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Key Performance Metrics for the Operative Miller

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Key Performance Metrics for the Operative Miller

- Extraction & Yield
- Patent Yield
- Screenings Percentage & Wheat.
- OEE – Overall Equipment Effectiveness
- EDT - Equipment Down Time
- Scheduled Repair Time
- 24 Hour capacity vs. Design Capacity
- Flour Moisture vs. Target.

Yield

Extraction= Flour/Dirty Dry Wheat Ground

Also known as "Input Yield, Raw Wheat Yield"

- IS influence by grain moisture.
- Long term – Flour Sold/Grain Purchased (after
- inventory balancing).
- USA 2024 77.39% (Milling and Baking News).

Total Products Yield = Flour/(Flour + Feed + Screenings)

- Also known as "Output Yield, Outrun Yield, Finished Product Yield".
- Is not influenced by grain moisture.
- Includes screenings.
- Long term – Flour Sold/(Flour Sold + Feed Sold).
- USA 2024 76.61% (Milling and Baking News).

B1 Yield = Flour/B1 Wheat

- Also known as "WTR Yield, 1st Break Yield".
- Does not includes screenings
- Used by miller operators for real-time mill performance monitoring.
- Impacted by evaporative loss in the milling process.
  - I.e. 1B wheat might be 16.0% moisture, Flour 14.3% and Feed 14.5%, so the B1 weight is heavier than the sum of the mill outputs.

Mill Products Yield = Flour/(Flour + Feed)

- Same calculation as the Total Products Yield, except screenings is excluded.
- Can be used by mill operators for real-time mill performance monitoring.
- The "Noise" caused by evaporative loss in the B1 yield is eliminated.

