WRAPP
WESTERN REGIONAL ASSOCIATION for Pavement Preservation
-- Dedicated to the improvement and promotion of the industry --

CALIFORNIA CHIP SEAL ASSOCIATION
Dedicated to Pavement Preservation
Founded 1987

Joint Inspector Training

Slurry/Micro Equipment Calibration, Inspection, and Verification

Joint Inspector Training

Chad Davis

Sales

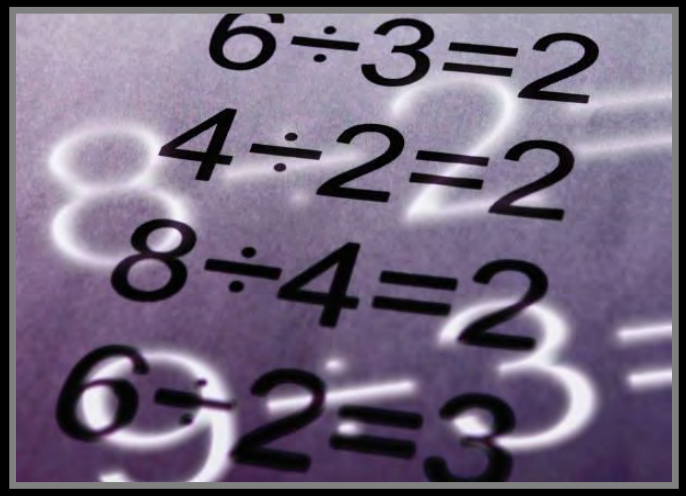
VSS Macropaver

Presentation Overview

- What is Calibration?
- Why do we do it?
- How is it done?

The Calibration Theory

- In Slurry Surfacing, all mix designs and formulations are based on the combined weight of dry aggregate and the weight of any mineral filler. To set the machines to a given mix design and to produce a consistent material, accurate information on the machine, feed rates or aggregate, emulsified asphalt, water, and additives is necessary. The mix design is based on dry aggregate and dry mineral filler. Corrections for moisture for aggregate could be necessary.

