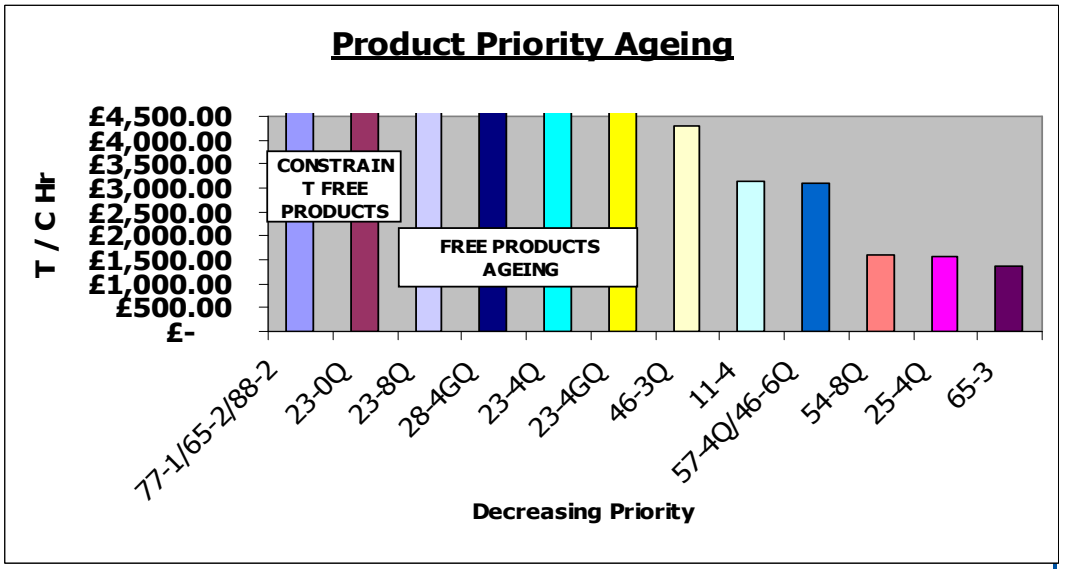
Given that Constraints are De-nite & Ageing what are the most profitable products to sell?

Product	De-nite Throughput per constraint hour	Ageing Throughput per constraint hour	Priority
46-6Q / 57-4Q	£2,071	£3,107	4
25-4Q	£703	£1,553	9
54-8Q	£2,281	£1,616	6
46-3Q	Free Product	£4,279	2
88-2 / 11-4	Free Product	£3,131	3
65-2 / 77-1	Free Product	Free Product	1
65-3	Free Product	£1,373	8
23-0Q	Free Product	Free Product	1
23-8Q	£1,933	Free Product	5
28-4GQ	£1,469	Free Product	7
23-4Q	£450	Free Product	11
23-4GQ	£626	Free Product	10





Step Two: Exploit the Constraint

The following actions are outside the control of Operations but should also be taken to exploit profitability.

Sales

- Focusing on selling the products with the highest Throughput per constraint hour (in accordance with the priority list)

S&OP (Sales and Operational Planning)

- Demand planning
  - Aggregate demand from Sales (plus knowledge of likelihood of order and what can be sold from stock to make the budget)
    - 4 week fixed plan of demand
    - Published weekly
    - One weeks demand exploits the capacity of de-nite kilns and then checked to ensure the ageing kiln's are not overloaded
    - Capacity of de-nite kilns planned to 90%
- Detailed scheduling
  - Takes weekly demand and turns it into a detailed schedule for:
    - Material Release, De-nite kilns and Shipping schedule

Step Three: Subordinate to the decisions

Buffer Management – based on Shipping Schedule (S-DBR)

Maintenance actions

- Combine routine maintenance into minimum number of shutdowns and fully prepare prior to release
- Increase maintenance cover 24 hours – 7 days
- Prioritise “de-nite” higher than “ageing” and then “15B1” (stop work on a non-bottlenecks to attend to bottlenecks)

Caustic Tank

- Minimise disruptions to caustic tank downtime

Hoist availability

- De-nite / Ageing prioritised over potassium decouple at all other operations
- Increase speed and traverse hoist diagonally

Stillage availability

- Justification for buying 2 pairs of stillages
- Mark boxes on floor in front of nickel soaking
- Determine plan to get the buffers in place of the right products

