TAPPICON

APRIL 28 – MAY 1, 2024 • CLEVELAND, OH

Application of AI-based Approach to Control Papermaking Process

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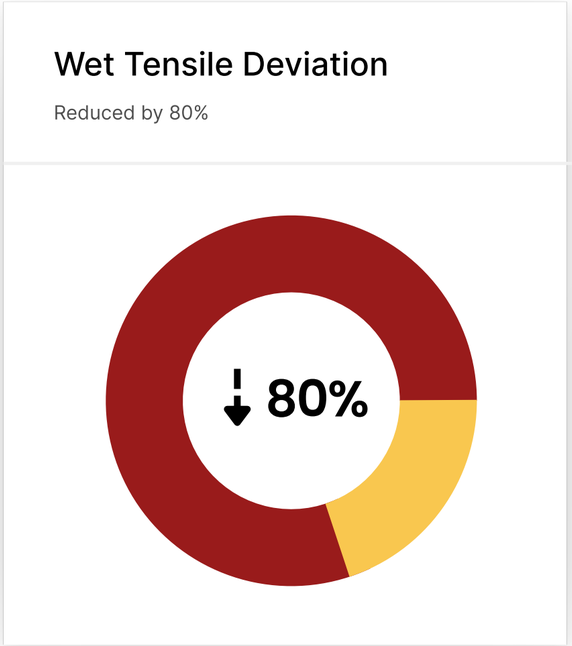
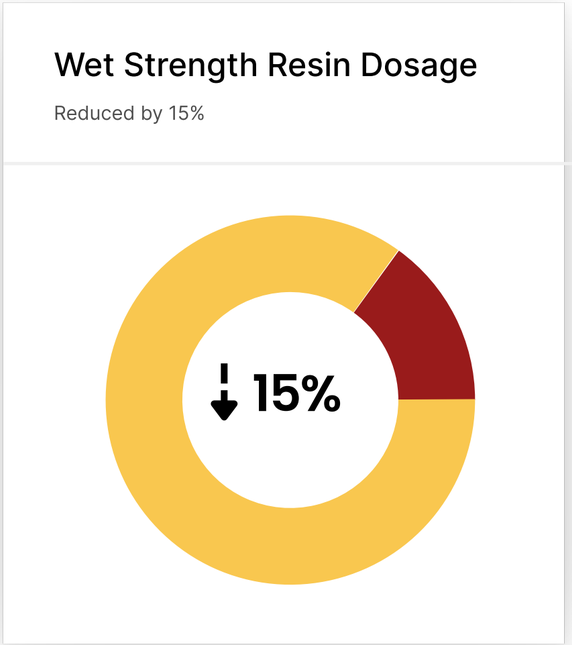
HABER

ACHIEVE AND SUSTAIN WET TENSILE WITH

ARTIFICIAL INTELLIGENCE

DRIVEN AUTOMATION





Tailored for unique applications, specialty paper offers distinct properties such as texture, weight, and coatings for specific needs such as packaging, laminates, etc.

SPECIALITY GRADE

Enhances paper durability against moisture, maintaining strength even when wet, crucial for applications like packaging and print base paper.

WET STRENGTH RESIN

Artificial intelligence simulates human intelligence, enabling machines to learn, reason, and solve complex problems.

ARITIFICIAL INTELLIGENCE

SCIENCE OF PAPERMAKING

Continuous Variation in

- Morphology of Fiber and Filler
- Fiber Orientation
- Sheet Consolidation
- Water Chemistry

Leading to inconsistent wet tensile

A specialty-grade manufacturer had >20 grades, changed every 3-4 days had

- **Inconsistent Wet Tensile**
  Standard deviation >0.5
- **Off quality production**
  5% rejection during grade change
- **Higher Wet Strength Resin Dosage**
  Avg of 27 Kg/MT

	Manual Control	Advanced Proces Control	Artificial Intelligence
Real Time Data	✗	✓	✓
Automated Control	✗	✓	✓
Higher Accuracy	✗	✓	✓
Continuous Learning	✗	✗	✓
Scalability	✗	✗	✓