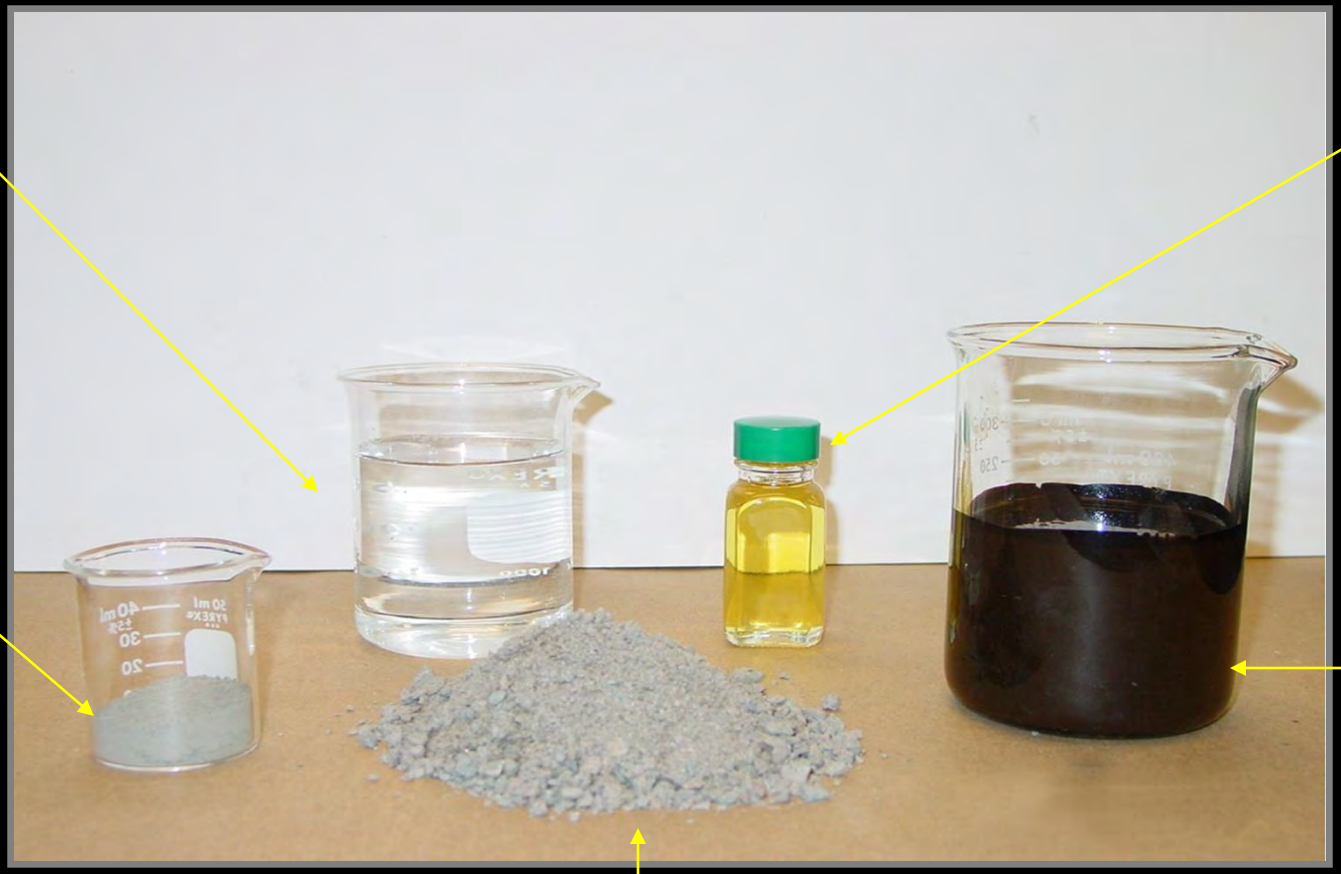


Why Calibrate?

- Correlate the volumetric measurement of the machine to mass measurement.
- Provides an equipment function check
- Set machine to produce a given mix

Good Info In = Good product out

Materials Used



Sample Mix Design

VSS EMULTECH

W. Sacramento, CA 95691	Redding, CA 66001	Bakersfield, CA 93308	White City, OR 97503
3785 Channel Drive	7200 Pit Road	3800 Gilmore Avenue	7701- 11th Street
Ph: (916) 371-8480	Ph: (530) 241-1364	Ph: (661) 323-5904	Ph: (541) 826-3373
Fx: (916) 371-2457	Fx: (530) 246-2912	Fx: (661) 323-2737	Fx: (541) 826-7122

05/07/08
VSSE-01-8006

Valley Slurry Seal
P.O. Box 981330
West Sacramento, CA 95798
0

ATTN: Mike Wallen

RE: Type II Microsurfacing

At your request, VSS Emultech analyzed a sample of screenings taken from the production stockpile. Based on the test results obtained in the laboratory we would recommend the following Micro Surfacing design.

Screenings	100.0 %
Cement	1.0 %
Water Added	10.0 %
PMCQS-1H	14.0 ± 1.0%
Aluminum Sulfate	As needed

The design meets the following specification criteria:

Test		ISSA Spec
Residual Asphalt	8.68	5.5 - 9.5
Wet Track Abrasion - 1 Hr.	452	538 g/m² max
- 6 Day	612	807 g/m² max
Excess Asphalt Loaded Wheel	463.0	538 g/m² max
Wet Stripping	95	90 min
Compatibility	BAA-11	BAA, AAA, 11, 12

The mix design is based on the sample received in the laboratory and conforms to the ISSA Type II gradation and meets all the physical requirements for Type II Micro Surfacing. Once production begins in the field, minor adjustments to the various components may have to be made.

If there are any questions regarding this mix design or if we can be of any further service do not hesitate to call us.

Sincerely,

S Houston

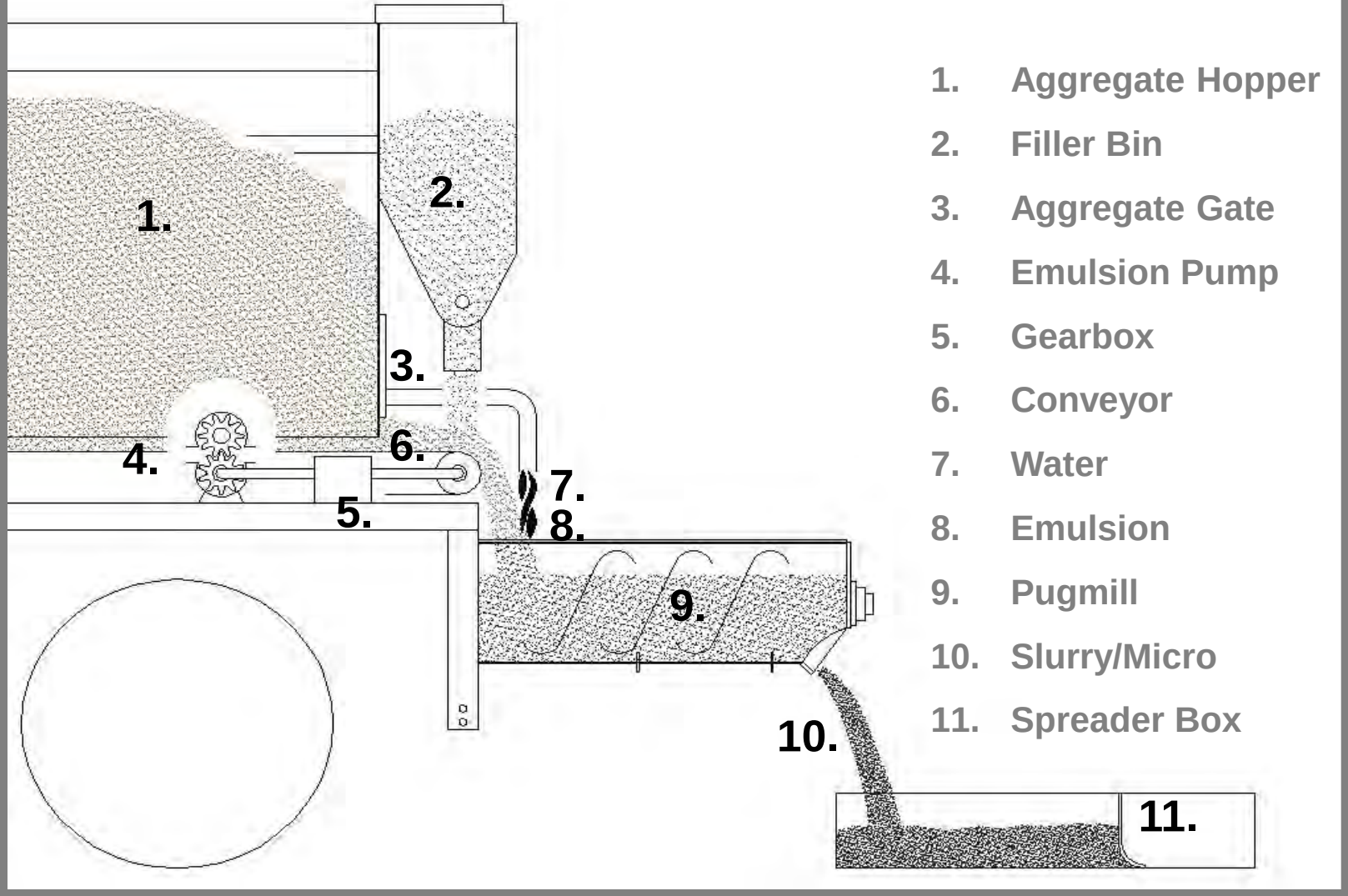
Sallie Houston
Technical Manager
(916)-397-8623

