National Cranberry Case

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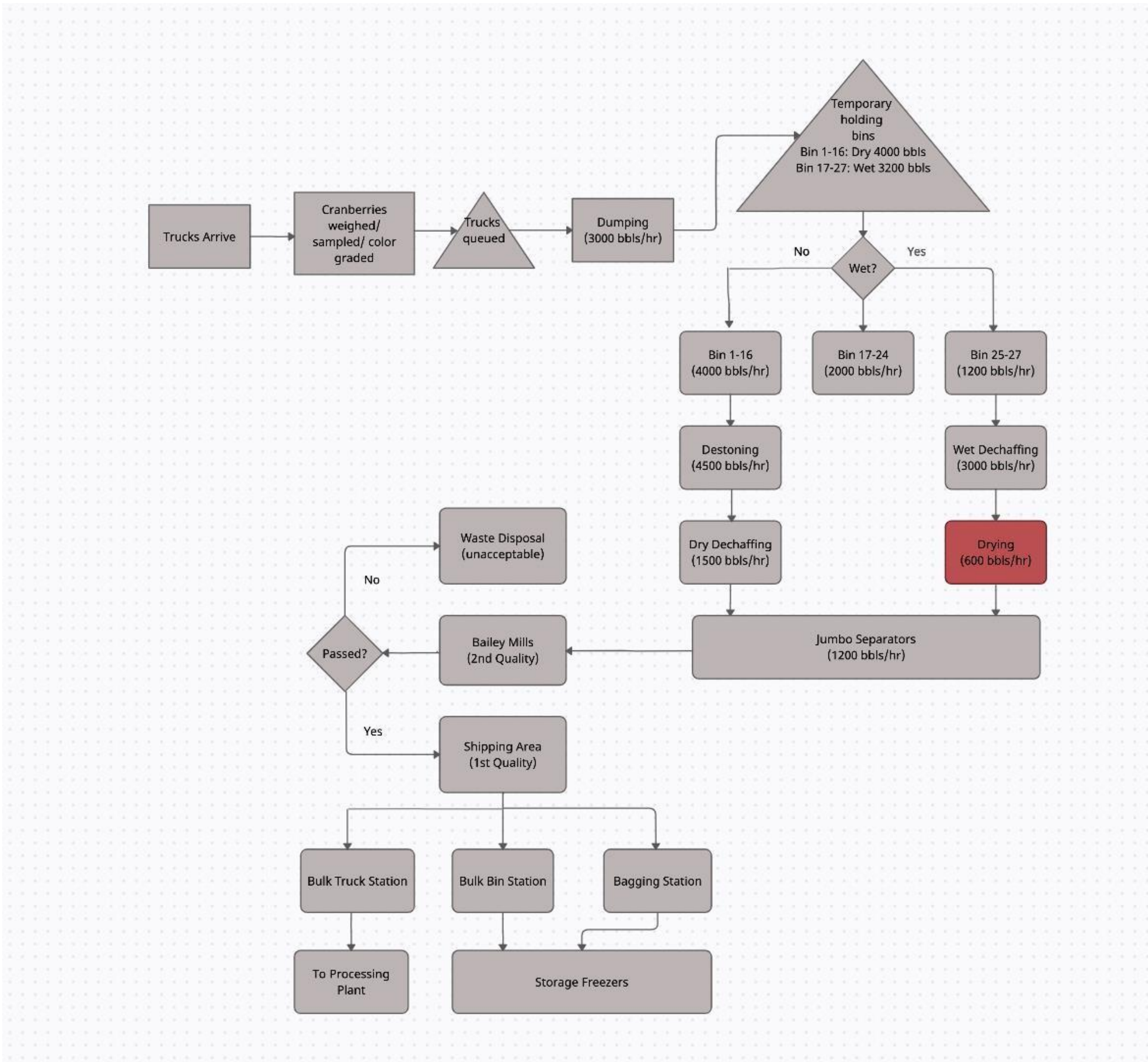
Solution 1:

PROCESS FLOW DIAGRAM



Solution 2:

The process at **RP1 is machine-paced** as there is no human involvement and all operations take place with the help of conveyor belts and machines. Only process which is worker-paced is testing and rest all operations right from receiving to temporary holding, destoning, dechaffing, drying, separation and bulking & bagging have no manual intervention.

Solution 3:

Analyzing the capacities of each process at the RP1 plant, we can conclude that "**Drying**" is the **bottleneck** of this process.

Refer to **Appendix 1** for all calculations related to each process capacity.