Tray availability

- Determine a replenishment system to ensure trays get replaced at the right time

Impact of Exploit & Subordinate

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STEP 2 & 3 - EXPLOIT & SUBORDINATE TO CONSTRAINT

MEDIUM TERM (Cont. from Short Tm)

EXPLOIT CURRENT EQUIPMENT ONLY

Top up to at least 4 tonnes

CCR Cycle time improvement

Constraint Utilisation increase to	92%	Utilisation	Available Hours	Capacity vs Order Forecast G	GY	GYR	GYRB	GYRBW	Spare Capacity
	No. of M/C	Tonnes per Batch							
15B1	1	90%	7056	70%	84%	108%	130%	130%	-30%
Ageing Kiln	1	92%	7560	55%	64%	90%	90%	99%	1%
Water Soak Dry	2	90%	15120	47%	54%	78%	78%	85%	15%
Pot Soak Dry	1	90%	7560	22%	26%	34%	34%	37%	63%
Fire Kiln	2	90%	15120	49%	59%	82%	82%	91%	9%
NI Soak Dry	1	90%	7560	52%	61%	82%	88%	95%	5%
De Nite Kiln	2	92%	15120	59%	70%	94%	101%	108%	-8%
Bin	1	90%	7560	32%	36%	51%	54%	57%	43%
De-Nite Throughput / C Hr									
Ageing Kiln Throughput / C Hr									

MEDIUM TERM (Cont. from Short Tm)

Total Cost	£	500,000.00	
ΔOE / Yr	£	50,000.00	
ΔThroughput/Yr	£	5,534,608.04	
ΔROI	11.0	Payback (Working Days)	25.3

Future Average T/CH	ΔCCR Capacity from Short Tm	Increased T
£ 2,730.41	22%	£ 4,050,139.93
£ 1,807.56	23%	£ 5,534,608.04

Synchronisation between S&OP and Production

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1. Quarterly £ Targe
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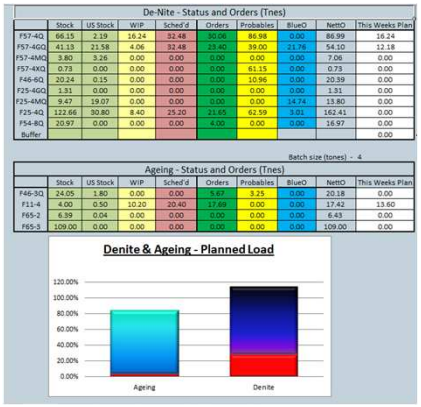
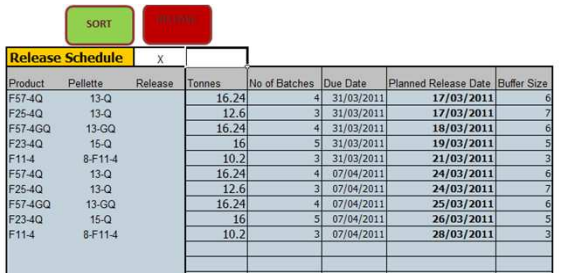
2. Automatic Weekly Plan Load Check (approx. 4 weeks in advance)



