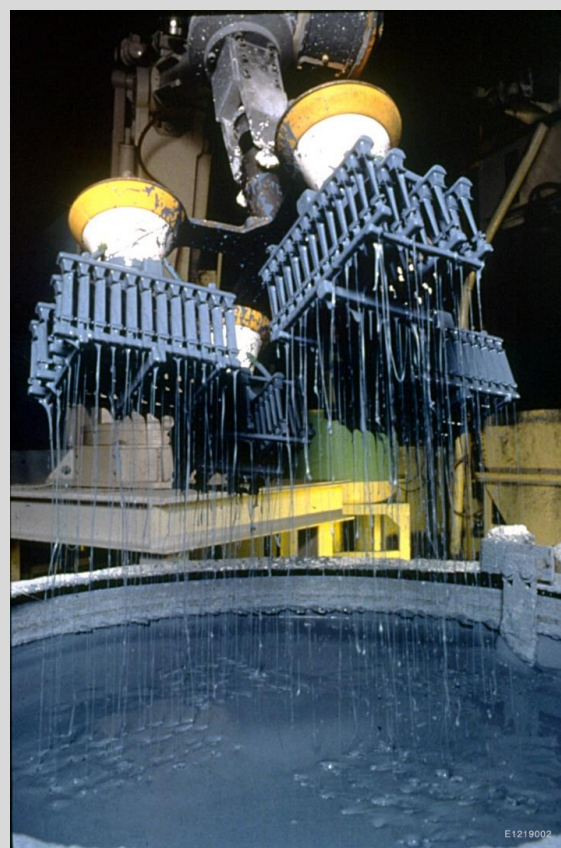


## BACKGROUND

- A wax assembly is repeatedly dipped into a slurry and sprayed with stucco until a “shell” is created
- The shell is used to cast metal and shell properties are important as the shell being too weak or too strong can lead to casting defects
- Properties like viscosity and plate weight are measured while plant temperature and humidity are controlled



## OBJECTIVES

Analyze the given data for general trends and use external weather data to find (if any) trends exist between environmental conditions and shell properties

## METHODS AND DATA

Two datasets from different plants where shells are manufactured from Oct 2019 – Sep 2022:

1. Whitehall, MI (HWC)
2. Wichita Falls, TX (HWF)

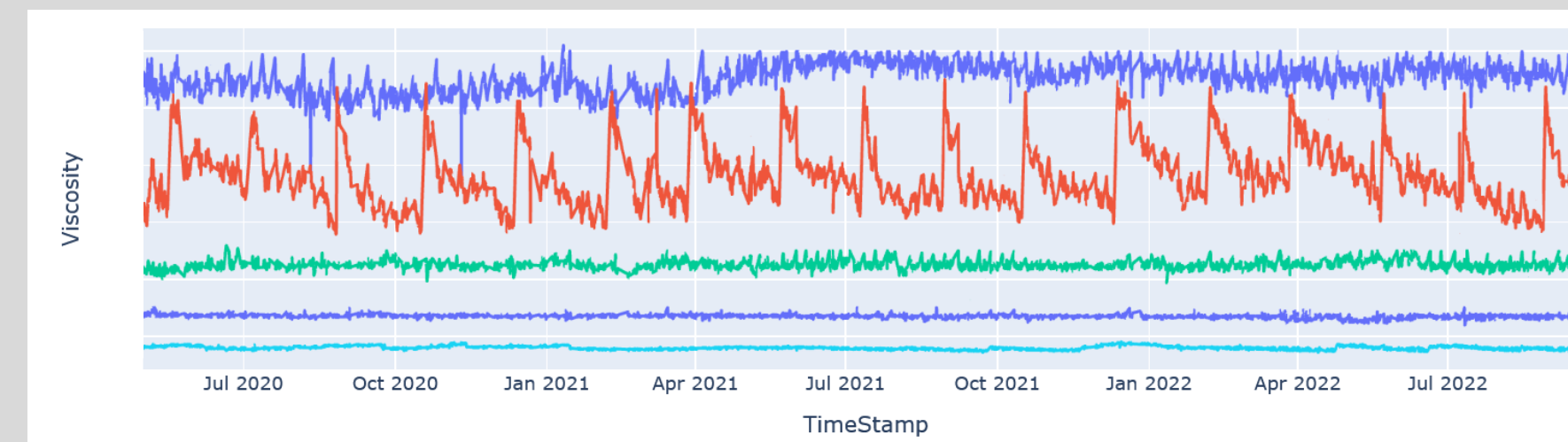
Data in these sets includes (but not limited to):