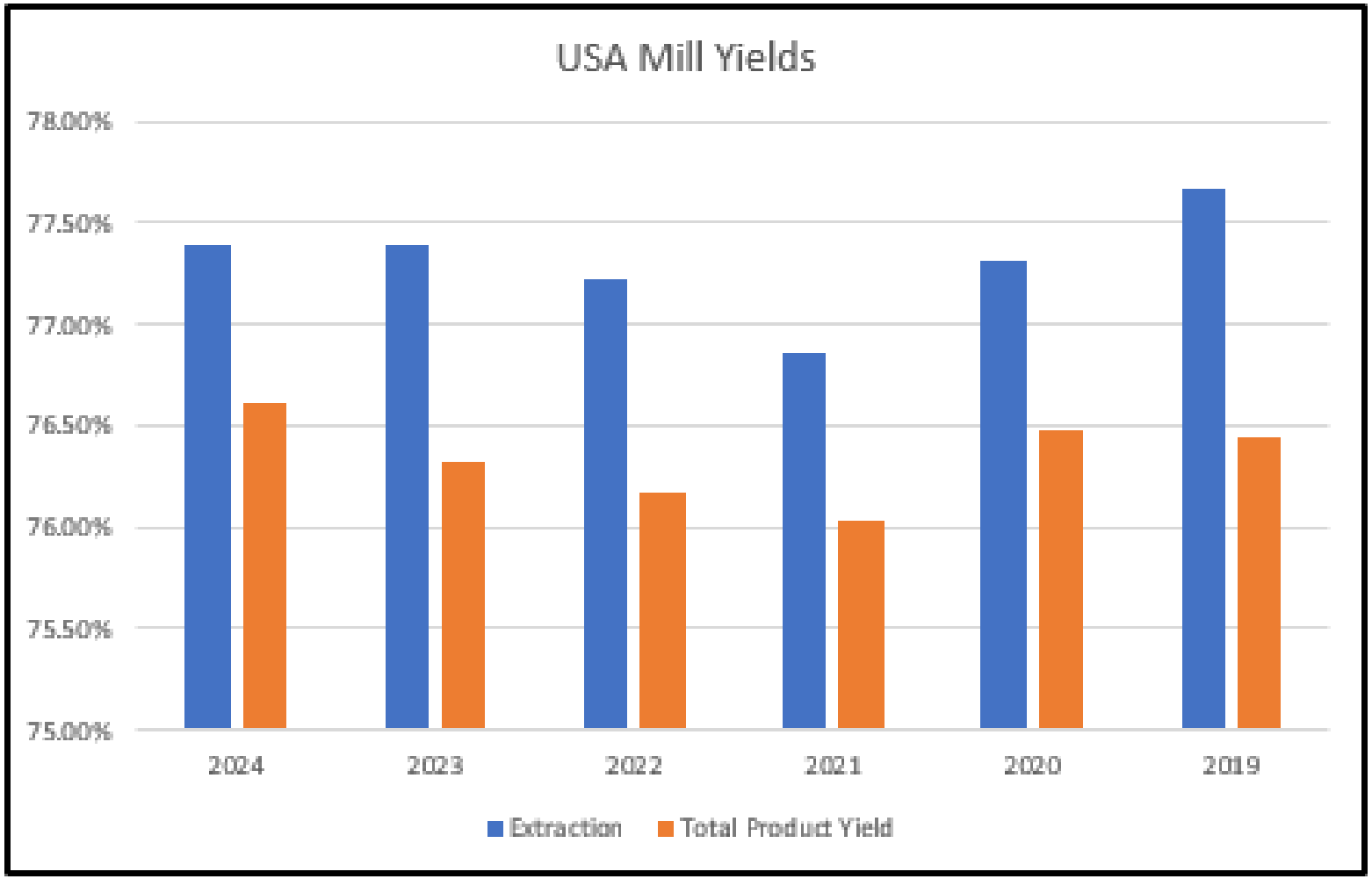
Yield

Production Data 500 ton mill

Product Scales	Tons
Uncleaned Dry Wheat	485
B1	500
Flour 1	370
Flour 2	10
Mill Feed	110
Screenings	7

Mill Products	**490**
Total Products	**497**
Extraction (DW Yield)	***78.35%***
Total Products Yield	***76.46%***
B1 Yield	***76.00%***
Mill Products Yield	***77.55%***
Patent Yield (%TP)	***74.45%***
Screenings (%TP)	***1.41%***
Moisture Gain (DW to TP)	***2.47%***
Evaporative loss (B1 to TP)	***-0.60%***

Yield



Source: Milling & Baking News.

Value of 1% Yield

YIELD IMPROVEMENT ECONOMIC ANALYSIS (BASED ON WHEAT SAVINGS)					
Daily Mill Flour Output MT	MT FL Produced per year	Wheat Price per Metric ton	Feed Value per Metric ton	Present Yield (%TP)	Yield Increase
380	114,000	$295.00	$155.00	75.50%	1.00%
IMPROVED YIELD	MT WHEAT SAVED	$ WHEAT SAVED	LOST FEED SALES/ TONS	$ LOST FEED SALES	***NET SAVINGS***
76.50%	1,974	$582,262	1,974	$305,934	***$276,328***

Patent Yield

- In many parts of the world the Mill is working to produce Patent Flour (F1) at a certain specification, typically ash or color that may require producing a lower grade by-product flour often called Clear Flour or F2. Due to the price difference between F1 and F2, it is important to try to maximize the production of the higher value F1.
- For example, in the USA and much of Europe a common flour for bread making is type 550 (0.55% ash on a dry matter basis). To produce HRW flour at this ash level 1.5 to 3% F2 production is typical.
- In this case, the Total Products Yield is 76.46%, but the Patent Yield is 74.45.