Sample Mix Design

Aggregate	100.0%
Cement	1.0%
Water Added	10.0%
Emulsion	14.0% +/- 1.0%
Aluminum Sulfate	As Needed

*Shown as a % of Aggregate

Typical Slurry Machine in operation

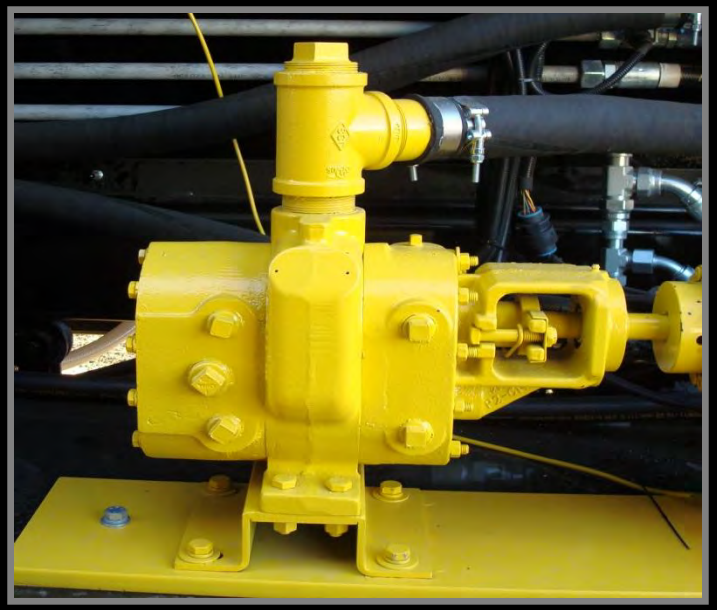


1. Aggregate Hopper
2. Filler Bin
3. Aggregate Gate
4. Emulsion Pump
5. Gearbox
6. Conveyor
7. Water
8. Emulsion
9. Pugmill
10. Slurry/Micro
11. Spreader Box

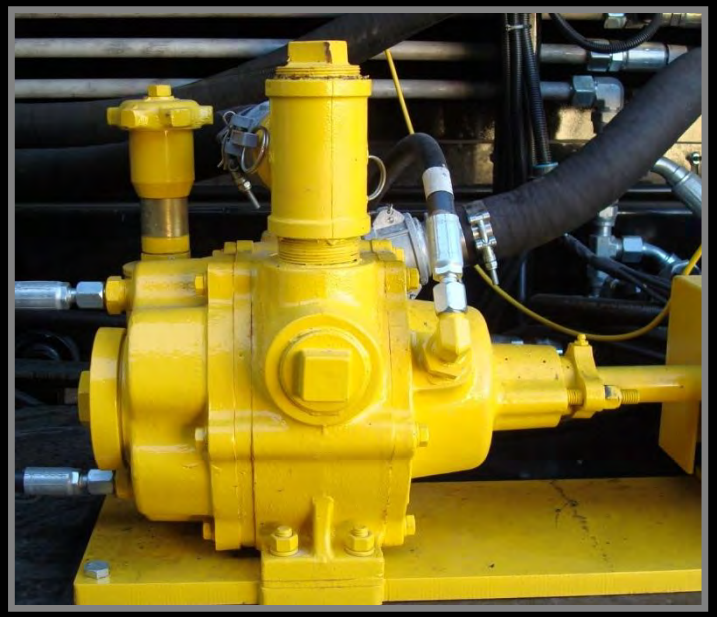
Emulsion Calibration

- What type of pump are you using?