1. Robot cell and slurry combination
2. Viscosity
3. Plate Weight
4. Temperature
5. Humidity
6. Timestamp

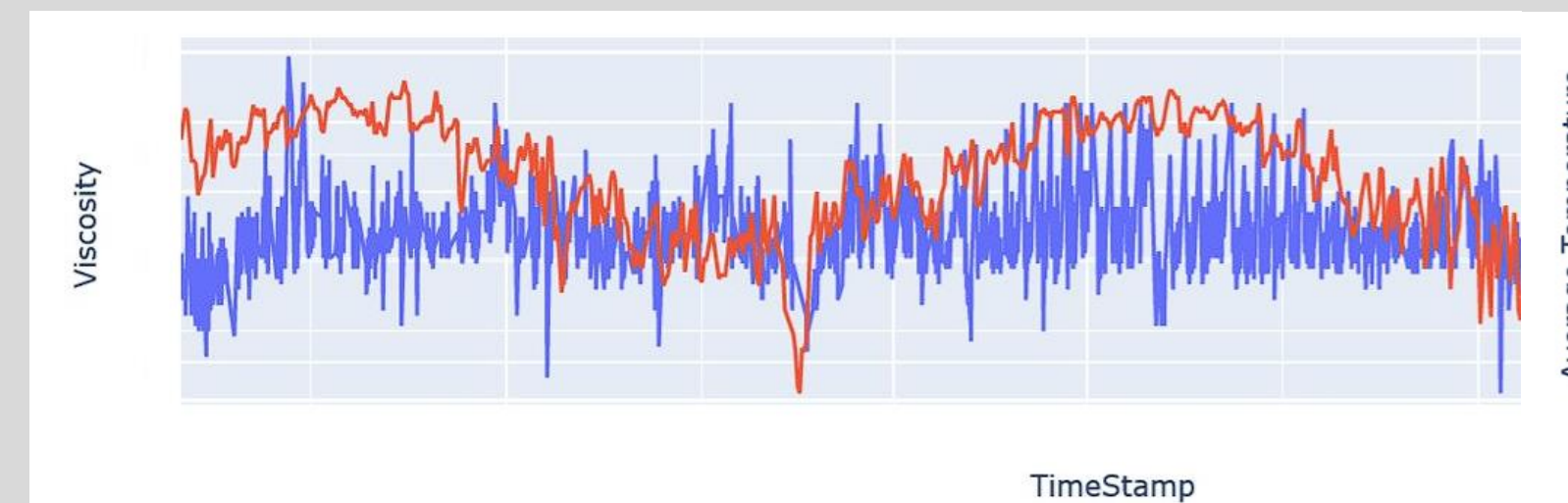
Two datasets for outside weather data from NOAA in both locations from Jan 2019 – Dec 2022:

