

# Type II Producer Data: Preliminary Analysis

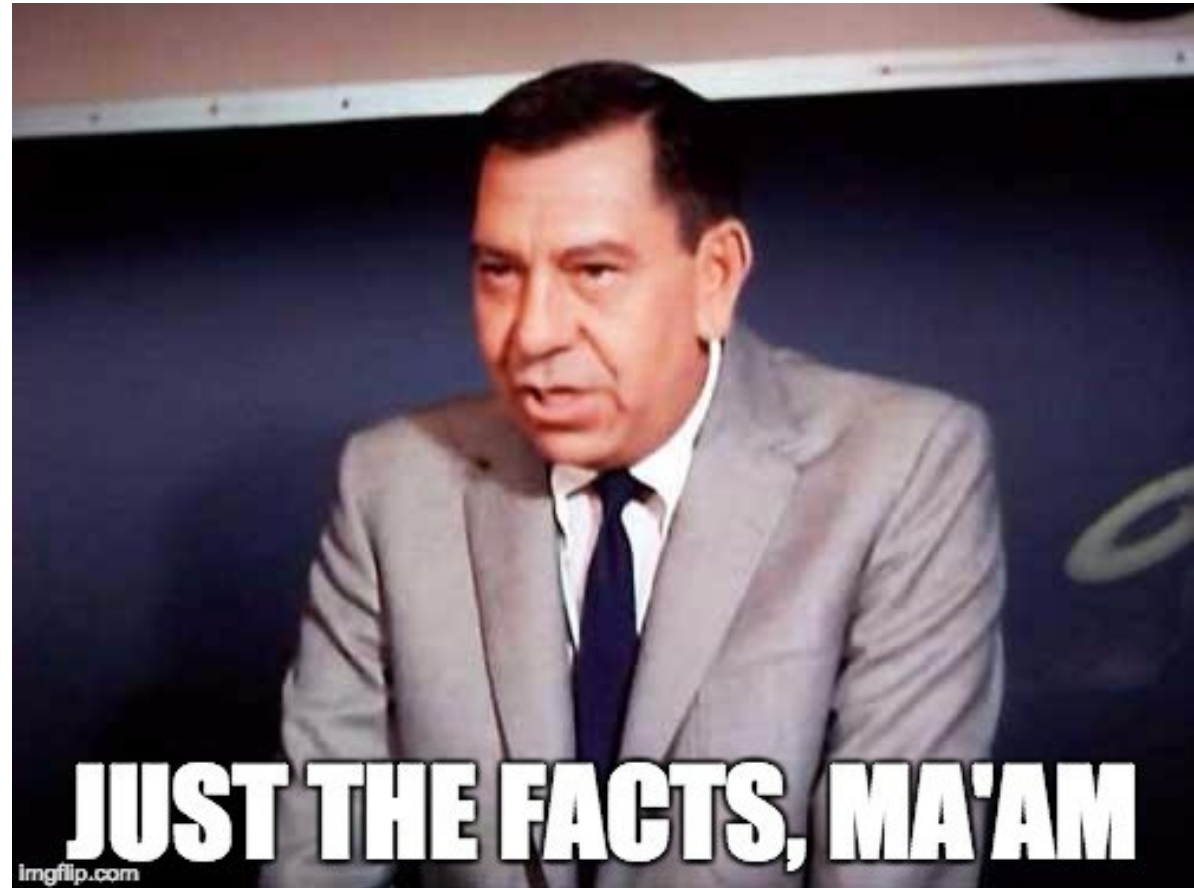
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# NC<sup>2</sup> Study of AASHTO M 240/ASTM C595 Type IL Cement Properties

- There has been much discussion of Type IL cement variability
- Specifics have been in short supply
- Like Joe said, we're just looking for the facts



<https://i.imgflip.com/13uchl.jpg>

# NC<sup>2</sup> Study of AASHTO M 240/ASTM C595 Type IL Cement Properties

- At the NC<sup>2</sup> meeting held in Rosemont, Illinois, April 8 - 10, 2025, a half-day workshop on implementation of blended cements was held
- Some NC<sup>2</sup> stakeholders (e.g., SHAs and contractors) raised concerns over the variability in limestone content of Type IL cements
- Information on cement characteristics is limited for users; SHAs receive 30-day mill certifications, which are often delayed and do not reflect day-to-day variations
- Stakeholders felt that more complete data for all parties is needed

# NC<sup>2</sup> Study of AASHTO M 240/ASTM C595 Type IL Cement Properties

- The NC<sup>2</sup> Chair sent a request to 23 cement companies identified from a review of the NC<sup>2</sup> states' approved product lists (APLs)
- In total across all companies, 82 cement plants were identified as having a Type IL cement listed on at least one state's APL
- 138 plant personnel were identified from the same scan of the APL data and were contacted
  - Some alive, some not sure, some in new jobs, some still there
  - Additional contacts were added from personal records
- The cement producers were requested to provide the following:

# NC<sup>2</sup> Study of AASHTO M 240/ASTM C595 Type IL Cement Properties

On behalf of NC<sup>2</sup>, the SHAs are collectively requesting Type IL cement data from all plants shown in Attachment 1, retroactive to January 1, 2022 through June 30, 2025, providing at a minimum the following information (for data available):

1. Bulk Shipping Sample Data (identify test methods used)
  - 3, 7, and 28-day compressive strength
  - Time of Set
  - Fineness
  - Loss on ignition
  - Sulfate Content (SO<sub>3</sub>)
  - Limestone content
2. Monthly Composite Samples
  - 30-day published mill certifications data

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- Limestone content

2. Monthly Composite Samples

- 30-day published mill certifications data

3.5 years if you're keeping score at home

**Note:** We were guided to ask for bulk shipping data by producers.

The thinking was it would best represent what was shipped, which may be different from what is produced on a given day, for many reasons (e.g., blending)

So, you might ask,  
how'd that work out for ya?

# Companies Responding = 10

- Amrize
- Ash Grove Cement
- CalPortland
- Cemex
- GCC
- Heidelberg Materials
- National Cement
- Quikrete Cement
- St Marys Cement
- St. Lawrence Cement

# By the Numbers

- Total plants identified, all companies = 82
- Total plants responding = 57 (70%)
- “Daily” data = 37 of 57 (65%)
- Number of plants still pending for daily data = 20 of 57 (35%)
  - 11 are promised, 6 are in discussion
  - 3 are not providing data beyond monthly mill certs (1 unresponsive, 2 data unavailable)
- Monthly Data (tabulated) = 46 of 57 (81%)
- Mill Certs (published) = 30 of 57 (53%)
- Limestone Targets = 50 of 57 (88%)
- Reporting time periods ranged from less than one year to three years

# Issues

- We were told going in – and can confirm – there is no uniform approach to what is analyzed and how frequently
- Data received included bulk daily shipping, daily composite, and monthly composite
- **Note:** For this purpose, daily *does not* mean “every day”. The term daily is being used to describe the incremental samples that are analyzed and are included in the average reported as a thirty-day mill cert
- In most cases, limestone is not analyzed on the bulk daily shipping sample – generally taken for ASTM C917 analysis... What is ASTM C917?



Designation: C917/C917M – 25

## Standard Test Method for Evaluation of Variability of Cement from a Single Source Based on Strength<sup>1</sup>

### 1. Scope\*

1.1 This test method covers a procedure for determining the variability of a hydraulic cement produced at a single source using strength tests as the characteristic property. It is intended that this test method normally be used for the predominant cement manufactured at a cement plant. Guidelines for sampling, testing, presentation of results, and evaluation are given.

# ASTM C917

## 4. Significance and Use

4.1 This test method is designed to present in a standardized format information on the variability of strength of cement from a single source over a period of time. It can be applied to all hydraulic cements covered in Specifications **C150**, **C595**, and **C1157**. The results derived from this test method are intended for information only and are not requirements of any existing ASTM specification. A specification may refer to this test method to obtain information on the variability of cement from a single source.

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# ASTM C917

4.2 The procedure is based on obtaining samples from locations during the delivery of cement to the user and is more representative of the variability of cement used in concrete production than test data reported on mill test reports. Variation determined from the test results is corrected for testing error, therefore giving the user one indicator of the source variation of the cement.