Fixed **Displacement** Pump



Variable Positive Displacement Pump



Emulsion continued

- Fill the machine with Emulsion.

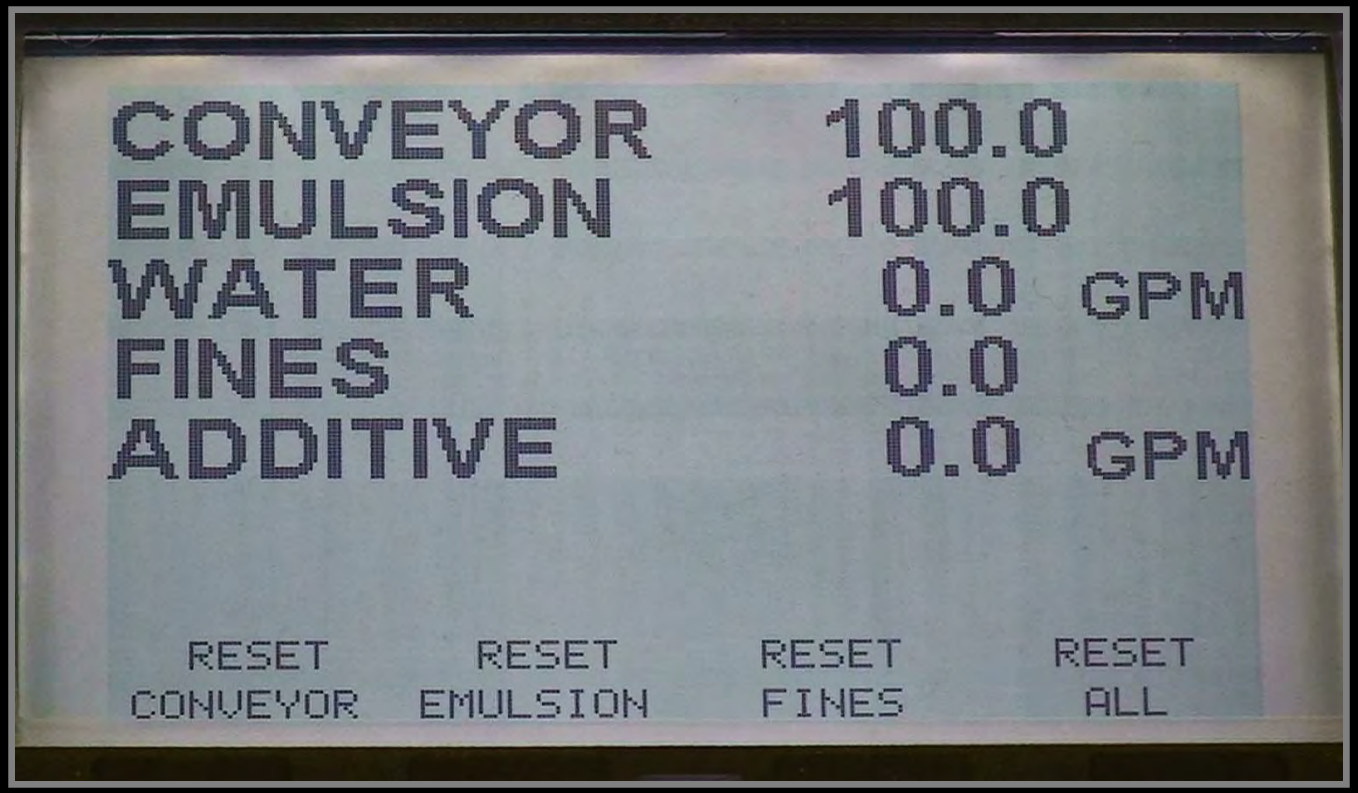
- Determine the gross weight

Emulsion continued

- Hook up pump outlet to a second container.

Emulsion continued

- Run desired counts on the head pulley / emulsion counter.