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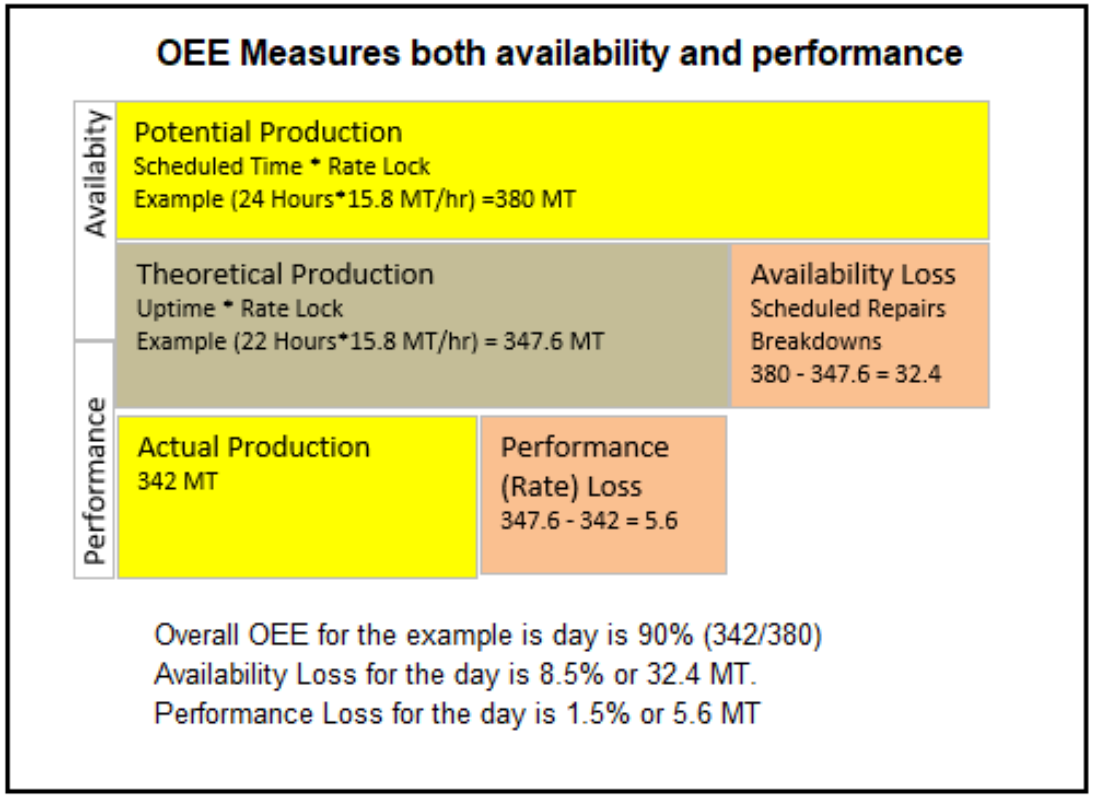
Screenings Percentage and Wheat

- **Screenings – The material removed during the wheat cleaning process should be tracked and monitored regularly by the miller. The easiest way to lose value in the milling business is to have a lot of good quality wheat going to screenings.**
- **Screenings percentage: Screenings/Wheat Cleaned = Screenings Percentage.**
  - **Typical for US #2 wheat – less than 2% Screenings.**
- **When the yield falls below expectations, the miller is quick to blame the wheat quality. But can the miller quantify the wheat quality? Does the miller have statistics showing current wheat quality to that in the past?**
- **Wheat measures to consider tracking**
  - **Thousand Kernel Weight – Clean Dry Wheat**
  - **Test Weight**
  - **Dry Wheat Moisture**
  - **Insect Damaged Kernels (#IDK per 100 grams)**

Mill OEE

- OEE Is a performance indicator used to quantify how well a manufacturing unit (line) performs relative to its design capacity, during the periods when it is scheduled to run. Expressed in percentage of potential production over a defined time period, **OEE is a function of: Design capacity, Scheduled time, Uptime, and actual Units Produced.**



Design Capacity/Rate Lock
Rate Lock = Design capacity of the mill, in units per hour. Rate Lock is only changed if a step change is made to the mill's throughput capability.

OEE Calculation

% OEE = (1- (calculated downtime/scheduled time))

- Scheduled time = all time less "excluded time" i.e. No demand time
  - (uncrewed/unlocked)
- Calculated downtime = ((Target Production – Actual Production)/Rate lock)
- Rate Lock: The target capacity for each milling unit for each grist.
  - Rate Loss = The difference between Rate Lock and the Actual Run Rate. This loss is captured in OEE.