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# ASTM C917 - Discussion

- Used by U.S. cement producers for quality control, universally
- Only focusses on strength
- Could – through adoption of new tests - provide an opportunity for obtaining more data but currently is not referenced by AASHTO or ASTM cement standards
- If modified – the important question is what to measure?
- Does limestone content alone tell us anything useful? A point to be revisited after the NC<sup>2</sup> study is completed

# Other Data Availability

- Monthly composites used for mill certs – from daily composites
- Daily composite - composite of hourly samples taken for process control at the mill
  - SO<sub>3</sub>, Blaine, 325 mesh
- Daily composites are not universal across all plants; maybe analyzed for specification requirements (i.e., limestone) but not for all plants
- Daily composites represent production but not necessarily shipping; depends on the sample point, number of circuits in a mill being combined, blending stockpiled material, etc.

# Data Analysis

- Daily data received for this study was primarily daily composite samples
- Some producers have limestone data from their ASTM C917 bulk shipping sample but must most do not
- Monthly composites (mill cert data) can and will be analyzed as well but the first pass will focus on the daily data that is available
- First pass is focusing on AASHTO M 240/ASTM C595 requirements for limestone targets



**Designation: C595/C595M – 24**

# **Standard Specification for Blended Hydraulic Cements<sup>1</sup>**

## 15. Certification

15.3 At the request of the purchaser, the manufacturer shall also state in writing that the amounts of a constituent in the finished cement will not vary more than the percentages listed in **Table 5** with a 99 % probability of compliance between lots or within a lot (see **Note 12**).

- **Questions:** What is in Table 5? What is a “lot”? What is Note 12?

**TABLE 5 Permitted Variation in Mass Percentage of Constituent**

Constituent	Maximum Variation in Amount From Target, % by Mass of Blended Cement
Silica fume, metakaolin, limestone	± 2.5
All other constituents	± 5.0



Designation: C183/C183M – 22

## Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement<sup>1</sup>

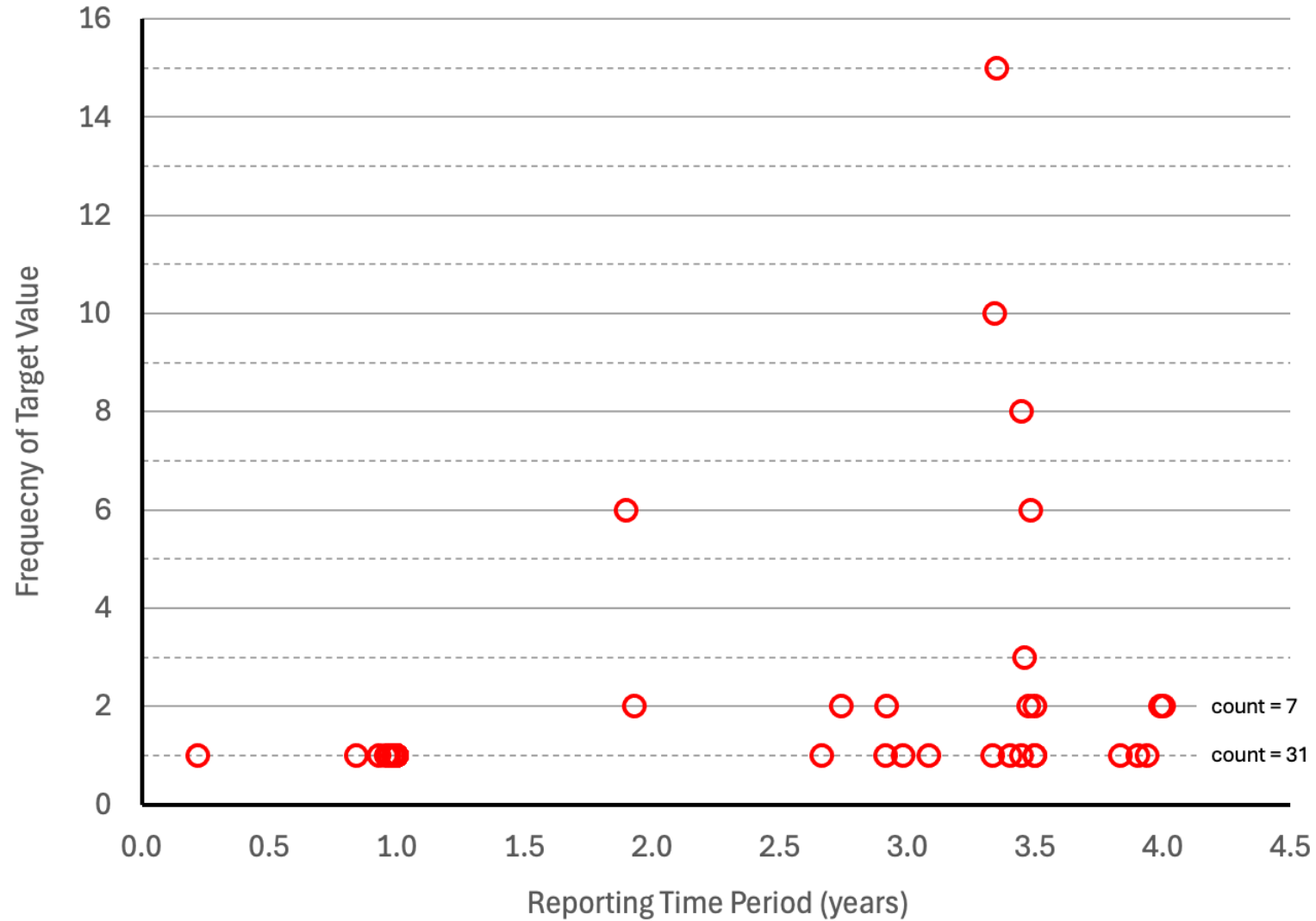
3.1.1 *lot (of cement), n*—specific quantity of cement offered for inspection at any one time. A lot may be one or more storage bins filled consecutively. A lot may also be the contents of one or more transport units representing cement drawn from the same storage bin.

NOTE 12—To satisfy the 99 % probability of compliance, the manufacturing process must be capable of producing a cement such that the standard deviation of the determined mass percentage of silica fume, metakaolin, or limestone in the cement is less than 1 %. For all other ingredients, the standard deviations of their determined mass percentages have to be less than 1.9 %. The variation in determined mass percentage includes that due to the amount and chemistry of the constituent, as well as that due to variation in verification testing. As an example, Type IP(5) made with silica fume indicates a blended hydraulic cement determined to contain between 2.5 % and 7.5 % silica fume by mass. A Type IP(20) cement made with fly ash indicates a blended cement determined to contain between 15 % and 25 % fly ash by mass.

