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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.

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; $s = \{ \sum (X_i - \bar{u})^2 / (N - 1) \}^{1/2}$

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	39.21	1.202	7.33
Axim	39.76	1.201	7.26
Euclid	39.50	1.204	-----
Grace	39.71	1.206	7.3
MasterBuilders	39.51	1.204	7.58
Sika	38.91	1.196	7.64

Cement Admixture

$$u = 39.43$$

$$S(X_i - u)^2 = 0.52$$

$$(N - 1) = 5$$

$$s = (0.52/5)^{1/2}$$

$$s = 0.32$$

Total Solids

Company	X_i	$(X_i - u)$	$(X_i - u)^2$
ODOT	39.21	-0.22	0.05
Axim	39.76	0.33	0.11
Euclid	39.50	0.07	0
Grace	39.71	0.28	0.08
MasterBuilders	39.51	0.08	0.01
Sika	38.91	-0.52	0.27

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	-0.22	-0.69
Axim	0.33	1.03
Euclid	0.07	0.22
Grace	0.28	0.88
MasterBuilders	0.08	0.25
Sika	-0.52	-1.63

Total solid values for all participants are within 1.63 standard deviations from the mean.

Cement Admixture

$$u = 1.202$$

$$S(X_i - u)^2 = 0$$

$$(N - 1) = 5$$

$$s = \{0/5\}^{1/2}$$

$$s = 0$$

Specific Gravity

Company	X_i	$(X_i - u)$	$(X_i - u)^2$
ODOT	1.202	0	0
Axim	1.201	-0.001	0
Euclid	1.204	0.002	0
Grace	1.206	0.004	0
MasterBuilders	1.204	0.002	0
Sika	1.196	-0.006	0

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	0	0
Axim	-0.001	0
Euclid	0.002	0
Grace	0.004	0
MasterBuilders	0.002	0
Sika	-0.006	0

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

Cement Admixture

$$u = 7.422$$

$$S(X_i - u)^2 = 0.122$$

$$(N - 1) = 4$$

$$s = \{0.122/4\}^{1/2}$$

$$s = 0.17$$

pH

Company	X_i	$(X_i - u)$	$(X_i - u)^2$
ODOT	7.33	-0.09	0.008
Axim	7.26	-0.16	0.026
Euclid	-----	-----	-----
Grace	7.3	-0.12	0.014
MasterBuilders	7.58	0.16	0.026
Sika	7.64	0.22	0.048

Company	$(X_i - u)$	$(X_i - u)/s$
ODOT	-0.09	-0.53
Axim	-0.16	-0.94
Euclid	-----	-----
Grace	-0.12	-0.71
MasterBuilders	0.16	0.94
Sika	0.22	1.29

The data points for the pH of the cement admixture sample fall between 0.53 and 1.29 standard deviations from the arithmetical mean. No procedural difference problems are detected for pH.

Conclusion

This program was established to ensure uniformity in the testing of admixtures, air entraining agents, and corrosion inhibitors.

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 testing 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.

I remain sincerely,

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