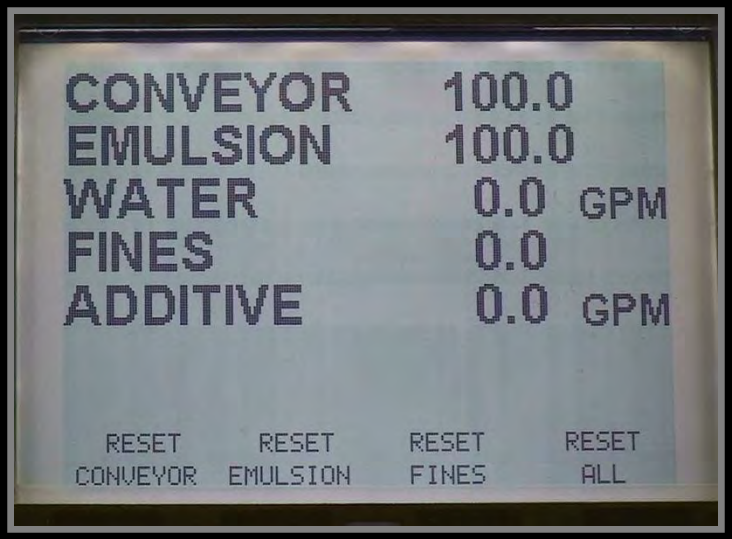


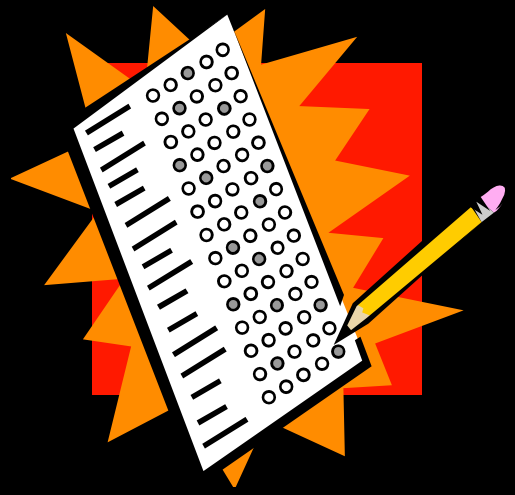
Emulsion continued

- Determine weight of emulsion that has been pumped from machine.

- $\frac{\text{Weight pumped}}{\text{\# of Counts}} = \text{Weight per Count}$

- Record results and run 3 tests to ensure accuracy of results





X 3

Record Results

***within 2% Average of 3 runs**

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How It's Done.
Aggregate Calibration

- Determine moisture content of aggregate
  - Normally is determined by a laboratory

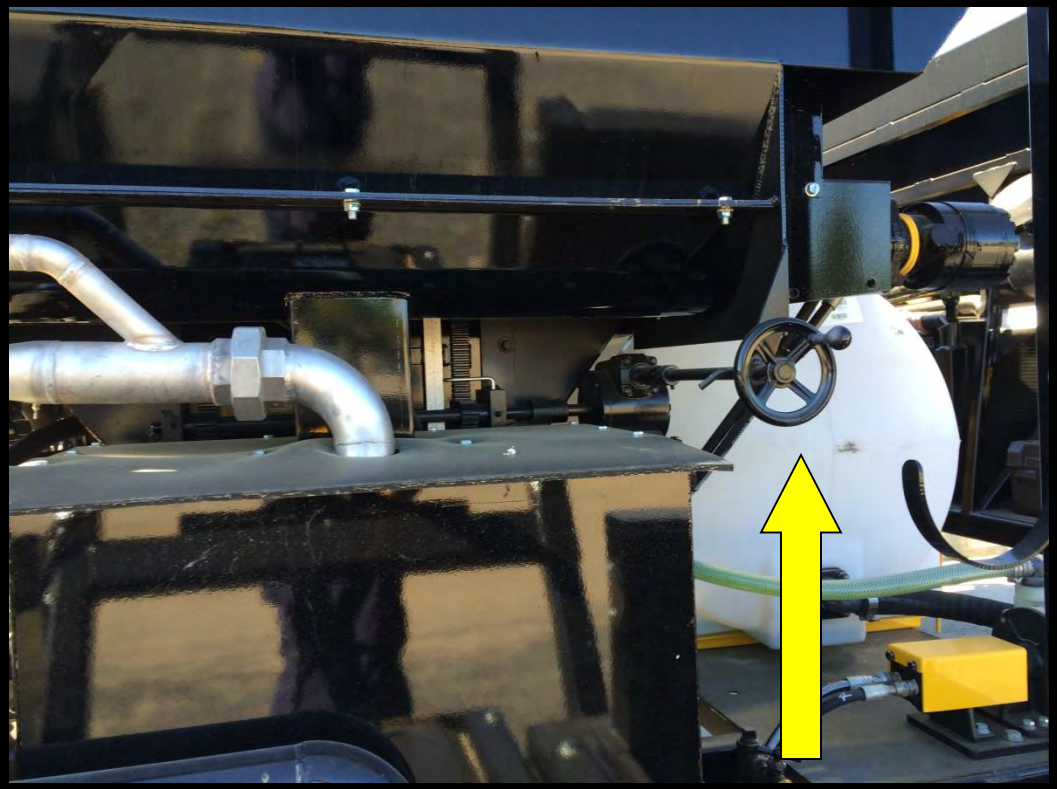
*ASTM C566-97

How It's Done.
Aggregate Calibration

- Select 3 gate settings that will be used to perform the calibration

How It's Done.
Aggregate Calibration

- Gate adjustments are made at the back of the aggregate hopper.



