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Subject: Results of the Round Robin tests on Admixture/Air Entraining agent/Corrosion Inhibitor sample, a comparison of data to show uniformity of results using specified methodology.

Introduction

The resulting data of the admixture/air entraining agent/corrosion inhibitor round robin testing program is analyzed and summarized around the arithmetic mean (\bar{u}). The standard deviation (s) is defined as the square root of the average square deviation of each data point from the mean. If N is the total number of data points, which becomes $(N - 1)$ considering degrees of freedom, X_i represents a data point, $\sum (X_i - \bar{u})^2$ is the sum of the square of the difference of the data points from the mean, the standard deviation would be; $s = \{ \sum (X_i - \bar{u})^2 \}^{1/2} / (N - 1)^{1/2}$

The number of standard deviations a data point is away from the mean, $(X_i - \bar{u})/s$, is an indication, for the purposes of this program, of the uniformity of testing between the participants. **A $(X_i - \bar{u})/s$ value of 2 or greater infers a procedural problem.**

Data

Cement Admixture

Company	Total Solids	Specific Gravity	pH
ODOT	42.85	1.299	5.91
Axim	43.01	1.297	5.98
Euclid	43.18	1.304	6.08
Grace	43.26	1.295	5.8
Hydration Kontrol	41.64	1.293	5.1
MasterBuilders	42.91	1.298	5.97
Sika	41.45	1.280	5.75
Russ Tech	41.70	1.294	5.05
Chryso Inc.	42.99	1.297	5.90

Cement Admixture

$$u = 42.55$$
$$S(Xi - u)^2 = 4.28$$
$$(N - 1) = 8$$
$$s = \{4.28 / 8\}^{1/2}$$
$$s = 0.73$$

Total Solids

Company	Xi	(Xi - u)	(Xi - u) ²
ODOT	42.85	0.30	0.09
Axim	43.01	0.46	0.21
Euclid	43.18	0.63	0.40
Grace	43.26	0.71	0.50
Hydration Kontrol	41.64	-0.91	0.83
MasterBuilders	42.91	0.36	0.13
Sika	41.45	-1.10	1.21
Russ Tech	41.70	-0.85	0.72
Chryso Inc.	42.99	0.44	0.19

Company	(Xi - u)	(Xi - u)/s
ODOT	0.30	0.41
Axim	0.46	0.63
Euclid	0.63	0.86
Grace	0.71	0.97
Hydration Kontrol	-0.91	-1.25
MasterBuilders	0.36	0.49
Sika	-1.10	-1.51
Russ Tech	-0.85	-1.16
Chryso Inc.	0.44	0.60

Total solid values for all participants are within 1.51 standard deviations of the mean.

Admixture

$u = 1.295$
 $S(Xi - u)^2 = 0$
 $(N - 1) = 8$
 $s = \{0/8\}^{1/2}$
 $s = 0$

Specific Gravity

Company	Xi	(Xi - u)	(Xi - u) ²
ODOT	1.299	0.004	0
Axim	1.297	0.002	0
Euclid	1.304	0.009	0
Grace	1.295	0.000	0
Hydration Kontrol	1.293	-0.002	0
MasterBuilders	1.298	0.003	0
Sika	1.280	-0.015	0
Russ Tech	1.294	-0.001	0

Chryso Inc.	1.297	0.002	0
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Company	(Xi - u)	(Xi - u)/s
ODOT	0.004	0
Axim	0.002	0
Euclid	0.009	0
Grace	0.000	0
Hydration Kontrol	-0.002	0
MasterBuilders	0.003	0
Sika	-0.015	0
Russ Tech	-0.001	0
Chryso Inc.	0.002	0

All of the specific gravity data are within 1 standard deviation of the mean. There are no procedural problems for specific gravity.

Admixture

$$u = 5.727$$

$$S(Xi - u)^2 = 1.169$$

$$(N - 1) = 8$$

$$s = \{1.169/8\}^{1/2}$$

$$s = 0.38$$

pH

Company	Xi	(Xi - u)	(Xi - u) ²
ODOT	5.91	0.18	0.032
Axim	5.98	0.25	0.063
Euclid	6.08	0.35	0.123

Grace	5.8	0.07	0.005
Hydration Kontrol	5.1	-0.63	0.397
MasterBuilders	5.97	0.24	0.058
Sika	5.75	0.02	0.000
Russ Tech	5.05	0.68	0.462
Chryso Inc.	5.90	0.17	0.029

Company	(Xi - u)	(Xi - u)/s
ODOT	0.18	0.47
Axim	0.25	0.66
Euclid	0.35	0.92
Grace	0.07	0.18
Hydration Kontrol	-0.63	1.66
MasterBuilders	0.24	0.63
Sika	0.02	0.05
Russ Tech	0.68	1.79
Chryso Inc.	0.17	0.45

The data points for the pH of the admixture sample fall between 0.05 and 1.79 standard deviations from the arithmetical mean. No procedural difference problems are detected for testing of pH.

Conclusion

This program was established to ensure uniformity in testing admixtures, air entraining agents, and corrosion inhibitors, according to specified methods.

The distance from the arithmetical mean of the submitted data, $(X_i - u)/s$, for each of the tests performed was less than 2 standard deviations for all participants. This shows uniformity in the performance of testing admixtures, air entraining agents, and corrosion inhibitors, among the participating producers and between these producers and the Ohio DOT.

I want to thank all the participants for your part in this program, for your cooperation, and your timely responses. I look forward to that same partnership in our future working relationship.

Thank You,

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