SYSTEM INFORMATION

90 day study

20-40% sheet ash

>20 speciality grades

330 m/min

50-120 g/m^2

60-70 MT per day

HABER APPROACH

01

Mined six months of Time-Series data

02

Analyzed multi-dimensionality of relevant parameters

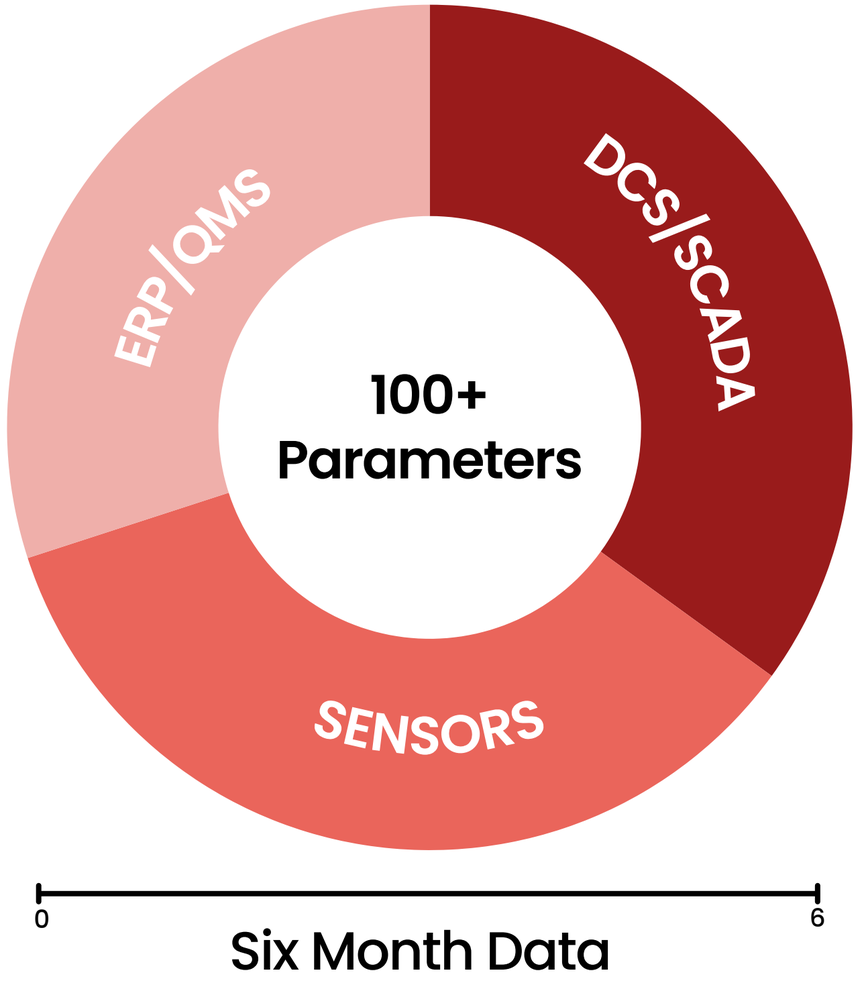
03

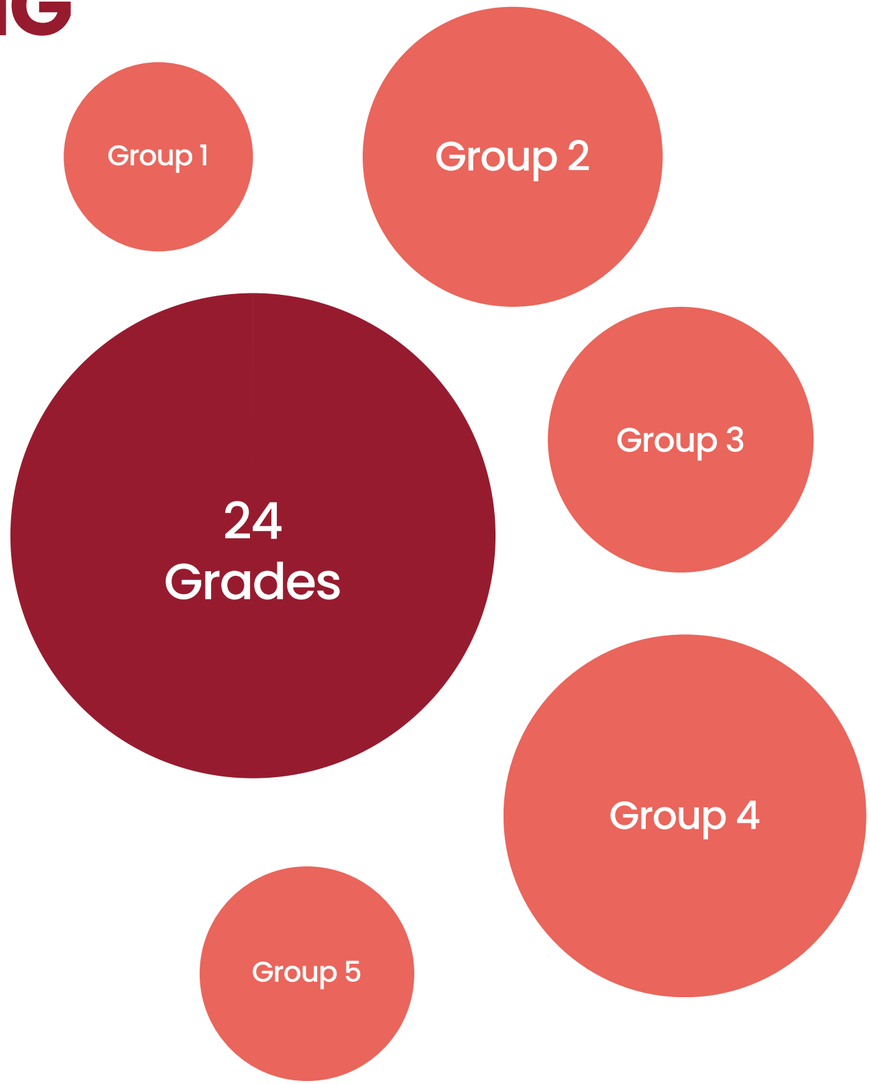
Designed Wet Tensile prediction algorithm