- Daily temperature (min, avg, and max)
- Precipitation
- Wind speed

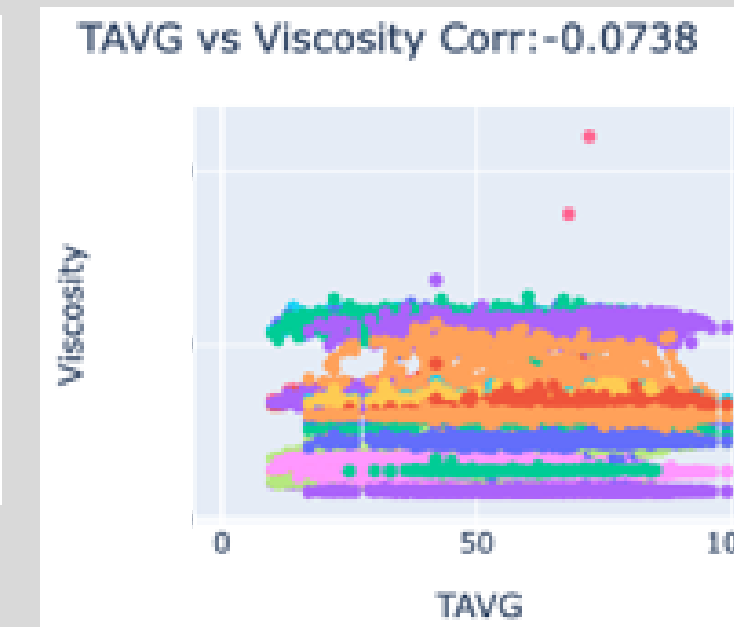
## VISCOSITY ANALYSIS



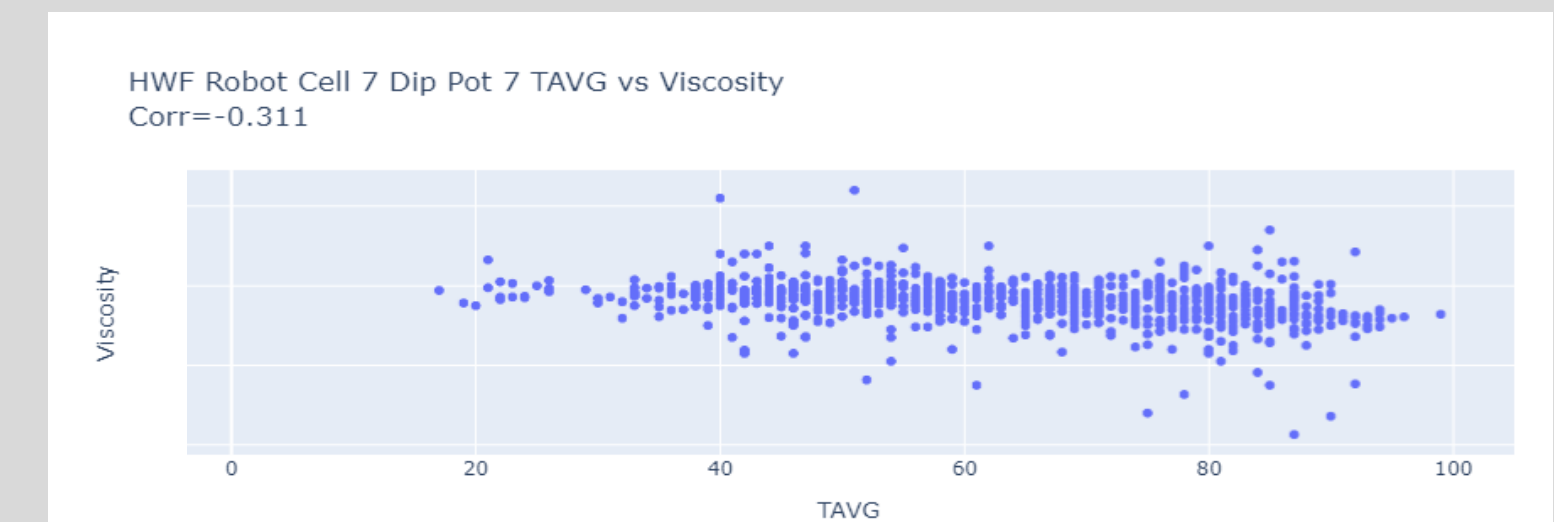
- Time series graphs comparing mean viscosity value over time.
- Each color showcases unique Plant, Robot Cell, Pot combos (HWC).
- Each combination has its own unique behavior over time