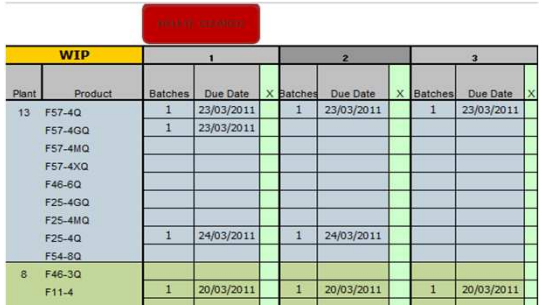
3. £ Check

4. Translated into a release schedule tied in with the Buffer length (processing time plus 2 days)



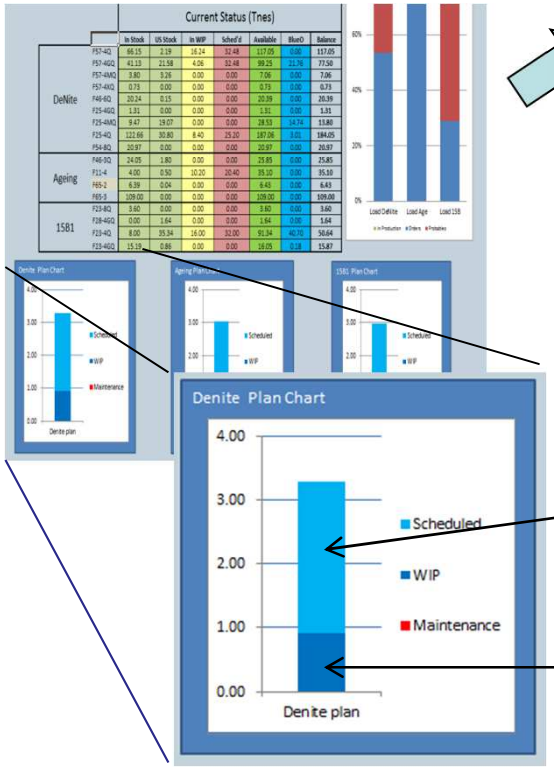
Product	Pellette	Release	Tonnes	No of Batches	Due Date	Planned Release Date	Buffer Size
F57-4Q	13-Q		16.24	4	31/03/2011	**17/03/2011**	6
F25-4Q	13-Q		12.6	3	31/03/2011	**17/03/2011**	7
F57-4GQ	13-GQ		16.24	4	31/03/2011	**18/03/2011**	6
F23-4Q	15-Q		16	5	31/03/2011	**19/03/2011**	5
F11-4	8-F11-4		10.2	3	31/03/2011	**21/03/2011**	3
F57-4Q	13-Q		16.24	4	07/04/2011	**24/03/2011**	6
F25-4Q	13-Q		12.6	3	07/04/2011	**24/03/2011**	7
F57-4GQ	13-GQ		16.24	4	07/04/2011	**25/03/2011**	6
F23-4Q	15-Q		16	5	07/04/2011	**26/03/2011**	5
F11-4	8-F11-4		10.2	3	07/04/2011	**28/03/2011**	3

5. Pellet production is scheduled and WIP is transferred onto WIP sheet, protective capacity is then



Plant	Product	1 Batches	1 Due Date	2 Batches	2 Due Date	3 Batches	3 Due Date
13	F57-4Q	1	23/03/2011	1	23/03/2011	1	23/03/2011
	F57-4GQ	1	23/03/2011				
	F57-4MQ						
	F57-4XQ						
	F46-6Q						
	F25-4GQ						
	F25-4MQ						
	F25-4Q	1	24/03/2011	1	24/03/2011		
	F54-8Q						
8	F46-3Q						
	F11-4	1	20/03/2011	1	20/03/2011	1	20/03/2011

7. Available load for the next week of planning is then altered depending on current load position on Ageing and De-nite updated automatically from the WIP sheet. Current stock position from SAP also taken into account.



7a. Planned work to be released in next 2 weeks

7b. WIP currently between start of Pelleting and Bin Off

6. Flow monitored using Buffer Management adapting the oven bay scheduler

Operations have shipping schedule with due dates which is managed using 3 colour priority system, visible to all

Many day to day changes to normal operations

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1. A 12-36 month view of maintenance plan to plan/consolidate maintenance *(WIP)*
2. Have 24/7 shift mechanical and electrical maintenance cover
3. Tray inventory management *(WIP)*
4. Stillage base replenishment plan (outlined and agreed)
5. CaAl trays all increased to 32kg from 30kg per tray
6. Al Al trays topped up from material supplier where possible (if correct product available)
7. Additional "kanban" stillages made up from material supplier to slot into every available Denite
10. Productivity measured and recorded on all CCR kilns
12. 57-4Q, 57-4GQ in 2 soaks only
13. Trials when possible on 57-4MQ, 57-4XQ to reduce to 2 soaks *(WIP)*
14. Al Al trial plan in progress for reducing time and/or temperature of 1st Denite *(WIP)*
15. Technicians (operators, mechanical, I/E) awareness of CCRs – TOC training
16. Downtime recording on the CCRs by operators *(WIP)*
17. Local planning decisions to maximise overall productivity e.g. 11-4 pelleting/ageing
19. Work to lower manufacturing specs to minimise Denites (and Ni costs!)
20. Slots 2x4hrs FETTE cleaning routines by maintenance/process
21. Kilian clean and tool change carried out every 4 days by maintenance
22. Compax clean and tooling check every day by maintenance