Aggregate continued

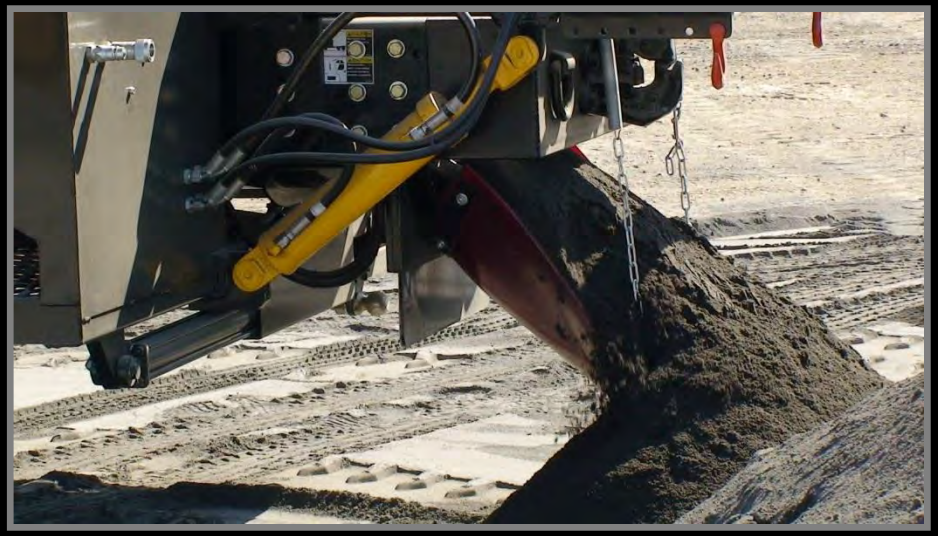
- Load the aggregate into the hopper
- Prime the Conveyor and gate (first run)