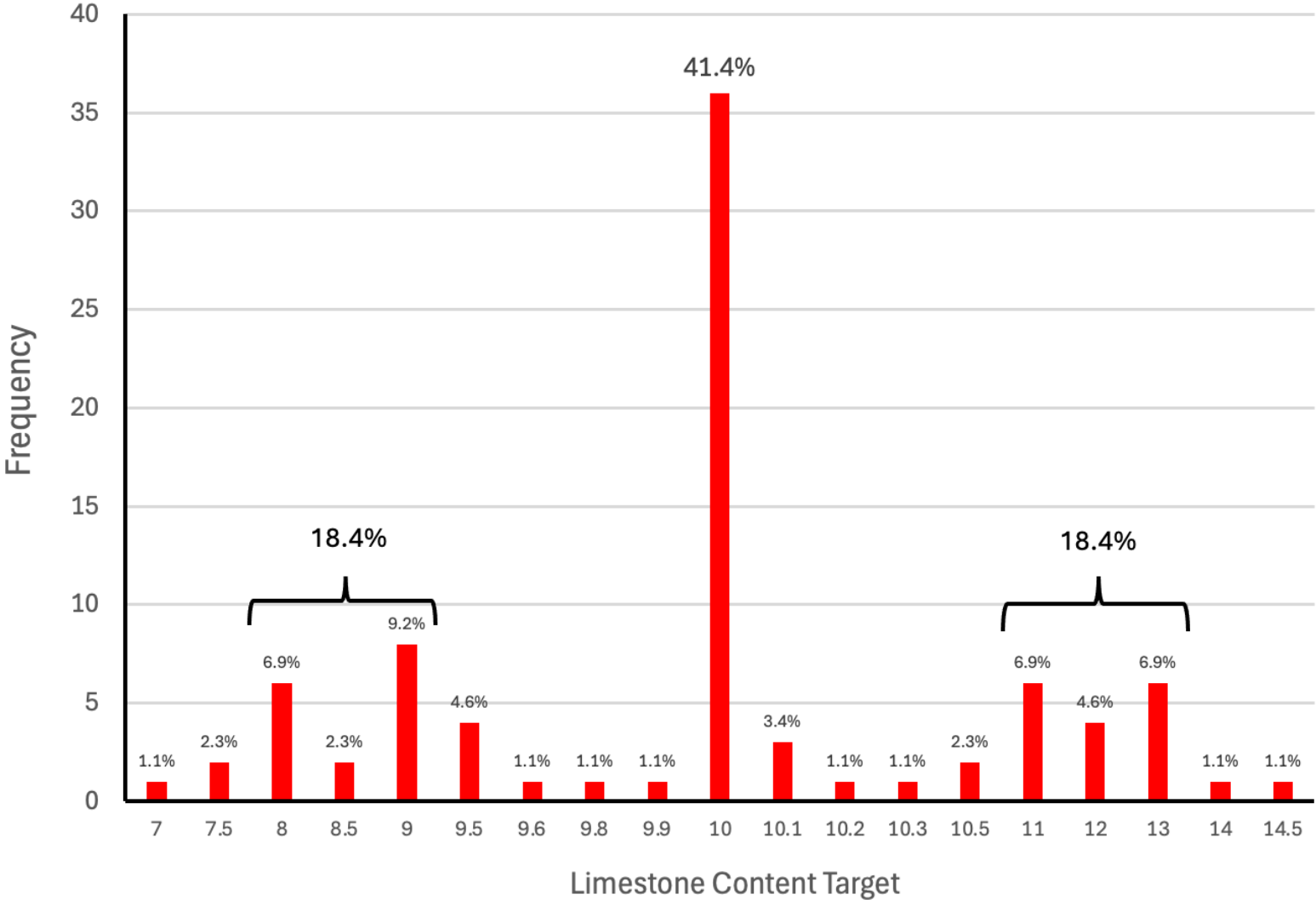
NOTE 12—To satisfy the 99 % probability of compliance, the manufacturing process must be capable of producing a cement such that the standard deviation of the determined mass percentage of silica fume, metakaolin, or limestone in the cement is less than 1 %. For all other ingredients, the standard deviations of their determined mass percentages have to be less than 1.9 %. The variation in determined mass percentage includes that due to the amount and chemistry of the constituent, as well as that due to variation in verification testing. As an example, Type IP(5) made with silica fume indicates a blended hydraulic cement determined to contain between 2.5 % and 7.5 % silica fume by mass. A Type IP(20) cement made with fly ash indicates a blended cement determined to contain between 15 % and 25 % fly ash by mass.

So, what did  
you learn so far?

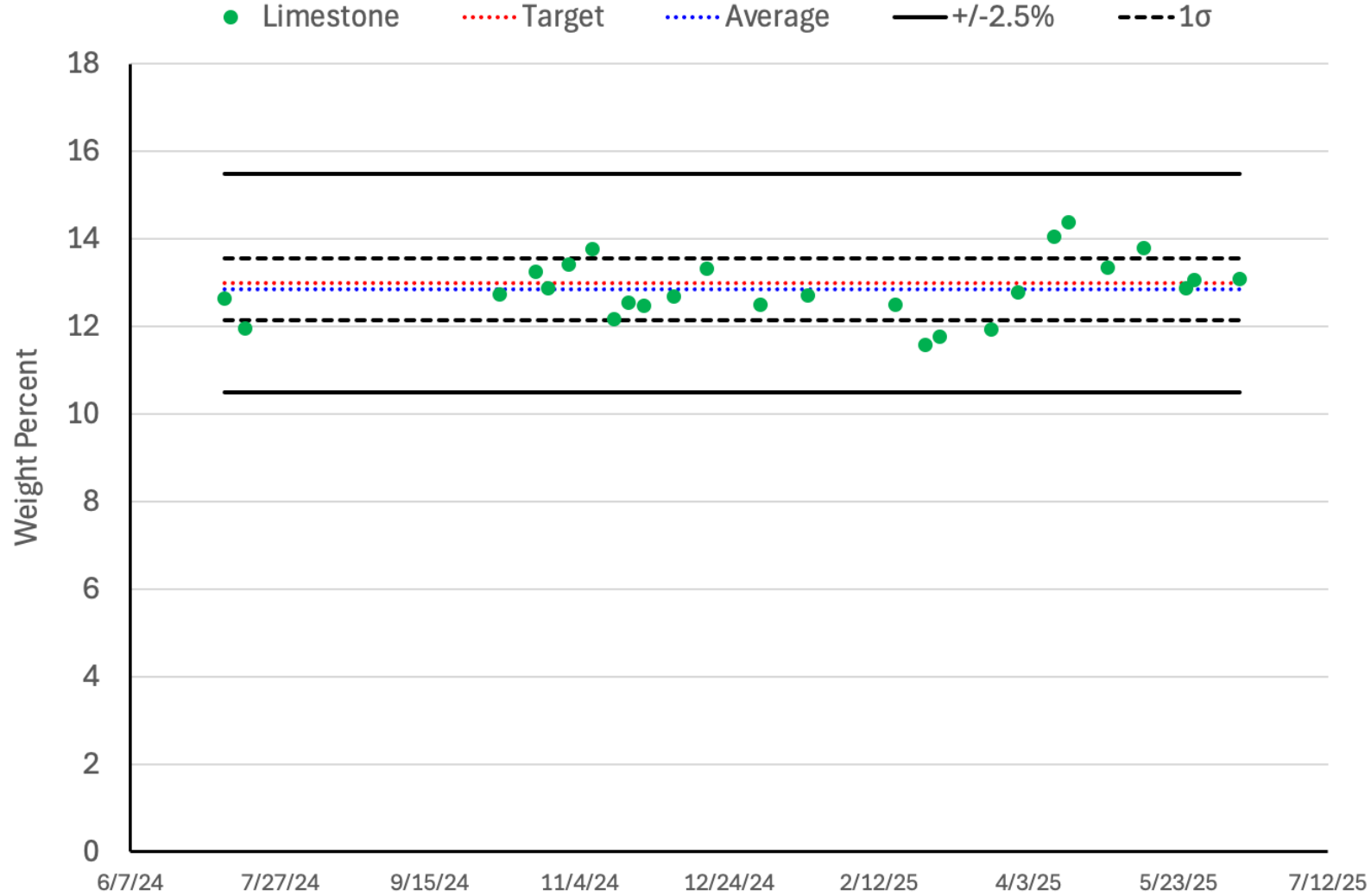
Number of Targets per Plant Over Reporting Time Period