Results

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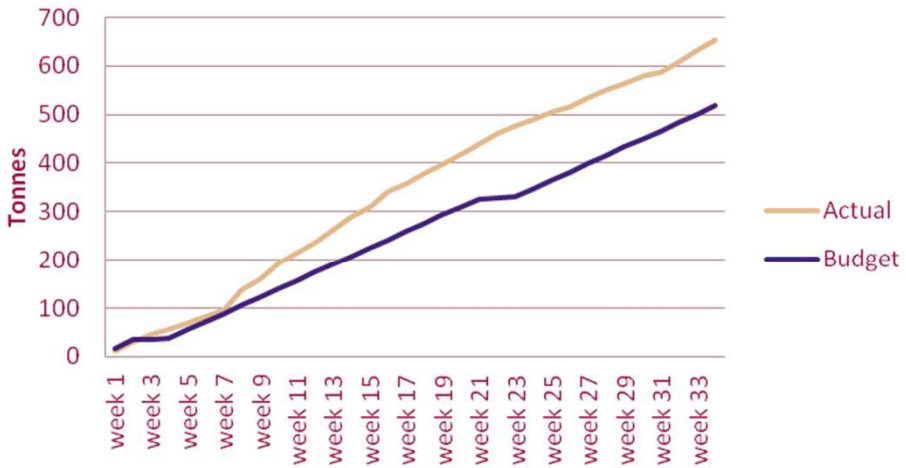
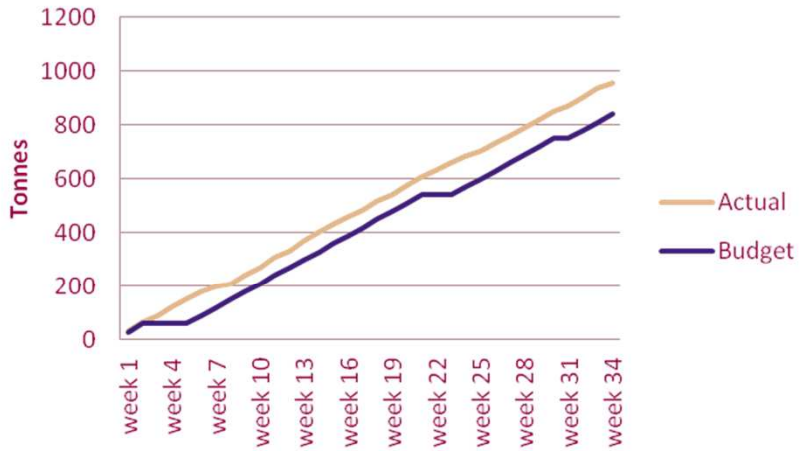
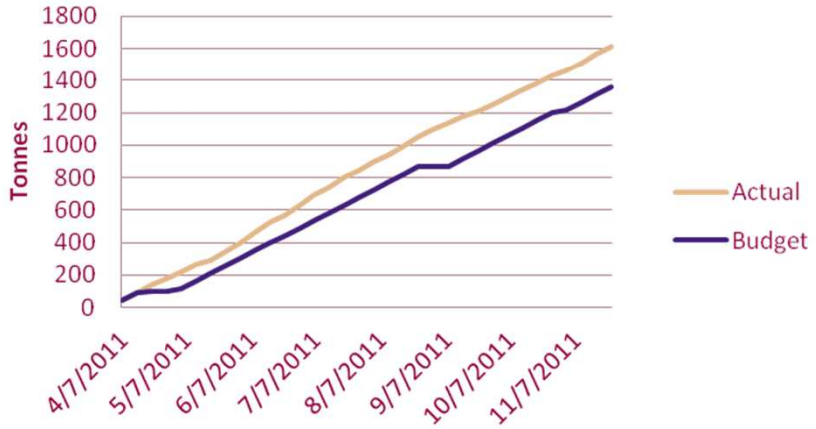
15 Plant +RSB Tonnes FY2011/12