Solution 4:

The following are the major problems faced by RP1:

1. **Bottleneck of Dryers**: The proportion of water harvested berries were high and dryers of berries were the bottleneck. This reduced the overall flow rate and also led to a long queue of trucks waiting outside the plant. These trucks waited to deliver their shipment and the drivers were frustrated with the wait time. The cranberry growers were unhappy with this situation as the cost of leasing a truck was $100/hr.
2. **Inaccurate Berry grading:** The color grading process was not very accurate. The berry receiver incorrectly classified half of the berries which resulted in unnecessary high cost. The cost premium of $1.50 per bbl was paid for 225,000 bbls out of 450,000 bbls of berries. These berries were misclassified as best color berries.
3. **Wet berries volume and high cost:** The growing volume of wet berries resulted in workers working overtime to empty the bins as these berries could not be left overnight in the bins. This mismanagement of wet berries which comprises maximum cooperative business resulted in high overtime cost as the workers had to work overtime to empty these bins.
4. **Extra Kiwanee Dumper -** A new Kiwanee dumper was bought for $200,000 with the aim to reduce the truck wait times as the queue would be reduced. But the overtime costs were increasing even after the installation.

Solution 5:

The overtime during the peak season is **13.26 hours**.
Refer to **Appendix 2** for all the calculations.

Solution 6:

The truck delay during peak season is **9 hours 1 min**
Refer to **Appendix 3** for all the calculations.

Solution 7:

Short-term recommendations :

1. **Having two shifts -**
   From **Appendix 2**, we know that the peak season overtime is 13.26 hrs.
   So, by adding another 8-hrs shift, we can reduce this overtime to 13.26 - 8 = **5.26 hrs** which will reduce the overtime costs spent on the workers.

2. **Converting dry bin to wet bin -**
   Wait time of trucks is several hours, this is because of holding bins that are fully occupied. So, if we convert **10 dry bins to wet bins**, this will reduce the truck wait times by holding a greater number of wet berries. Refer to **Appendix 4**.

   This is a short term solution since this does not solve the overtime issue caused by the bottleneck capacity of dryers.

Long-term recommendations :

1. **Adding 1 dryer unit -**
   From **Appendix 5**, we can see that adding 1 dryer unit to the system at a cost of $60,000 would reduce the plant operational hours considerably and lead to aggregate cost savings of **$174,540.**

2. **Install Light Meter System -**
   From **Appendix 6**, we can install a light meter system that saves **~$247,500** that would have otherwise been paid as a premium on 450,000 barrels. However, before the implementation of the light meter system, NCC should discuss this with the growers since this change impacts them the most. They would no longer be paid the premium on poor graded berries.

Appendix 1:

Process capacities of various processes shown in Flowchart at RF1:

Kiwanee Dumpers:

Dumpers -> 5
Time to unload the truck -> 7-8 mins
Avg time to unload -> 7.5 mins
Avg truck delivery volume -> 75 bbls
Total Dumper Capacity = 5 dumpers * 75bbls/truck * 1truck/7.5mins * 60mins/hr
= **3000 bbls/hr**

Temporary Holding Bins:

Total bins -> 27

Dry Bins:
Bins 1 – 16 -> Capacity: 250 bbls/hr
Total Capacity: 16 bins * 250 bbls/hr = **4000 bbls/hr**

Wet or Dry Bins:
Bins: 17 – 24 ->Capacity: 250 bbls/bin
Total Capacity: 8 bins * 250 bbls/hr = **2000 bbls/hr**

Wet Bins:
Bins: 25 – 27 ->Capacity: 400 bbls
Total Capacity: 3bins * 400 bbls/hr = **1200 bbls/hr**

Destoning:

Destoners -> 3
Capacity of 1 destoner = 1500 bbls/hr
Total Capacity = 1500 bbls/hr * 3 destoners = **4500 bbls/hr**

Dechaffing:

Dry Defacching:
Capacity of dechaffer = 1 dechaffer * 1500 bbls/hr = **1500 bbls/hr**

Wet Dechaffing:

Dechaffers -> 2
Capacity of 1 dechaffer = 1500 bbls/hr
Total Capacity = 2 * 1500 bbls/hr = **3000 bbls/hr**

Drying:

Dryers -> 3
Capacity of dryer = 200 bbls/hr
Total Capacity = 3 * 200 bbls/hr = **600 bbls/hr**

Jumbo Separators:

Separators -> 3
Capacity per Separator = 400 bbls/hr
Total capacity of 3 separators = 3 * 400 bbls/hr = **1200 bbls/hr**

Since, the **drying process** has the minimum capacity, it is the **bottleneck** in the processes at RP1 plant.