### Limestone Targets

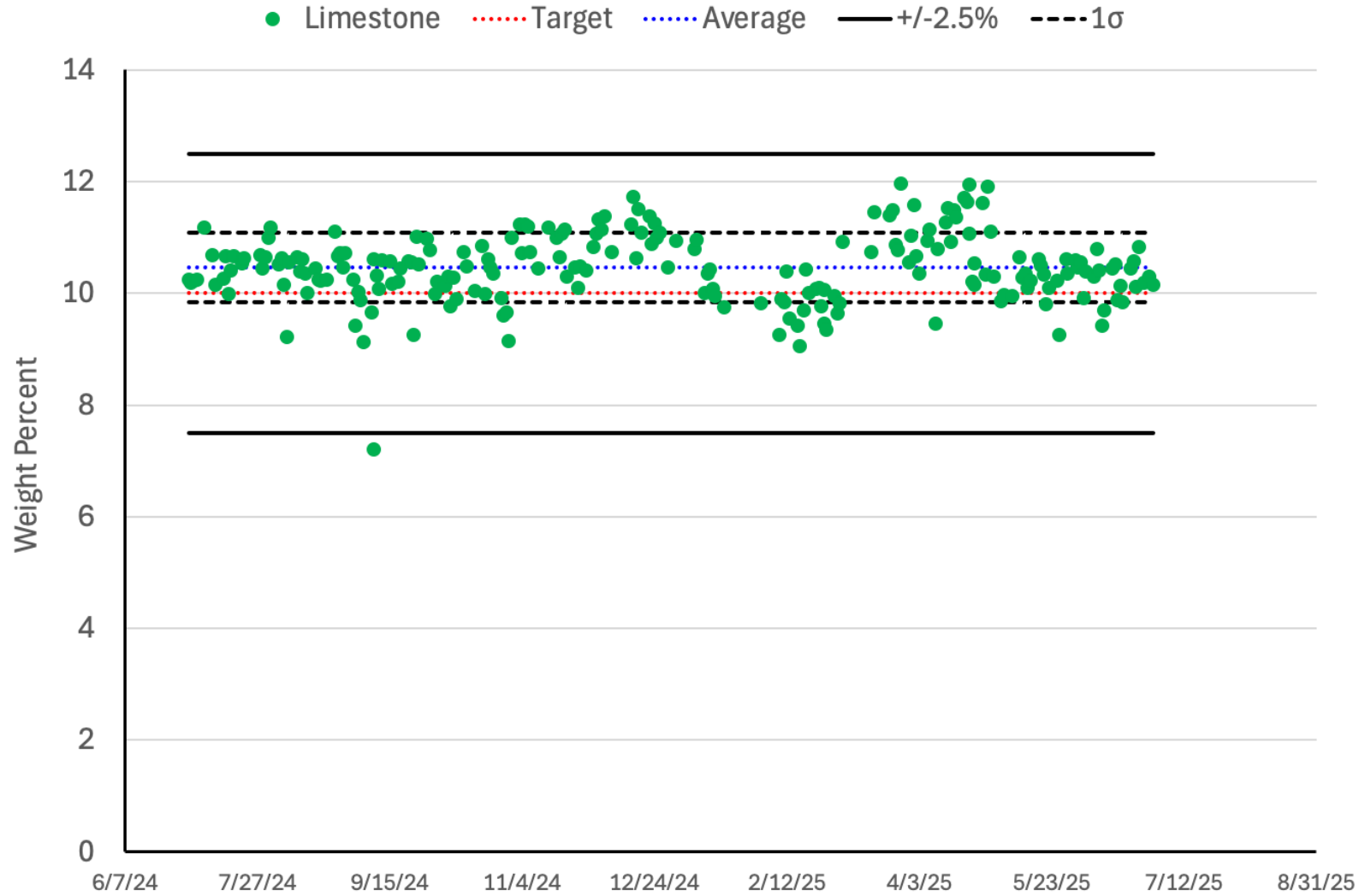


### Plant 183 - Limestone



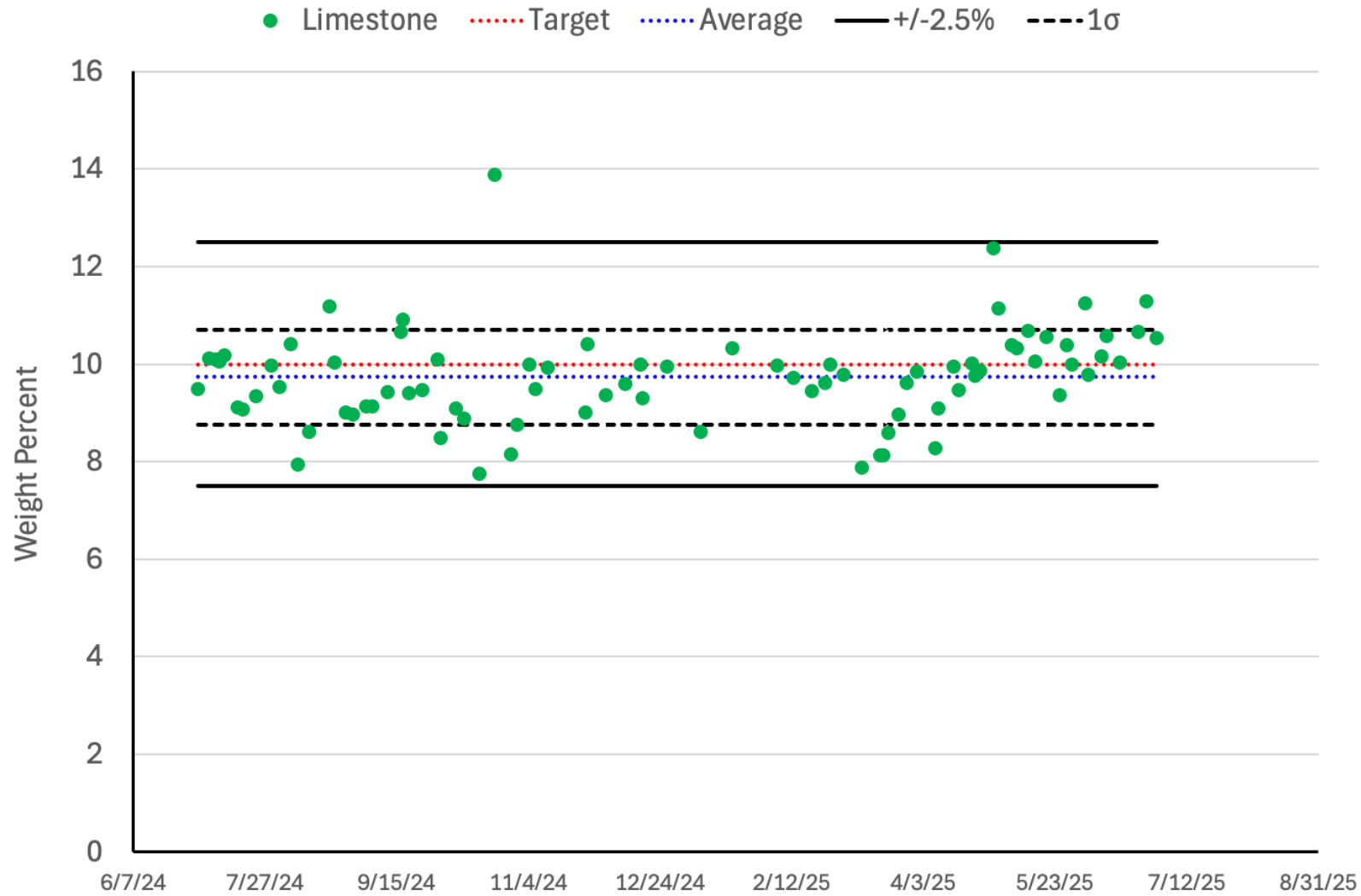
Min (%)	11.6
Max (%)	14.4
Median (%)	12.8
Average (%)	12.9
Std Dev	0.70
C of V	5.4%
+ 1σ	13.5
- 1σ	12.2
% ± 1σ	69%
Target (%)	13
+ Dev. Absolute (%)	1.38
- Dev. Absolute (%)	1.43
% ± 2.5% of Target	100.0%

### Plant 843 - Limestone



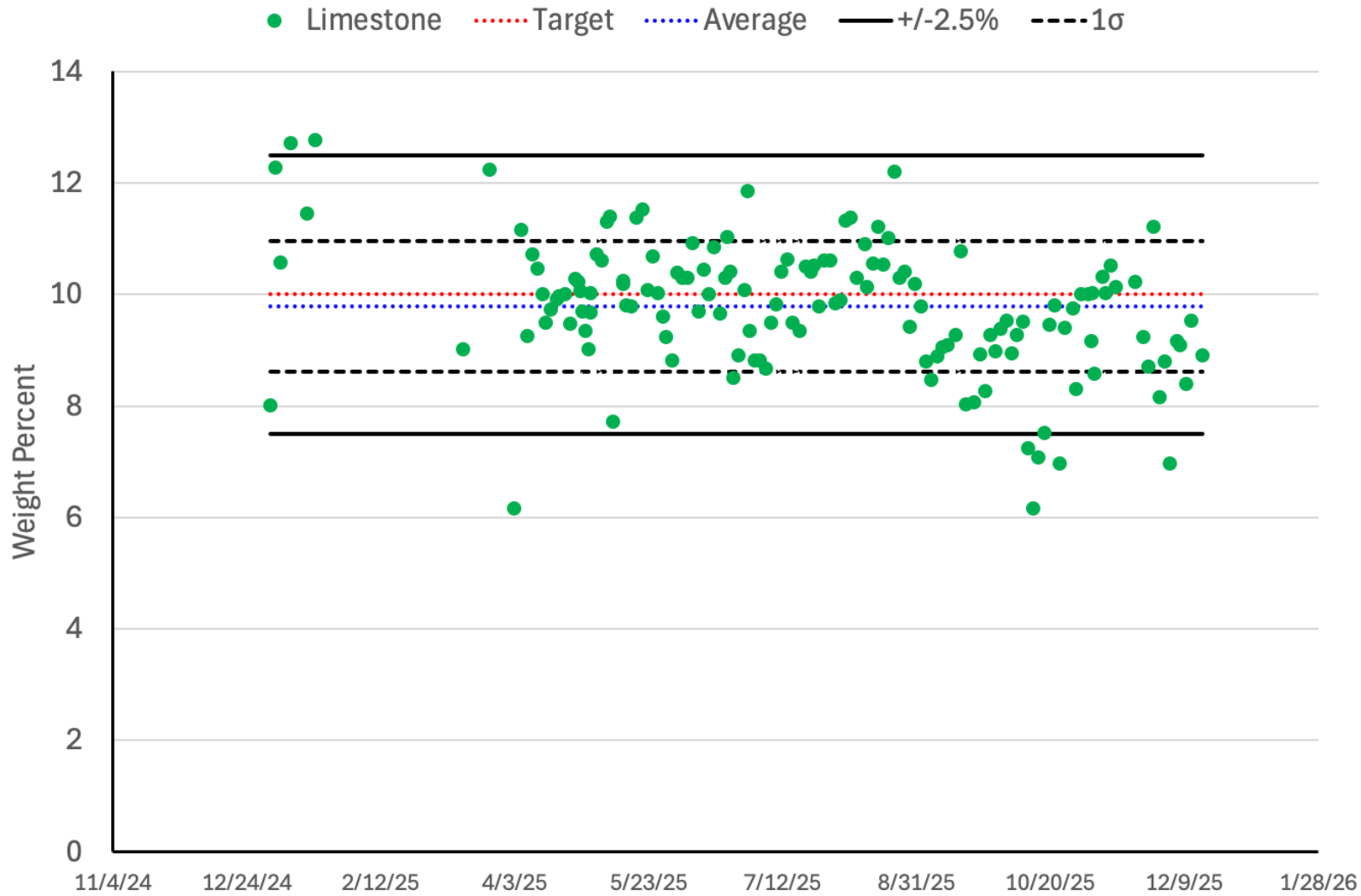
Min (%)	7.2
Max (%)	12.0
Median (%)	10.5
Average (%)	10.5
Std Dev	0.62
C of V	5.9%
+ 1σ	11.1
- 1σ	9.8
% ± 1σ	89%
Target (%)	10
+ Dev. Absolute (%)	1.96
- Dev. Absolute (%)	2.79
% ± 2.5% of Target	99.5%