04

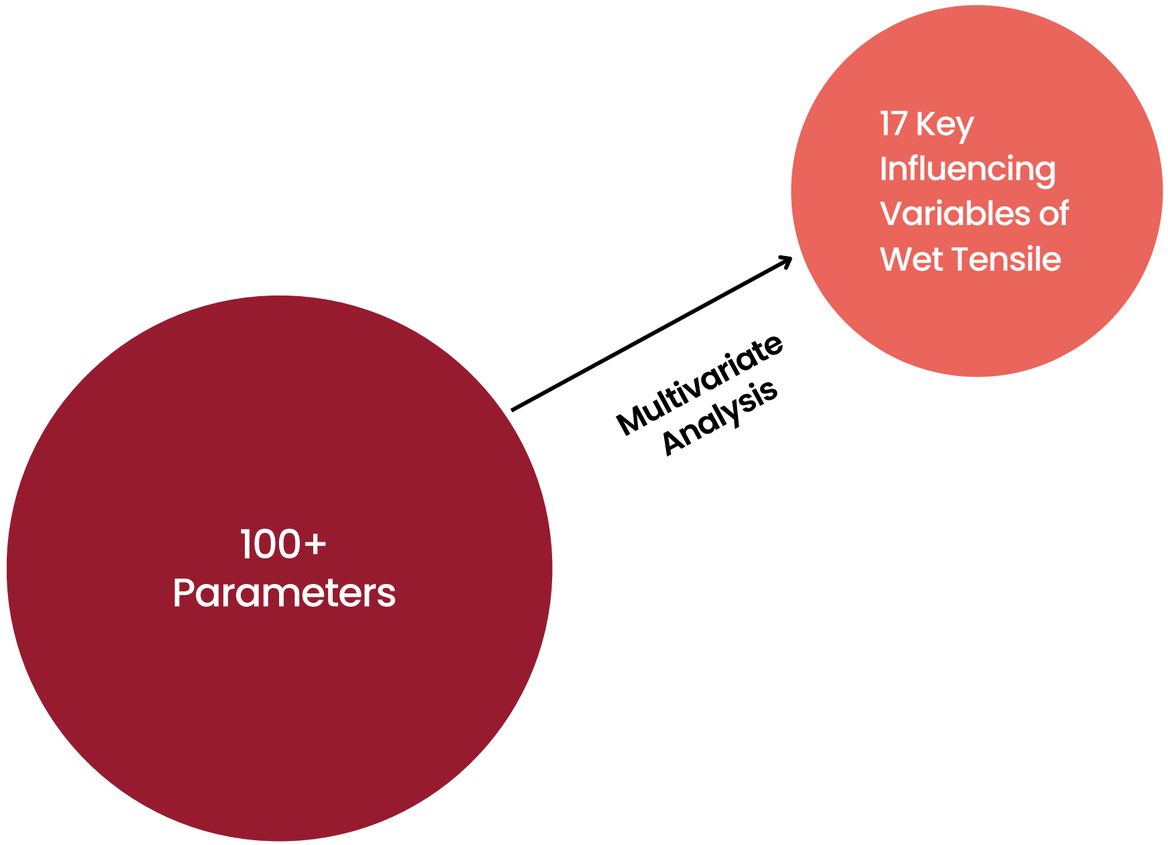
Engineered Wet Strength Resin dosage model