Appendix 2:

Process capacity -> 600 bbls/hr
Number of delivery trucks -> 243 trucks
Avg truck delivery -> 75 bbls
Therefore, total demand = number of delivery trucks * avg truck delivery = 243 * 75
= **18,225 bbls**

From exhibit 1, we know that unloading from the trucks starts at 7 am and ends at 7 pm. Hence, the total time required to unload is 12 hours.

Input rate -> total demand / total truck unloading time = 18225/12 = **1518.75 bbls/hr**

Dry berries input rate -> 30% of input rate = (30/100) * 1518.75 = **455.63 bbls/hr**
Wet berries input rate -> 70% of input rate = (70/100) * 1518.75 = **1063.13 bbls/hr**

The minimum demand is 1063.13 bbls/hr
We know the bottleneck is 600 bbls/hr. i.e., the process flow rate -> 600 bbls/hr

Cycle Time -> (1 / process flow rate) = 1/600 hr/bbls

Demand for wet berries -> 70% of total demand = (70/100) * 18225 = **12757.5 bbls**

Wet berries flow rate -> wet berries demand * cycle time = 12757.5 * (1/600) = **21.26 hrs**
Worker time -> 8 hrs (11 am to 7 pm)
Therefore, overtime during peak season = 21.26 - 8 = 13.26 hrs

Appendix 3:

Wet berries input rate -> 1063.13 bbls/hr
Process capacity -> 600 bbls/hr
Inventory buildup rate -> demand - bottleneck = 1063.13 - 600 = **463.13 bbls/hr**

Capacity of wet berries bin -> (8 * 250) + (3 * 400) = **3200 bbls**
Therefore, total time taken to unload the wet berries -> capacity of wet berries bin / inventory buildup rate = 3200/463.13 = **6.91 hrs**

We know that the unloading starts from 7 am to 7 pm. i.e., total time required to unload is 12 hrs. So, 6.91 hrs from 7 am is 1.55 PM. After 1.55 PM, there is a wait time for trucks.

Inventory buildup throughout the day -> inventory buildup rate * total unloading time = 463.13 * 12 = **5557.56 bbls**

As, capacity of wet berries bin is 3200 bbls and inventory buildup throughout the day is 5557.56 bbls, the remaining wet berries in truck = 5557.56 - 3200 = **2357.56 bbls**
Hence, time taken to unload the remaining wet berries -> 2357.56/600 = **3.93 hrs**
So, 3.93 hrs from 7 pm is 10.56 pm.

Therefore, the inventory will start building up from 1.55 pm to 10.56 pm. i.e., 9 hrs 1 min

Appendix 4:

Input rate of wet berries = Inventory / Time = 12757/12 = 1063.13 bbls/hr

Process capacity -> 600 bbls/hr

Build up rate = 1063.13 – 600 = 463.13 bbls/hr

Inventory buildup throughout the day = 463.13 * 12 = 5557.56 barrels

This amounts to 3200 barrels in wet bins and 2357.56 (5557.56 – 3200) barrels in trucks.

Processing Rate of dry bins -> 250 bbls/hr.

Therefore, the number of bins that should be converted from dry to wet = 2357.56/250 = 9.43 bins.

Number of bins to be converted to handle wet berries = 10 bins

Cost incurred in converting 10 bins = $10,000 * 10 = $100,000

Appendix 5:

a) Adding One Dryer unit:

Processing capacity for 4 dryers = (4*200) = 800 bbls/hr.
Fr om Exhibit 1's data, the Demand for wet berries is 12758 bbls on 23rd September 1995.

So, the RP1 operates from 7 AM to 10:56 PM continuously for 15.95 hours.

Hourly cost of Labor:
Peak season lasts for 16 weeks
There are 7 working days per week.
Total salary of Seasonal and Non-Seasonal Employees = (27*13)+(15*8) = 471
For the peak season (16 weeks), Total hourly cost of Labor = 471 * 7 * 16 = $ 52,752.

If the plant operates overtime, 9 employees are needed to run the operation and the wage rate is 12/hr. The hourly cost of labor after 11 pm = 9 * 12 * 7 * 16 = $ 12,096

Time savings due to installation of 1 dryer = 5.26 hours (overtime)

Corresponding cost savings = (5.26 * 12,096)
= $ 63624.96

Cost of Installing 1 Drying unit = $60,000

Aggregate Savings = $234,540- $60,000 = $ 174,540

Appendix 6:

NCC pays a premium of $1.50 on 450,000 barrels of berries.

Loss incurred = $1.5 * 450,000/2 = $337,500

Cost of Installation of Light Meter System = $40,000 + Cost of Labor

Savings = 337,000 – (40,000 + Cost of Labor)

= $297,500 – Cost of Labor

Assuming that the Cost of Labor is ~$50,000. The savings of ~$247,500 would be highly significant for NCC.