### Plant 641 - Limestone



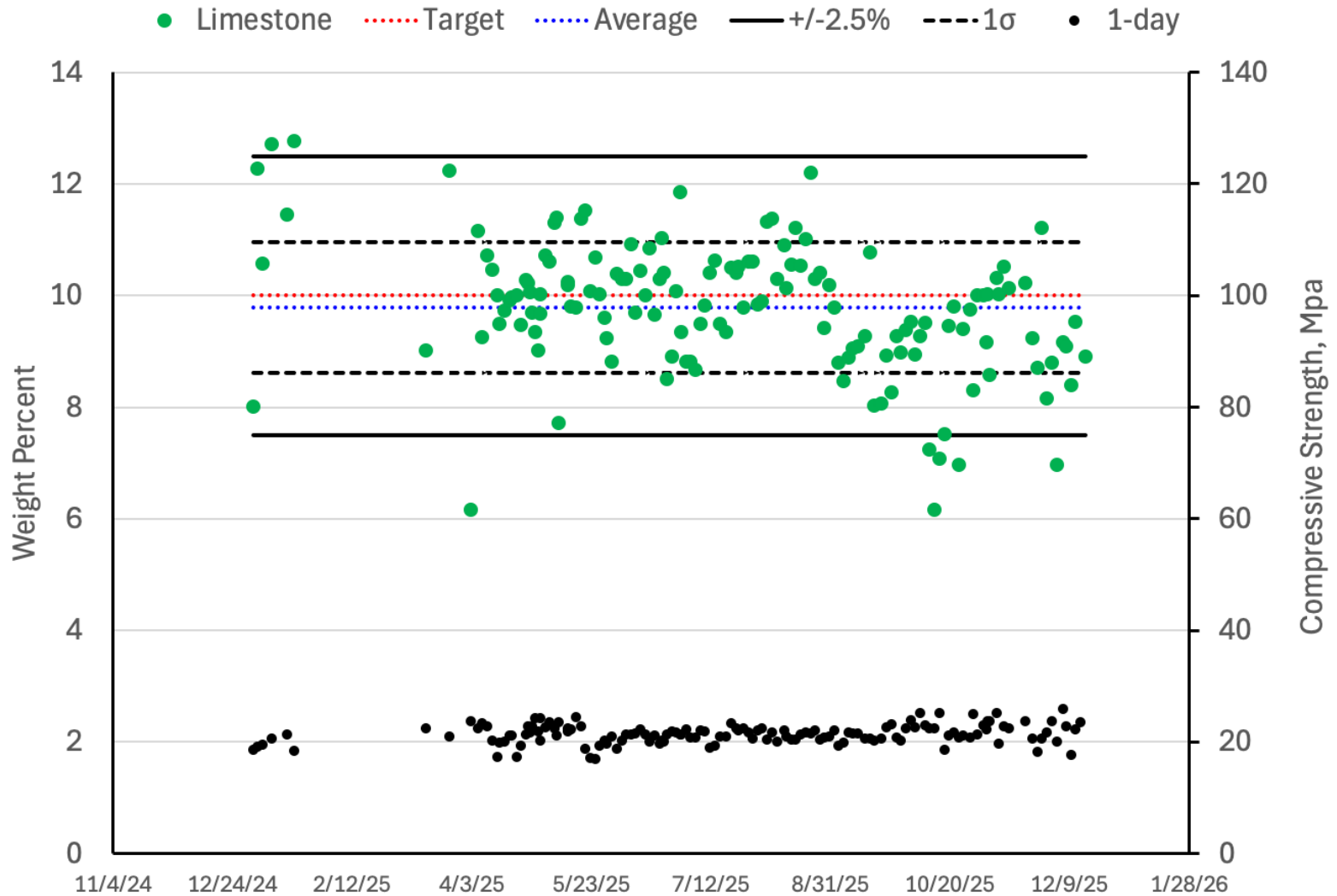
Min (%)	7.8
Max (%)	13.9
Median (%)	9.8
Average (%)	9.7
Std Dev	0.97
C of V	10.0%
+ 1σ	10.7
- 1σ	8.8
% ± 1σ	76%
Target (%)	10
+ Dev. Absolute (%)	3.89
- Dev. Absolute (%)	2.24
% ± 2.5% of Target	98.8%

### Plant 667 - Limestone



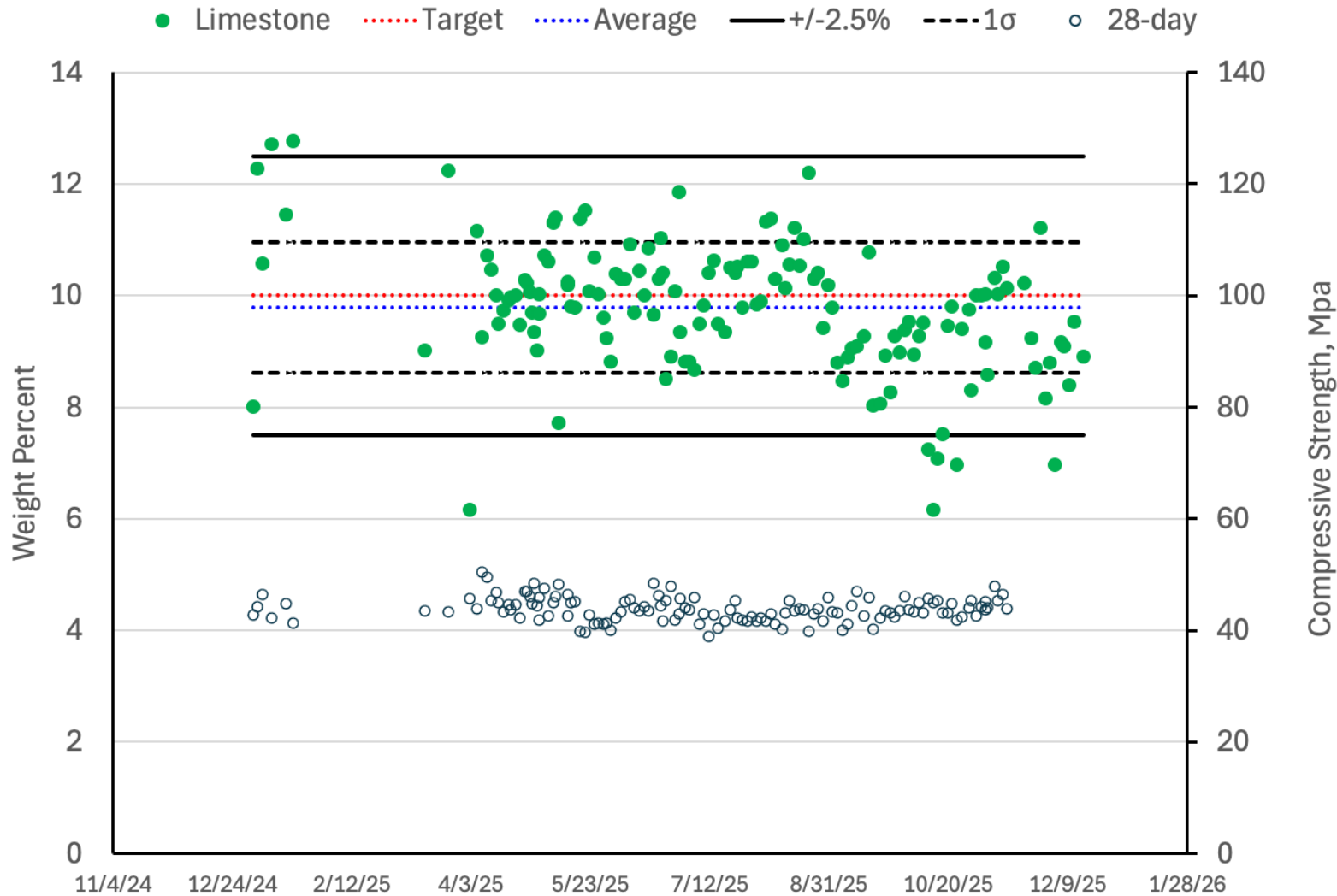
Min (%)	6.2
Max (%)	12.8
Median (%)	9.8
Average (%)	9.8
Std Dev	1.17
C of V	11.9%
+ 1σ	10.9
- 1σ	8.6
% ± 1σ	75%
Target (%)	10
+ Dev. Absolute (%)	2.8
- Dev. Absolute (%)	3.8
% ± 2.5% of Target	94.4%