DATA EXTRACTION AND CLEANING





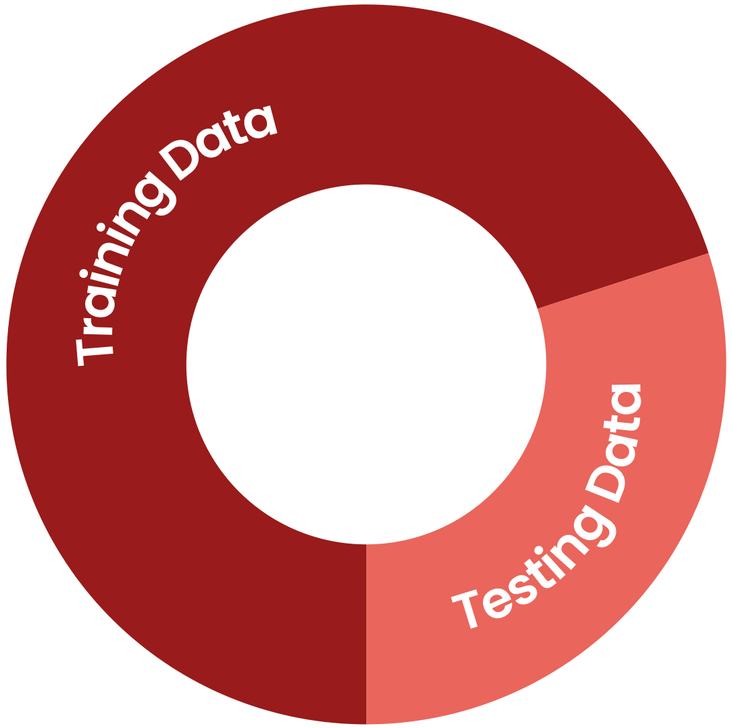
MULTIVARIATE ANALYSIS



Some of these variables are:

- Sheet Ash
- pH
- Grammage
- WSR Dosage
- Degree of Refining
- White water Consistency (fiber and filler)
- Fresh water Hardness