- Mean Viscosity of a Single Plant, Cell, and Dip Pot (indigo) vs Time and Outside Weather Temperature (red) vs Time

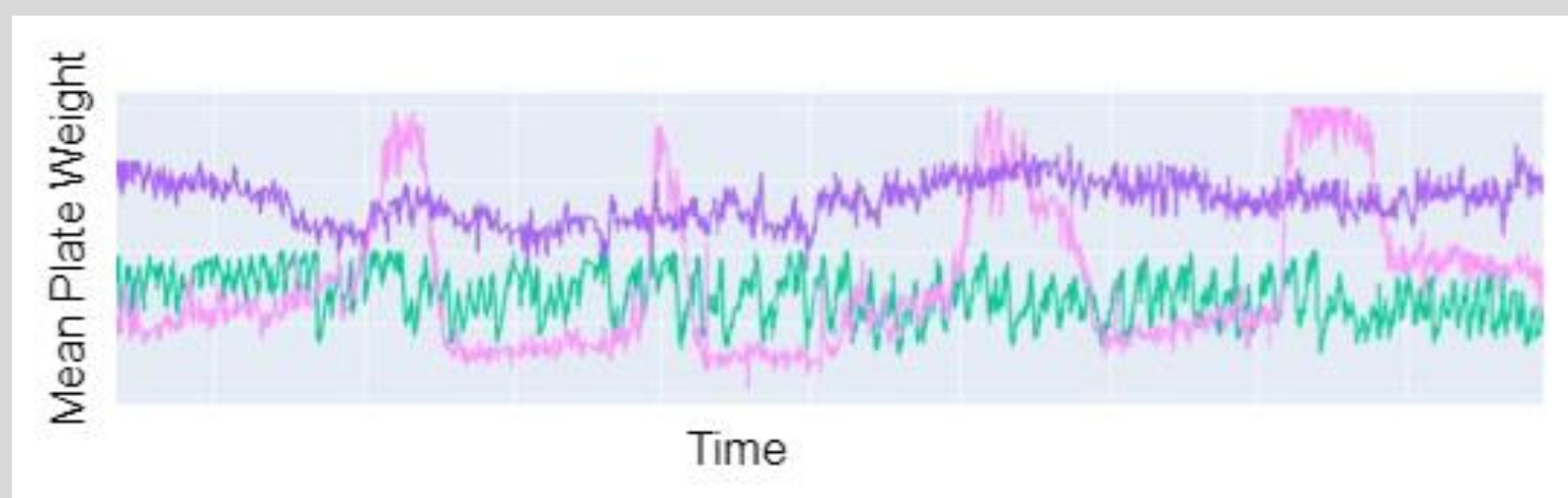


- Correlation plot between Viscosity and Outside Temp for each combination
- Each color is a different plant/pot/cell combination
- No correlation across the dataset

