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**Office of Materials Management**  
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Chemical Section  
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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 ( $\mu$ ). 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,  $\sum (X_i - \mu)^2$  is the sum of the square of the difference of the data points ( $X_i$ ) from the mean ( $\mu$ ), the standard deviation would be;  $s = \{ \sum (X_i - \mu)^2 \}^{1/2} / (N - 1)^{1/2}$

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

Data

**Sample tested: Cement Admixture**

<b>Company</b>	<b>Total Solids</b>	<b>Specific Gravity</b>	<b>pH</b>
ODOT	44.85	1.214	8.07
Axim	44.34	1.212	8.08
Euclid	47.91	1.215	8.13
Grace	47.38	1.212	8.20
Hydration Kontrol	48.46	1.212	8.30
BASF	46.44	1.214	8.17
Sika	48.15	1.210	8.12
Russ Tech	48.53	1.212	8.19
Chryso Inc.	46.05	1.212	8.12
ProMix	48.32	1.212	8.02

Total Solids

$$\mu = 47.04$$

$$\sum (X_i - \mu)^2 = 21.42$$

$$(N - 1) = 9$$

$$s = \{21.42 / 9\}^{1/2}$$

$$s = 1.54$$

<b>Company</b>	<b>X<sub>i</sub></b>	<b>(X<sub>i</sub> - μ)</b>	<b>(X<sub>i</sub> - μ)<sup>2</sup></b>
ODOT	44.85	-2.19	4.80
Axim	44.34	-2.70	7.29
Euclid	47.91	0.87	0.76
Grace	47.38	0.34	0.12
Hydration Kontrol	48.46	1.42	2.02
BASF	46.44	-0.60	0.36
Sika	48.15	1.11	1.23
Russ Tech	48.53	1.49	2.22
Chryso Inc.	46.05	-0.99	0.98
ProMix	48.32	1.28	1.64

<b>Company</b>	<b>(X<sub>i</sub> - μ)</b>	<b>(X<sub>i</sub> - μ)/s</b>
ODOT	-2.19	-1.42
Axim	-2.70	-1.75
Euclid	0.87	0.56
Grace	0.34	0.22
Hydration Kontrol	1.42	0.92
BASF	-0.60	-0.39
Sika	1.11	0.72
Russ Tech	1.49	0.97
Chryso Inc.	-0.99	-0.64
ProMix	1.28	0.83

Total solid values for all participants are within 1.75 standard deviations of the mean.

Specific Gravity

$$\mu = 1.212$$

$$\sum (X_i - \mu)^2 = 0$$

$$(N - 1) = 9$$

$$s = \{0/9\}^{1/2}$$

$$s = 0$$

Company	$X_i$	$(X_i - \mu)$	$(X_i - \mu)^2$
ODOT	1.213	0.001	0
Axim	1.212	0.000	0
Euclid	1.215	0.003	0
Grace	1.212	0.000	0
Hydration Kontrol	1.212	0.000	0
BASF	1.214	0.002	0
Sika	1.210	-0.002	0
Russ Tech	1.212	0.000	0
Chryso Inc.	1.212	0.000	0
ProMix	1.212	0.000	0

Company	$(X_i - \mu)$	$(X_i - \mu)/s$
ODOT	0.001	0
Axim	0.000	0
Euclid	0.003	0
Grace	0.000	0
Hydration Kontrol	0.000	0
BASF	0.002	0
Sika	-0.002	0
Russ Tech	0.000	0
Chryso Inc.	0.000	0
ProMix	0.000	0

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

pH

$$\mu = 8.14$$

$$\sum (X_i - \mu)^2 = 0.058$$

$$(N - 1) = 9$$

$$s = \{0.058/9\}^{1/2}$$

$$s = 0.08$$

Company	$X_i$	$(X_i - \mu)$	$(X_i - \mu)^2$
ODOT	8.07	-0.07	0.005
Axim	8.08	-0.06	0.004
Euclid	8.13	-0.01	0.0001
Grace	8.20	0.06	0.004
Hydration Kontrol	8.30	0.16	0.026
BASF	8.17	0.03	0.001
Sika	8.12	-0.02	0.0004
Russ Tech	8.19	0.05	0.003
Chryso Inc.	8.12	-0.02	0.0004
ProMix	8.02	-0.12	0.014

Company	$(X_i - \mu)$	$(X_i - \mu)/s$
ODOT	-0.07	-0.88
Axim	-0.06	-0.75
Euclid	-0.01	-0.13
Grace	0.06	0.75
Hydration Kontrol	0.16	2.00
BASF	0.03	0.38
Sika	-0.02	-0.25
Russ Tech	0.05	0.63
Chryso Inc.	-0.02	-0.25
ProMix	-0.12	-1.50

The data points for the pH of the admixture sample should be less than 2 standard deviations from the mean. No problems are detected for the testing of pH, except that the standard deviation value of 2.00 may indicate procedural problems that need to be addressed.

### 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,  $(X_i - \mu)/s$ , for each of the tests performed was less than 2 standard deviations for all but one participant. A standard deviation of less than 2 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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