### Plant 667 - Limestone & 1d Strength



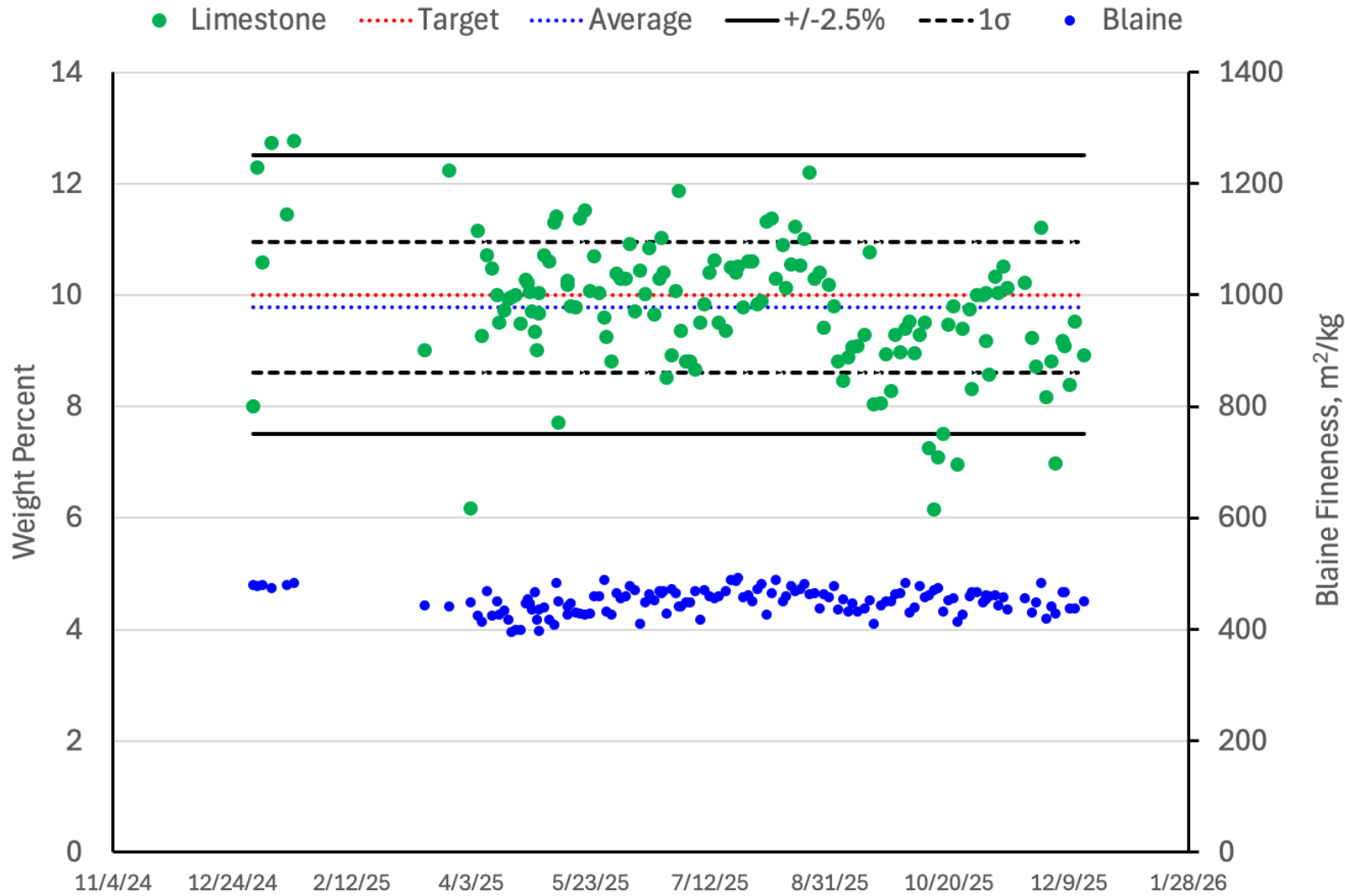
Min (%)	6.2
Max (%)	12.8
Median (%)	9.8
Average (%)	9.8
Std Dev	1.17
C of V	11.9%
+ 1σ	10.9
- 1σ	8.6
% ± 1σ	75%
Target (%)	10
+ Dev. Absolute (%)	2.8
- Dev. Absolute (%)	3.8
% ± 2.5% of Target	94.4%

### Plant 667 - Limestone & 28d Strength



Min (%)	6.2
Max (%)	12.8
Median (%)	9.8
Average (%)	9.8
Std Dev	1.17
C of V	11.9%
+ 1σ	10.9
- 1σ	8.6
% ± 1σ	75%
Target (%)	10
+ Dev. Absolute (%)	2.8
- Dev. Absolute (%)	3.8
% ± 2.5% of Target	94.4%