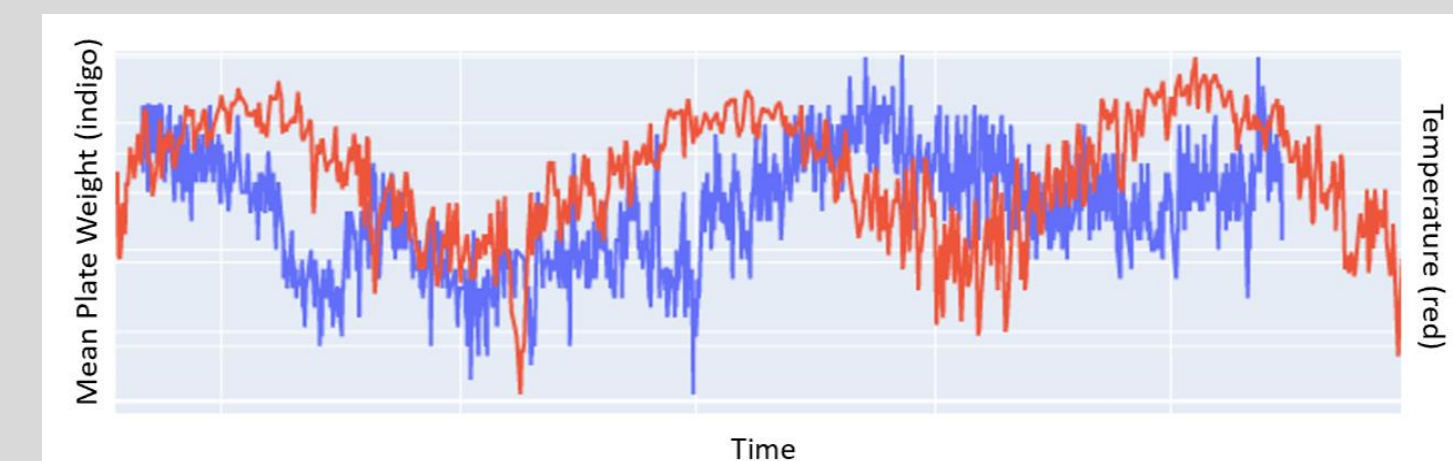


Within each plant/cell/pot combination, there are some slurries that have a significant relationship (> 0.3) between outside temperature and viscosity