Aggregate continued

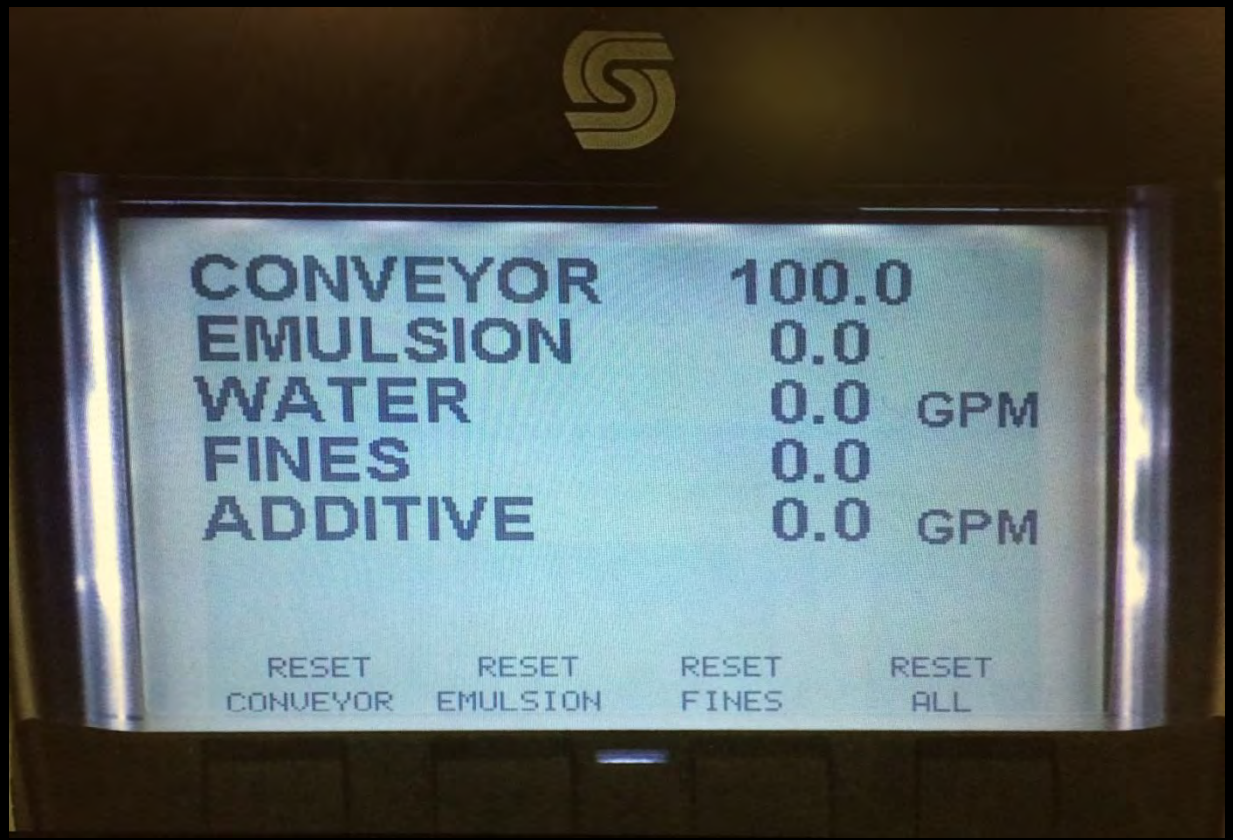
- Weigh the machine

Aggregate continued

- Make sure the counter is at Zero
- Run out your desired counts



Run out desired counts

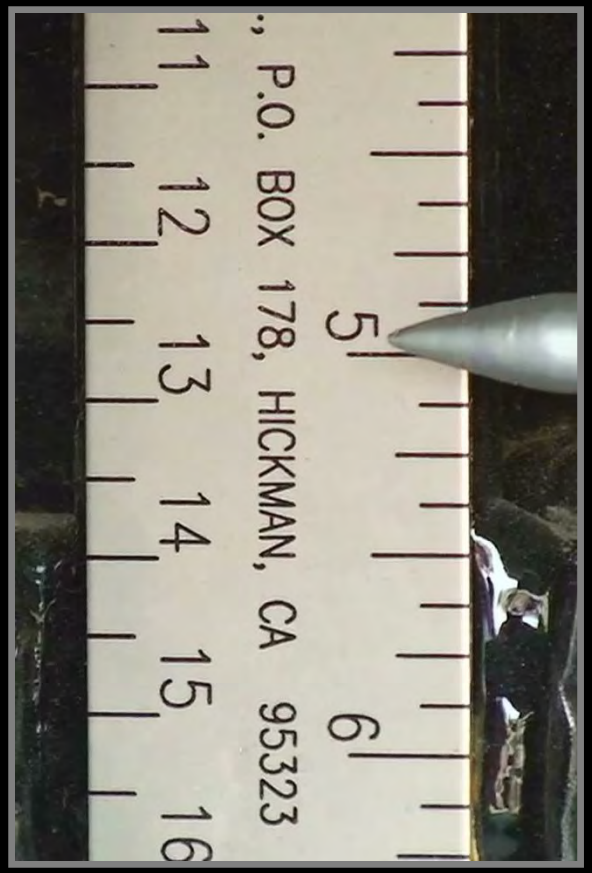


Aggregate continued

- Re-weigh the machine

Aggregate continued

- Do this 3 times at 3 different gate settings



- Record Information

- $\frac{\text{Weight of aggregate}}{\text{\# of Counts}} = \text{Weight per count}$

How It's Done.
Dry Additive / Mineral Filler Calibration

- Two types of methods to supply dry additive.

➡ Mechanically connected:

  – Usually directly connected to Aggregate Belt
  – Would use a gate to adjust the amount of material delivered.

➡ Hydraulically connected:

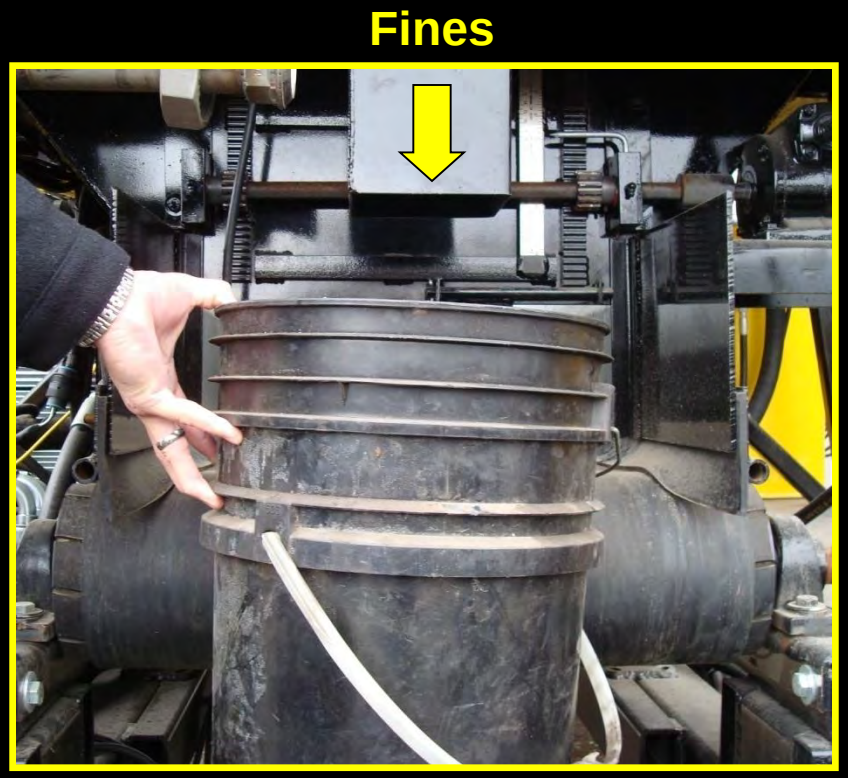
  – Would use a hydraulic flow control to adjust the amount of material being delivered.