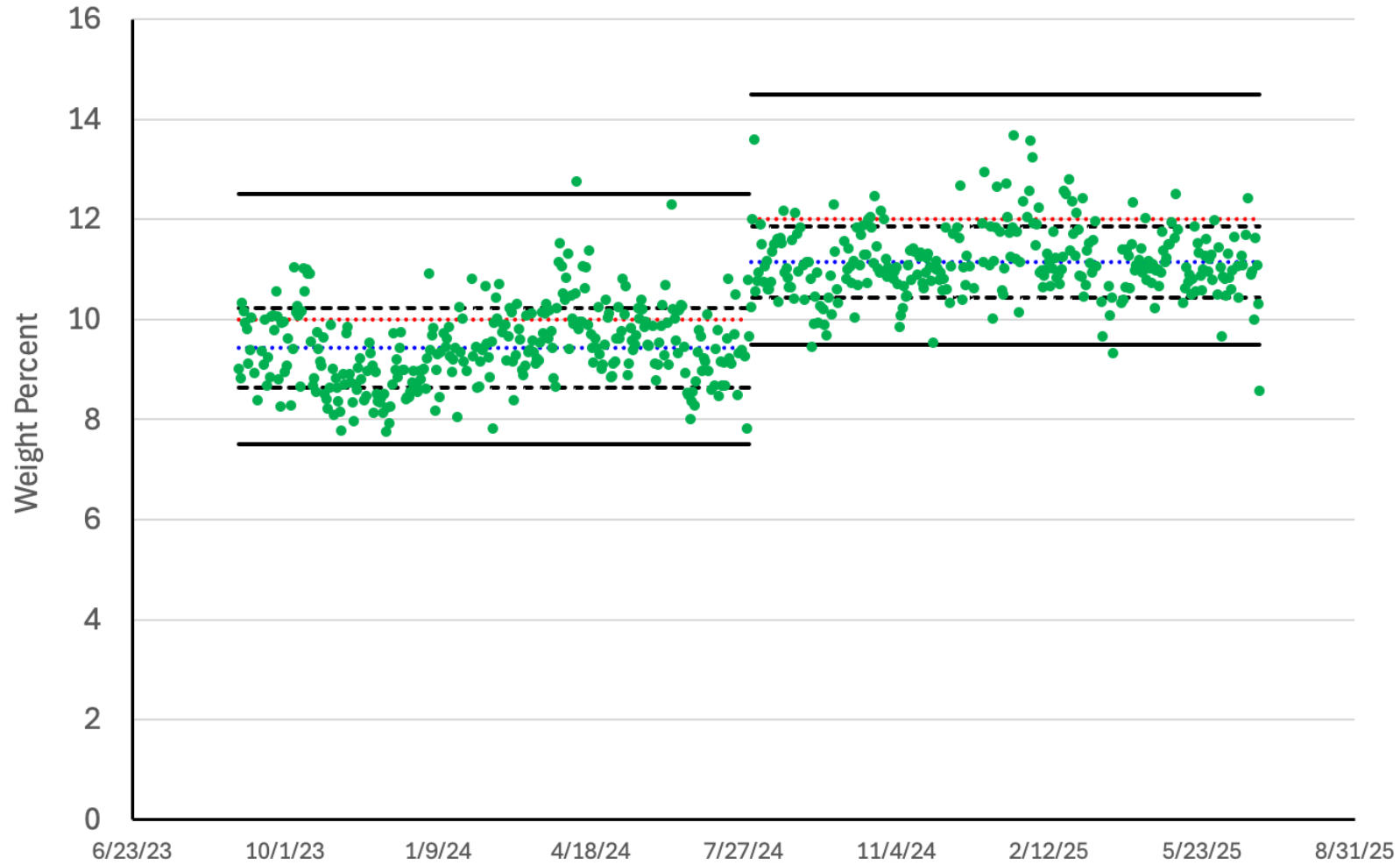
## Plant 667 - Limestone & Blaine Fineness



Min (%)	6.2
Max (%)	12.8
Median (%)	9.8
Average (%)	9.8
Std Dev	1.17
C of V	11.9%
+ 1σ	10.9
- 1σ	8.6
% ± 1σ	75%
Target (%)	10
+ Dev. Absolute (%)	2.8
- Dev. Absolute (%)	3.8
% ± 2.5% of Target	94.4%

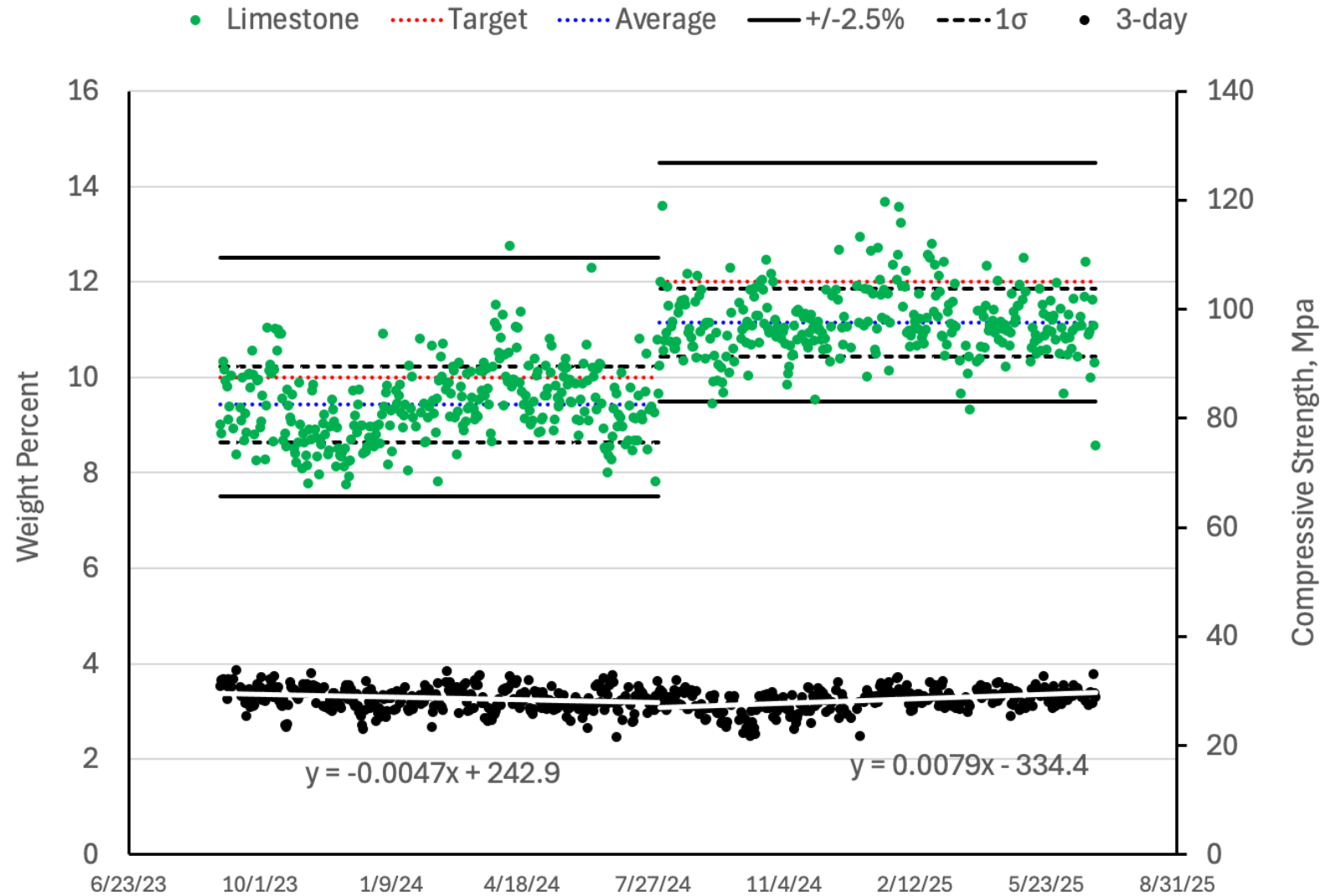
## Plant 402 - Limestone

● Limestone    ..... Target    ..... Average    — +/-2.5%    - - - 1σ



Min (%)	7.8	8.6
Max (%)	12.8	13.7
Median (%)	9.4	11.1
Average (%)	9.4	11.1
Std Dev	0.80	0.72
C of V	8.5%	6.4%
+ 1σ	10.2	11.9
- 1σ	8.6	10.4
% ± 1σ	69%	73%
Target (%)	10	12
+ Dev. Absolute (%)	2.8	1.7
- Dev. Absolute (%)	2.3	3.4
% ± 2.5% of Target	99.7%	99.0%