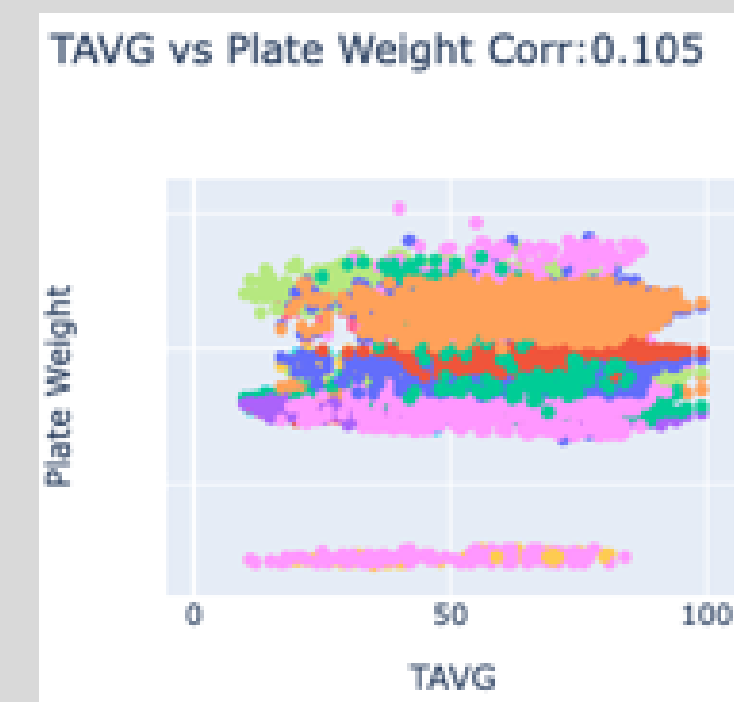
## PLATE WEIGHT ANALYSIS



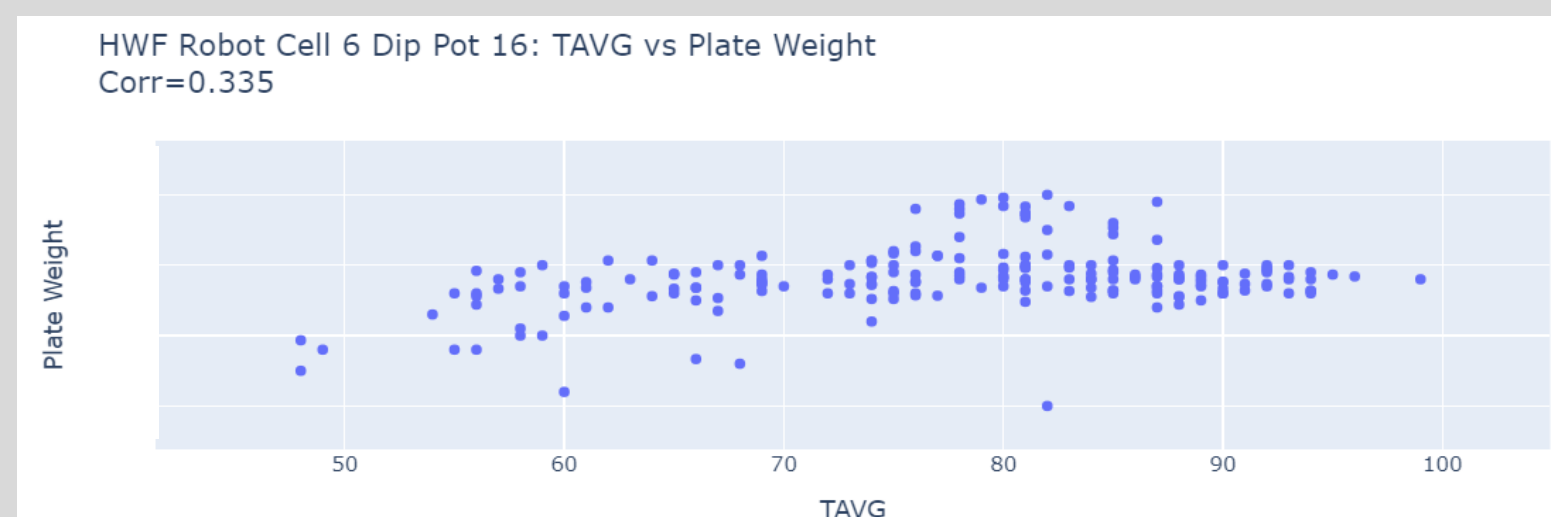
- Time series graphs comparing mean plate weight value over time.
- Each color showcases a unique Plant, Robot Cell, Pot combos (HWF)
- Each combination has its own unique behavior over time



- Mean Plate Weight of a Single Plant, Cell, and Dip Pot (indigo) vs Time and Outside Weather Temperature (red) vs Time



- Correlation plot between Plate Weight and Outside Temp for each combination
- Each color is a different plant/pot/cell combination
- No correlation across the dataset



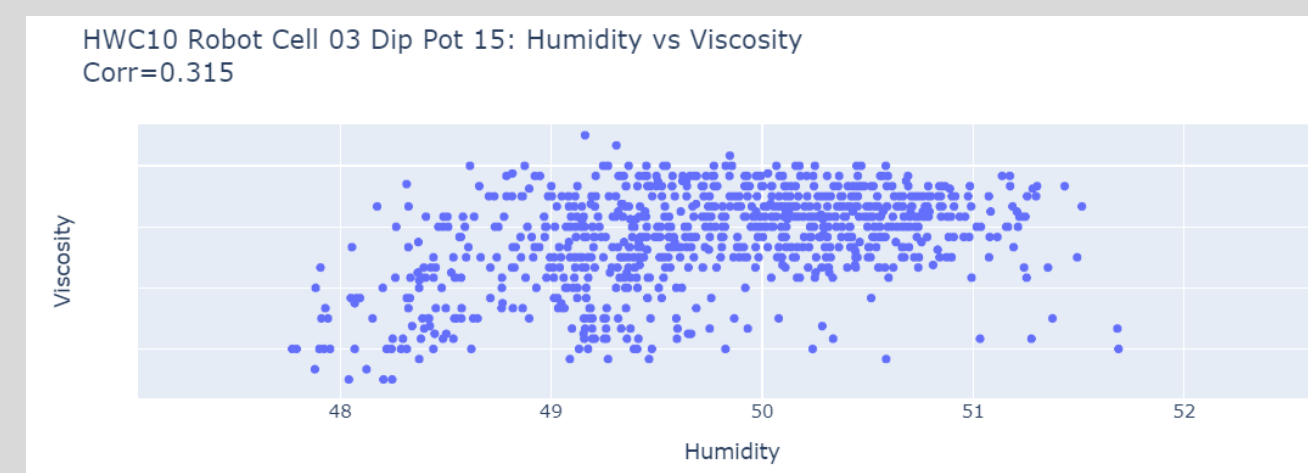
Within each plant/cell/pot combination, there are some slurries that have a significant relationship (> 0.3) between outside temperature and plate weight