13 Plant Tonnes FY2011/12



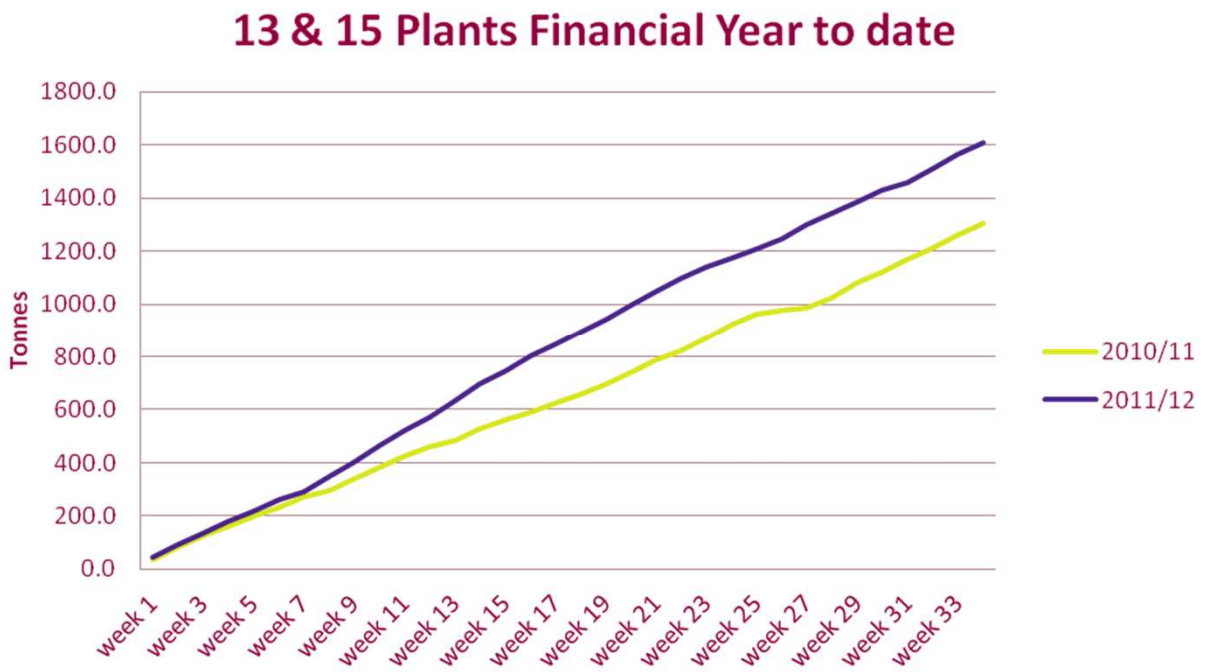
13&15 Plant Tonnes FY2011/12



Results

The "Stretched target" before the introduction of TOC was to increase capacity by 200 tonnes in 2011/12

YTD actual increase of 300 tonnes @ average T of £5,000 per tonne



Sustainability

Internal Expertise

Training for a small group of 3 people to be internal experts in TOC (including the Plant Manager) – using the TOC Insights

- Operations
- Finance & Measurements
- Project Management
- Distribution

Four concepts of flow

Apply the thinking in multiple rounds of focusing on flow problems and evaluating improvement ideas

Results – examples of benefits from TOC thinking

- 8G23 Project – problem in “pelleting” – solution: shut down entire “pelleting” bay, total loss of “pelleting” for 2 weeks
  - ✓ TOC solution – modify pipework and equipment, move “Kilians”, continuous availability of “pelletting”

- 8B7 planned relining for 3 weeks, reducing flow of CaAl, less loading on Denites
  - ✓ TOC – calculate spare capacity on Denites and bring sufficient Al Al stock on Site to process on the Oven Bay during relining

- Whilst 8B7 still offline, 8B6 failed on a Friday(!), stopping flow of CaAl completely
  - ✓ TOC – “D” Shift made up stillages of “Al Al” and processed as much as possible *(44 tonnes AA made, versus 15 tonnes normal, so overall tonnage remained high)*
  - ✓ TOC – when 8B6/8B7 recovered, backlog of CaAl on oven bay. Brought forward the 54-8Q campaign, run alongside 57-4Q, backlog worked through quicker, increasing tonnage overall

Step Four: Elevate

Increase Capacity

- Final fire kiln for 65-3 to be used for Ageing
- Check for kiln capacity externally for Ageing, De-nite
- Improve reliability in the control systems of kilns
- 35 Plant - investment in additional De-nite capacity
- Investment in additional “pelletting”

- Bottlenecks not yet broken – so no Step 5