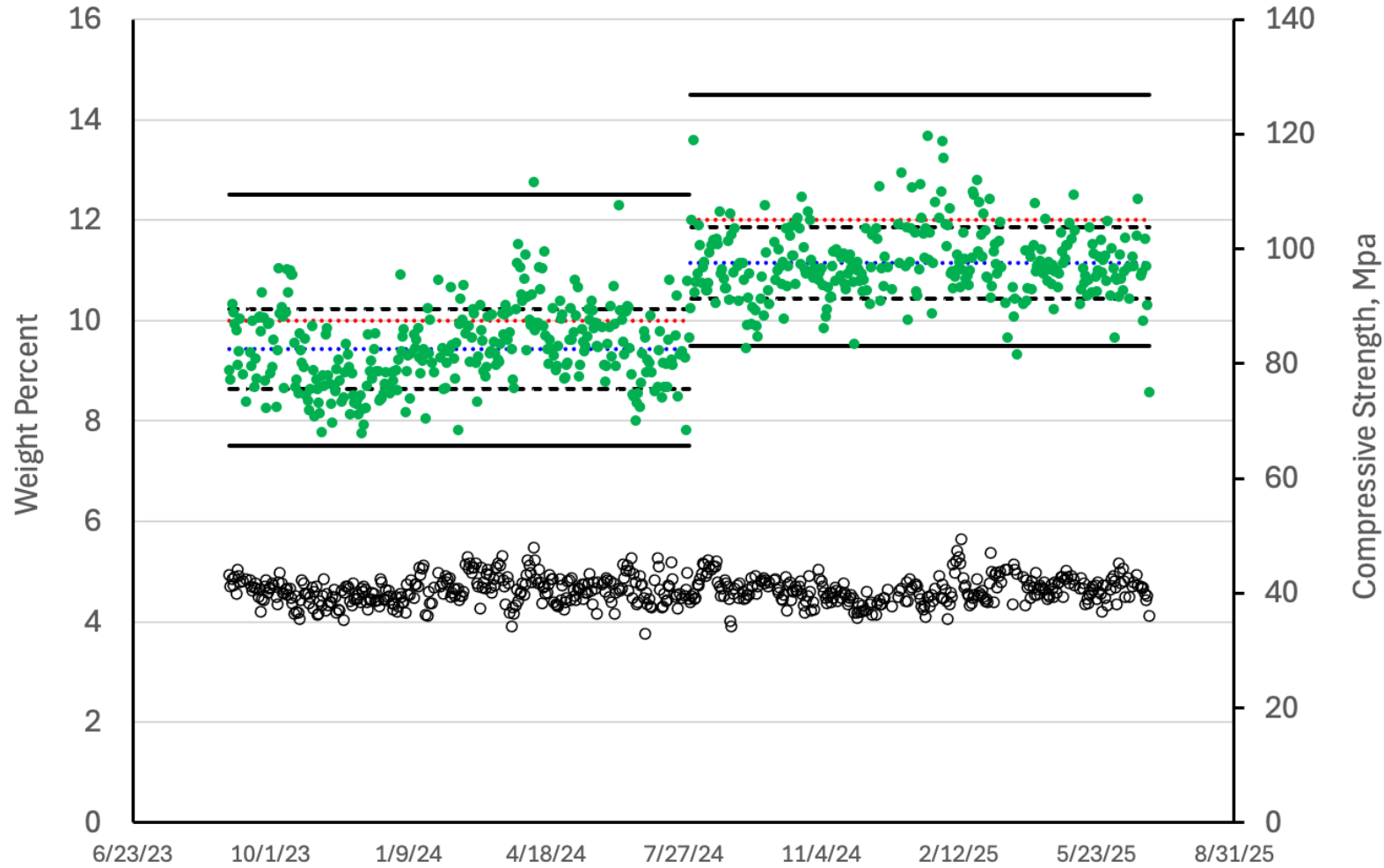
## Plant 402 - Limestone & 3-day Strength



Min (%)	7.8	8.6
Max (%)	12.8	13.7
Median (%)	9.4	11.1
Average (%)	9.4	11.1
Std Dev	0.80	0.72
C of V	8.5%	6.4%
+ 1σ	10.2	11.9
- 1σ	8.6	10.4
% ± 1σ	69%	73%
Target (%)	10	12
+ Dev. Absolute (%)	2.8	1.7
- Dev. Absolute (%)	2.3	3.4
% ± 2.5% of Target	99.7%	99.0%

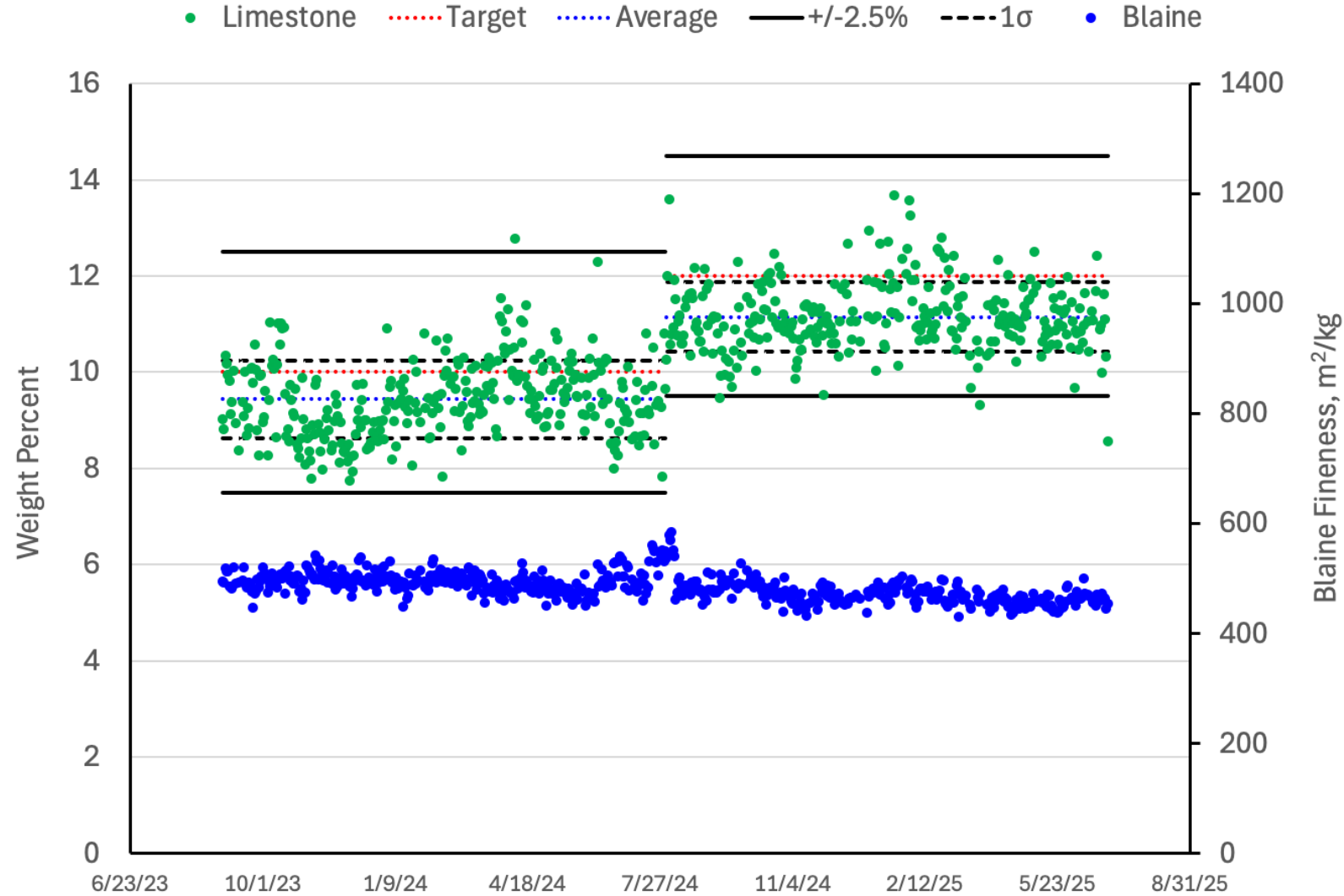
## Plant 402 - Limestone & 28-day Strength

● Limestone    ● Target    ● Average    — +/-2.5%    - - - 1σ    ○ 28-day



Min (%)	7.8	8.6
Max (%)	12.8	13.7
Median (%)	9.4	11.1
Average (%)	9.4	11.1
Std Dev	0.80	0.72
C of V	8.5%	6.4%
+ 1σ	10.2	11.9
- 1σ	8.6	10.4
% ± 1σ	69%	73%
Target (%)	10	12
+ Dev. Absolute (%)	2.8	1.7
- Dev. Absolute (%)	2.3	3.4
% ± 2.5% of Target	99.7%	99.0%

## Plant 402 - Limestone Blaine Fineness



Min (%)	7.8	8.6
Max (%)	12.8	13.7
Median (%)	9.4	11.1
Average (%)	9.4	11.1
Std Dev	0.80	0.72
C of V	8.5%	6.4%
+ 1σ	10.2	11.9
- 1σ	8.6	10.4
% ± 1σ	69%	73%
Target (%)	10	12
+ Dev. Absolute (%)	2.8	1.7
- Dev. Absolute (%)	2.3	3.4
% ± 2.5% of Target	99.7%	99.0%

# Closing


- The data analysis process continues - waiting for remaining data submissions; following up with producers where data is incomplete or not clear
- Lots of manual processing – it's amazing the different ways people can put the same information in a spreadsheet
- A more complete – hopefully complete – analysis will be provided at the Fall NC<sup>2</sup> meeting
- Integrating with other studies will be important moving forward
- The support of the cement producers to data is greatly appreciated and the study could not happen without their participation

# Questions?

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or

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*periculosum est tempus indoctus*

We are doomed