## FUTURE WORK

### Humidity Analysis:

Goal is to replicate analysis with outside temperature with a dataset that has **outside humidity data**

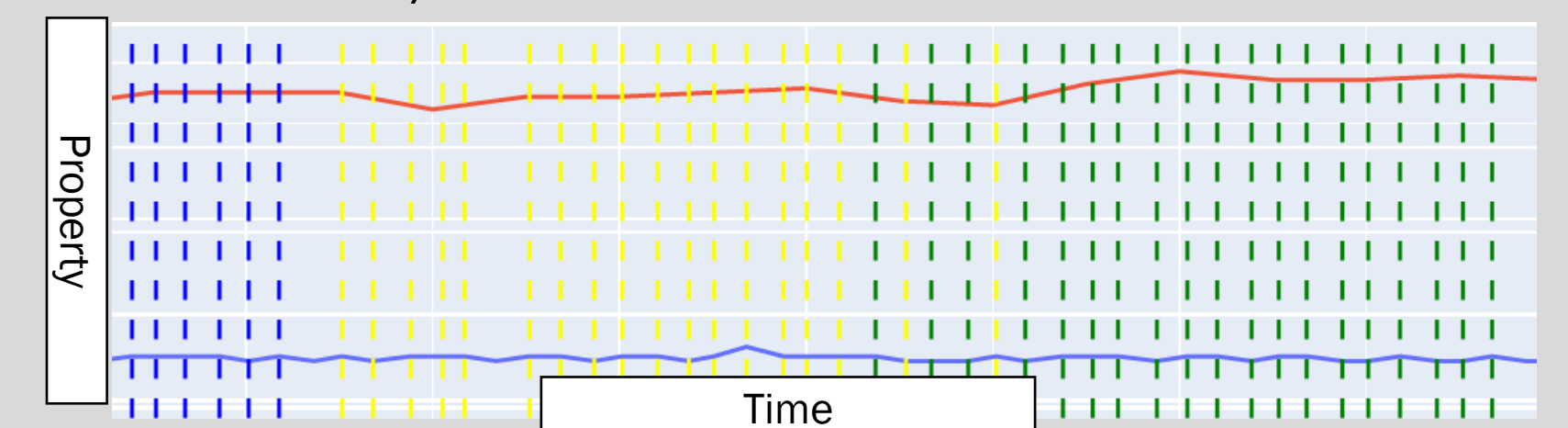
- There are combos where humidity has a significant relationship to slurry properties
- Improve combination correlation analysis



### Thin Add Type Analysis:

Goal is to mark a specific location in time where something was added to the slurry to characterize specific behavior in a time series graph

- Blue = Water
- Yellow = Ludox
- Green = 50/50 mix



## ACKNOWLEDGEMENTS

We would like to thank Haydn Schroader, Ben Gregory, Bart Kilinski, Raheleh Rahimi, Kevin Amstutz, and the rest of the Data Mine staff for all their help with the project this year.