**Natural Blends Inc. Case: Notes**

**Process Settings (as described in the case):**

* The facility operated at capacity, with one 8-hour shift per day, six days a week, for a total of 36 weeks per year during the prime orange growing season.
* The production process consisted of six operations: (1) sorting/storing, (2) extraction, (3) filtration, (4) concentration, (5) testing, and (6) blending.
* Capacity was measured in terms of the equivalent amount of finished juice concentrate (so that we do not have to multiply by hydration constant).
* Schematic representation of the process:



* Florida growers delivered three sizes of oranges (small, medium, and large) to the Orange Grove plant on a daily basis.
* Oranges were sorted by size and stored in three separate bins. (Time spent sorting and filling bins was negligible.)

**Description of Activities:**

* **Storage:** Each storage bin had a capacity of 80,000 pounds. (This meant that each bin could have held the number of oranges required to produce 80,000 pounds of finished juice concentrate.)
* **Extraction**: Requires setup to change over when switching from a bin of one size to another size was 20 minutes. Capacity = 20,000 pounds/hour of finished juice concentrate, irrespective of the orange size it was processing.
* **Filtration:** Capacity = 20,000 pounds/hour of finished concentrate. After it ran (filtering juice) for 90 minutes, the machine’s filter had to be changed to clear the debris. Setup Time = 30 minutes.
* **Juice Concentration**: Some of the water in the juice was removed. Capacity = 18,000 pounds/hour. No setups were required.
* **Juice Testing/Storage**: Concentrated juice was tested frequently for characteristics such as color and sugar content and separated into one of four large storage tanks. (Processing time = negligible.) Capacity of four tanks = 250,000 pounds.
* **Blending**: Mixing from the four tanks of concentrate in the appropriate proportions. Capacity = 22,000 pounds/hour. Setup time = 40-minute setup time was required to change from one blend to another or from one order to another.

**Process Flow Diagram:**



*Q 1: Just consider the steps 2 to 4 of the production process. Assume that the process is running only one size of oranges, Identify the bottleneck.*

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*Q 2- Draw the time activity diagram. How much orange juice concentrate can be processed in one 8-hour workday?*

* In addition, the run-time of the system is limited by filtration, which requires a 30-minute setup for every 90 minutes of run-time.
* Therefore, the amount of juice product processed in one 8-hour day is:

(Amount of time the process is running per day) \*(production rate when running) = (8 hr - (0.5 hr/filter change \* 4 filter changes) \* 18,000 lbs/hr = 108,000 lbs per day.

*Q 3: Assume extraction has previously been set up for the size oranges being processed. How much idle time will there be in the extraction operation during one 8-hour workday?*

* Since the time the extraction process is able to run is exactly the same as when filtration is running, the idle time can be calculated from the time required for filter changes over the 8-hour day.
* (0.5 hr/filter change \* 4 filter changes/day) = 2 hours of idle time per day

*Q 4:* *If you could add storage capacity somewhere between steps two and four in this production line in order to increase daily output, where would you place it? How much storage would you add? Why?*

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(a) amount processed in concentration in 30 minutes = (0.5 hours) \* (18,000 lbs per hour) = 9,000 lbs

(b) amount stored during 90-minute run = (1.5 hours) \* (20,000 - 18,000 lbs per hour) = 3,000 lbs of storage capacity.

The amount of storage capacity needed between filtration and concentration is 3,000 lbs.

During the 8-hour workday, this would improve the output of the system by 12,000 lbs of finished concentrate [(4 cycles of filter changeovers) \* (3,000 lbs per 30-minute changeover)] for a total output quantity of 120,000 lbs.

**Assignment Questions**

**Q 1:** Refer to the Natural Blends Case. Consider the following production settings:

* The production system was running three sizes of oranges: large, medium, and small in **equal amounts every week** (not necessarily equal amounts every day).
* Furthermore, each orange size be processed at least once per day, but that as long as equal amounts of all three sizes were processed during a week.
* Again, consider just the process steps of extraction, filtration and concentration as shown in the figure below (**note that there is no storage between the stages**):

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Here are the two scenarios under the setting described above:

* Scenario 1: 8 batches of each size

S M L S | M L S M | L S M L | S M L S | M L S M | L S M L

* Scenario 2: 8 batches of each size

S M M L | L S S M | M L L S | S M M L | L S S M | M L L S |

Construct the activity-time diagram. What is the daily and weekly production capacity during each of these scenarios? What is the total amount of juice concentrate you can process through the three process steps (two through four) in one 8-hour workday and 6 days a week?