MODEL DEVELOPMENT & EVALUATION

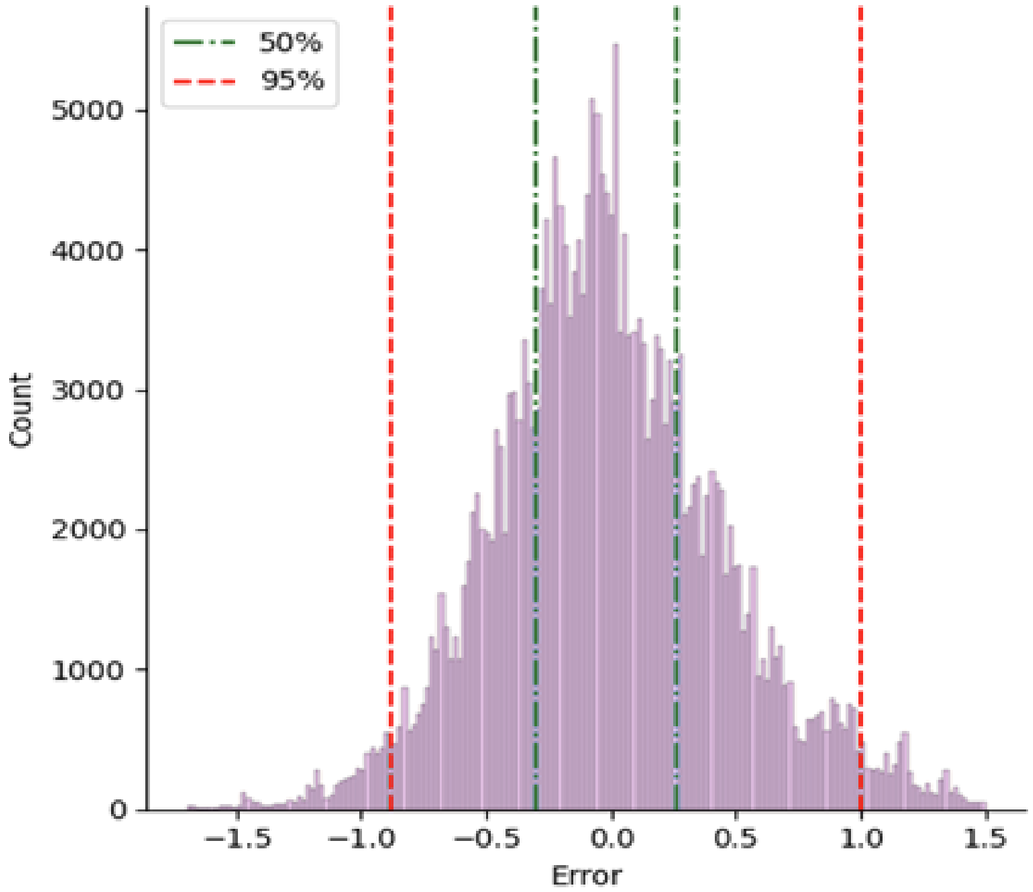


ML MODELS

- Support Vector Regression
- K Nearest Neighbour
- Linear Regression

- R Square
- RMSE

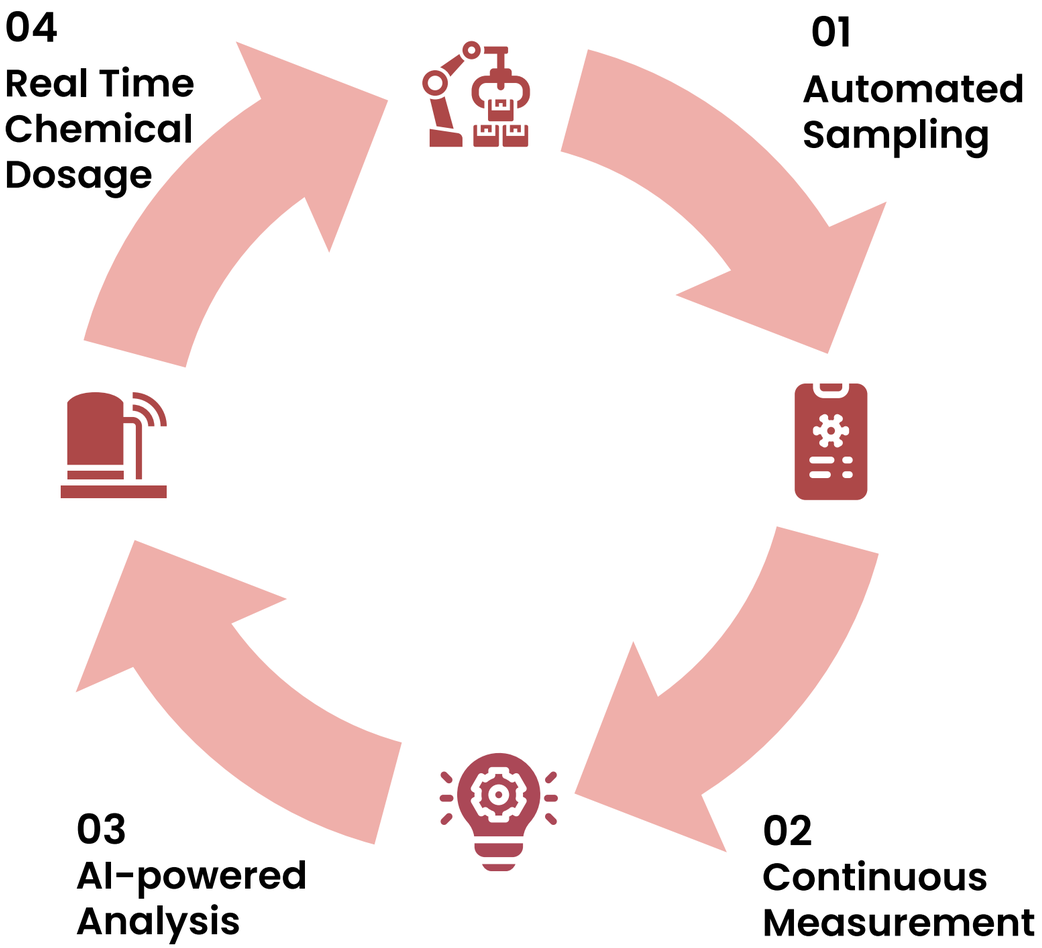