- Example: A 500 ton/day mill is scheduled to run 24 Hours, and Target production is 380 tons of flour. The mill runs 22 hours, having 2 hour of breakdown time. Actual production is 347.6 tons.
- Rate Lock: 380Tons/24Hours = 15.8 Tons/hr.
- Calculated Downtime: (380-342)/15.8 = 2.4 Hours
- OEE: (1-(2.4/24)) = 90%
- EDT = 2 Hours
- Rate Loss = 0.40 Hours

- Above 90% OEE is considered world class.

Equipment Down Time & Scheduled Repair Time

- EDT (Breakdowns) and Scheduled Repairs should be tracked. A common manner of expressing these metrics is as a percent of the mill's runtime.
- For example, during the month of July, a Mill ran 42,220 minutes and recorded 2402 minutes of EDT and 1206 minutes of Planned Maintenance.
- EDT: 2402/42220 = 5.69%
- Planned Maintenance: 1206/42220 = 2.86%
- **Targets:**
  - EDT less than 3%
  - Planned Maintenance about 2.5%

Equipment Down Time

If the mill is not operating, the reason should be recorded. Below are Mill Downtime categories that may be appropriate descriptors for downtime.

- **Scheduled Downtime**
  - Planned Maintenance
  - Shutdown or Start-up
  - Mill Change Over
  - Fumigation.

- **Unscheduled Downtime – Break-downs.**
  - Airlock
  - Belt
  - Choke
  - Sifter
  - Rollermill
  - Blower
  - Electrical Failure
  - Computer or PLC
  - Purifier
  - Filter or Fan
  - Bearing
  - Electric Motor

Equipment Down Time

- **Unscheduled Downtime – Scheduling/Planning**
  - Flour Bins Full
  - Feed Bins Full
  - No grain
  - Operator Shortage
  - Rate Loss
  - Misc.
- **Unscheduled Outside Source**
  - External Power Failure
  - Weather related stoppages
  - Misc.
- Targets:
  - EDT less than 3%
  - Scheduled Repairs about 2.5%

24 Hour Capacity vs. Design Capacity

- Most mills have a "Design Capacity" that was determined when the mill was constructed. In most of the word it is expressed as Metric Tons of wheat on the B1 in 24 hours. Over time bottlenecks in the milling process may arise that cause the mill operators to run the mill at a reduced rate.

- We often hear the operators say that the mill runs better if the B1 load is reduced by 5 or 10 percent. It is the work of the Head Miller to ensure that the mill runs well at the design capacity or better.

- Actual 24-Hour Capacity vs. Design Capacity
  - 24-hour capacity: Actual B1 scale through put/minutes run * 1440 (minutes in a day)
  - Example: In July, a mill ground 12,744 MT on the B1, running 42,220 minutes.
  - 12,744/42,220 = 0.3018MT/Minute. 0.3018 * 1440 = 434.6 MT/24 hours.
  - Calculated 24-Hr capacity: 434.6. Design Capacity 480.
  - 434.6 / 480 = 90.5% of design.

Flour Moisture

- During the tempering process water is added to the wheat to toughen the bran and mellow the endosperm, making separation of the two easier in the milling process. In addition, tempering works to deliver the flour at the moisture content promised to the baker. Keeping flour moisture at the desired target has significant impact to the financial performance of a mill.

Moisture Optimization Economic Analysis

Daily Mill Flour Output MT	MT FL Produced per year	Average Flour Price per MT	Present Moisture	Future Moisture	Moisture Reclaim
380	114,000	$440.00	13.70%	14.20%	0.50%

Moisture Gain in MT	***Net Moisture Revenue***
570	***$250,800***

Summary

The astute miller should watch mill KPIs with the same diligence they give to the grind of the rolls. Understanding how mill operation impacts financial performance helps create focus on the most impactful work.