LAB VS PREDICTED WET TENSILE



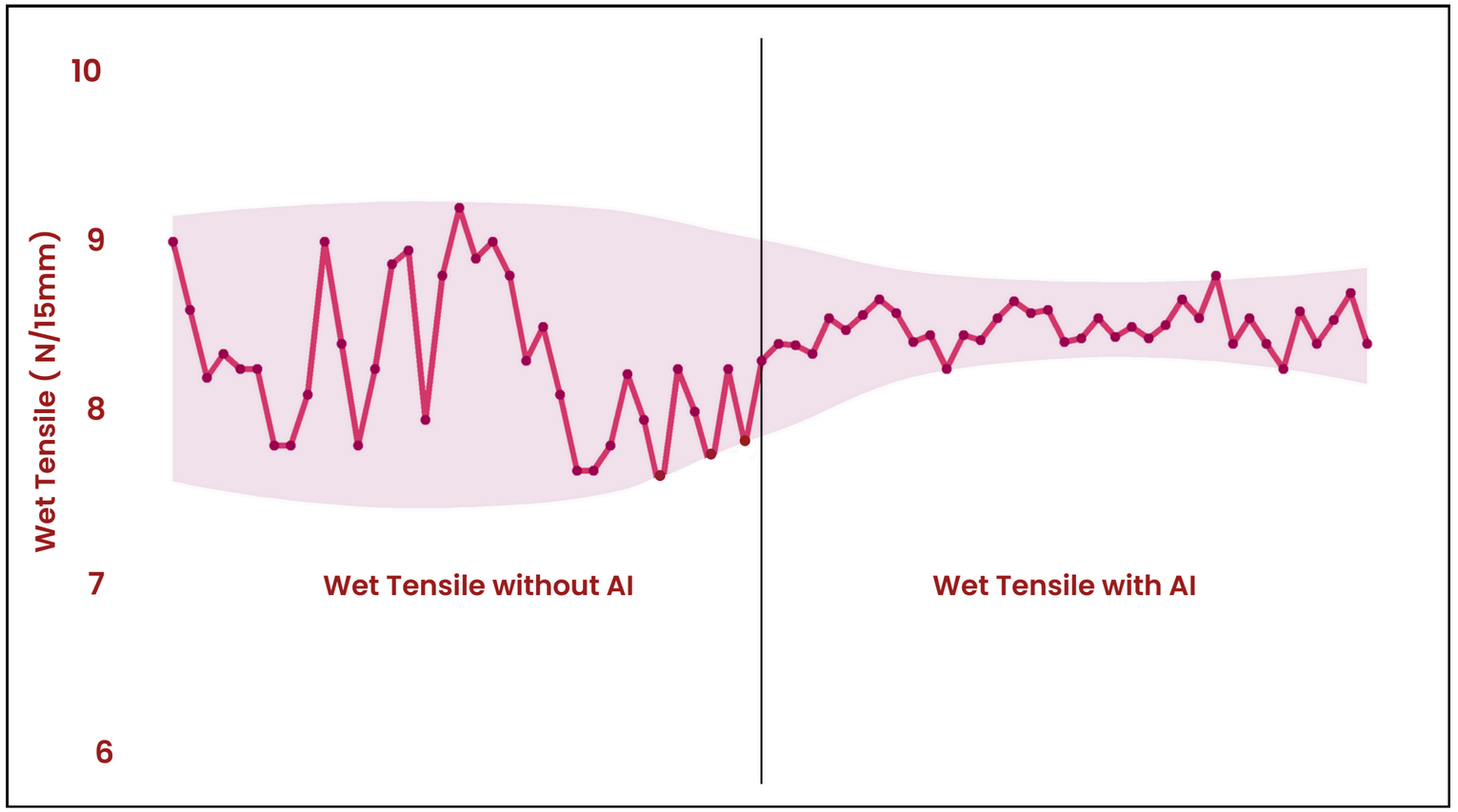
R Square	0.94

> 95% of the variation between the lab wet tensile strength and predicted wet tensile strength falling within the range of -1 to 1

AUTOMATED WET STRENGTH RESIN DOSING

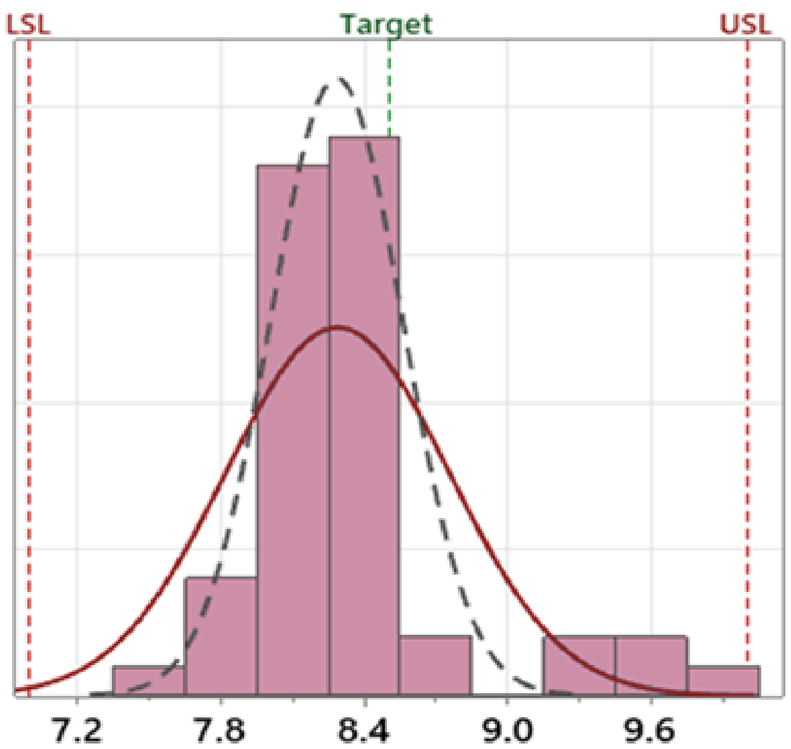


LOWER WET TENSILE DEVIATION

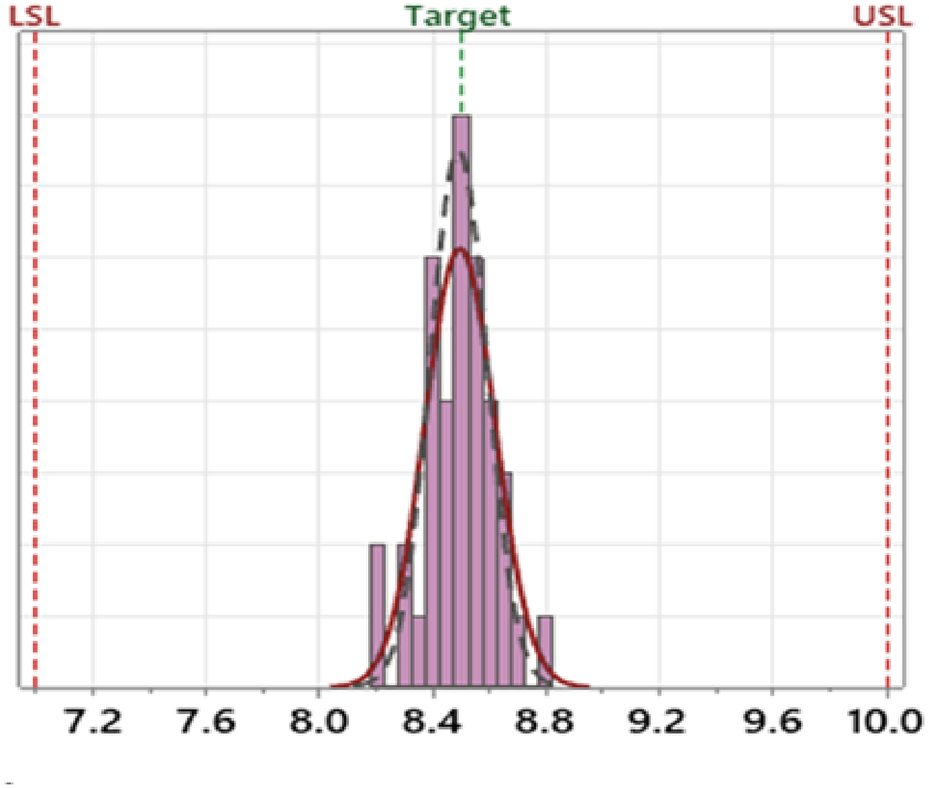


	Without AI	With AI
Std Dev	0.5	0.1
Average	8.3	8.5

LOWER WET TENSILE DEVIATION

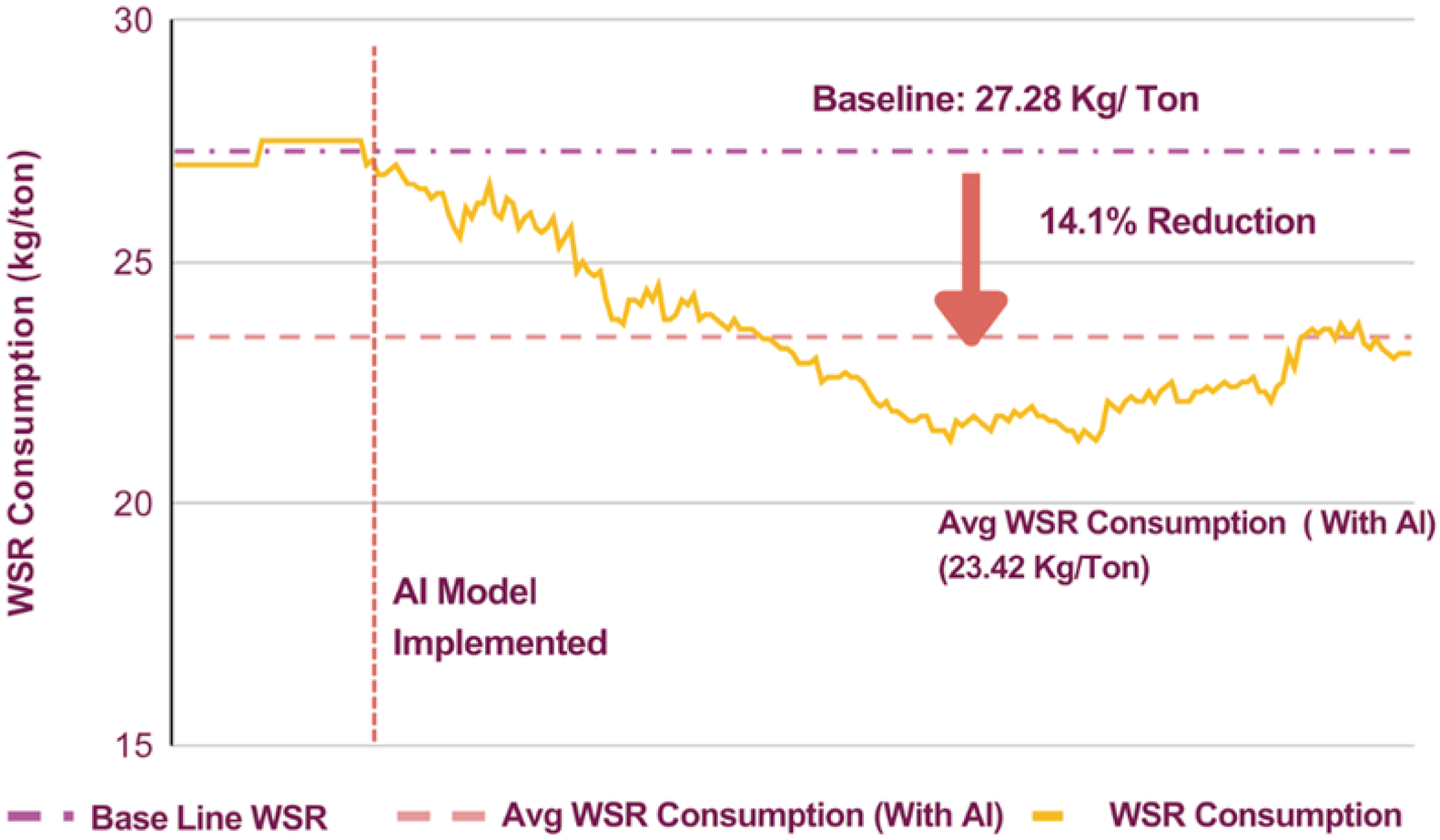


Without AI : CpK=1.54



With AI : CpK=4.04

LOWER WET STRENGTH RESIN DOSAGE



CONCLUSION

The specialty-grade manufacturer could reduce wet tensile variation while optimising wet strength resin dosage in real time:

- **Consistent Wet Tensile**
  Standard deviation of 0.1 (80% improvement)

- **Lower Off-quality Production**
  1.5% rejection during grade change (70% improvement)

- **Reduce Wet Strength Resin Dosage**
  Avg of 23 Kg/Mt (14% reduction)

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THANK YOU!

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