Dry Additive continued

- Load Fines into machine

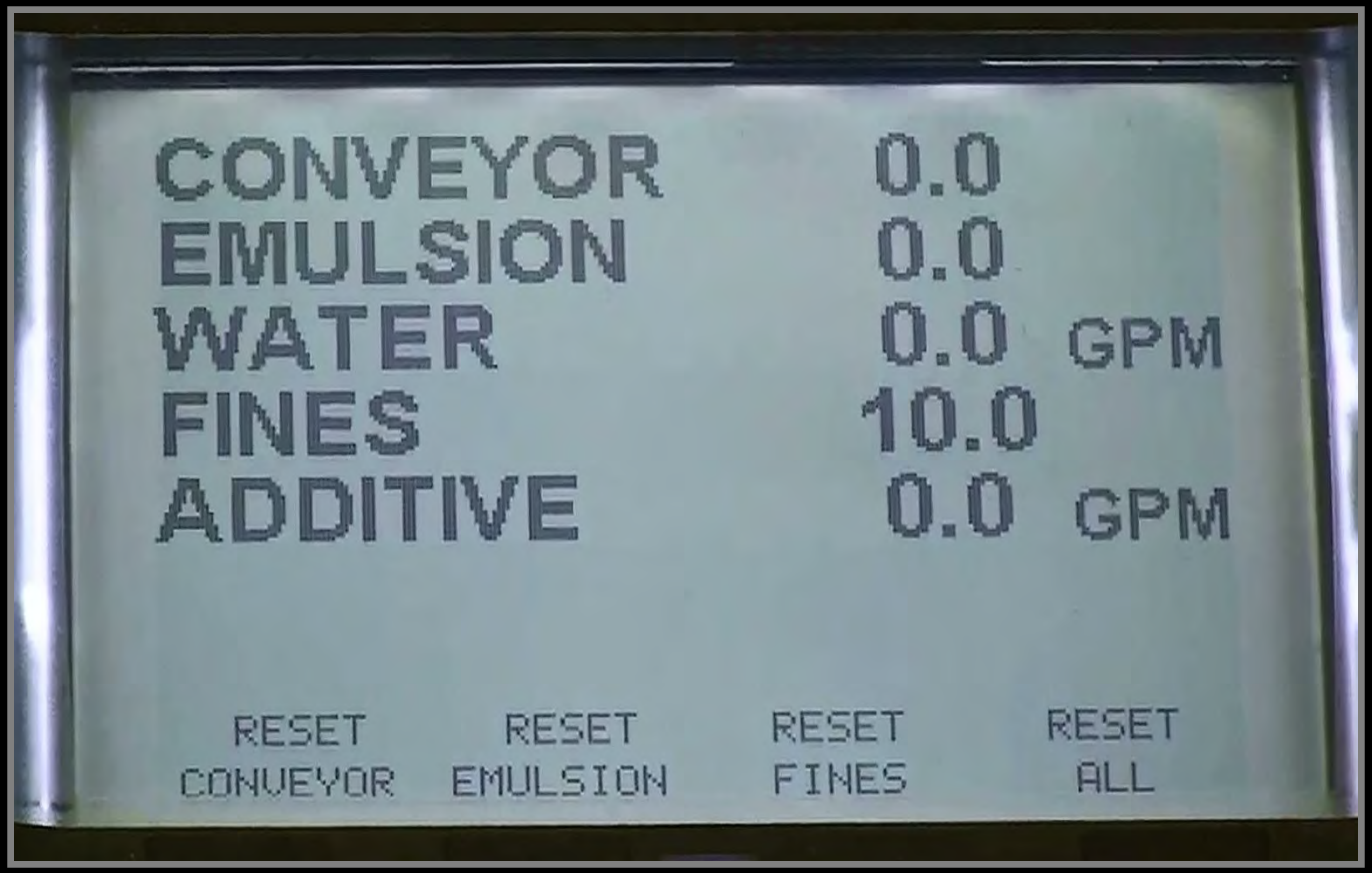
Dry Additive continued

- Weigh small box, can or bucket
- Use small box, can or bucket to catch dry mineral that falls from the feeder



Dry Additive continued

- Run counts for about 20 lbs. of material (9.1kg)



Dry Additive continued

- Weigh the container with material
- Subtract the weight of the container

- $\frac{\text{Weight of fines}}{\text{\# of Counts}} = \text{Weight per count}$

Calibration Charts

Emulsion Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Emulsion Type: _____

Emulsion Temperature: _____

Emulsion Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)					
Light Weight	lbs (Kg)					
Emulsion Pumped	lbs (Kg)					
Head Shaft Revolutions	Rev counts				SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)					

% Emulsion to Aggregate Ratio

	UNITS		Gate Setting	
Agg. Gate Setting	in. (cm)			
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)			
Ave Agg. / Rev	lbs/Rev (Kg/Rev)			
Emulsion to Agg.				
% Emulsion to Agg Ratio	%			

Emulsion Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Emulsion Type: _____

Emulsion Temperature: _____

Emulsion Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)	43100	41620	40100		
Light Weight	lbs (Kg)	41620	40100	38640		
Emulsion Pumped	lbs (Kg)	1480	1520	1460		
Head Shaft Revolutions	Rev counts	100	100	100	SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)	14.8	15.2	14.6	44.60	14.87

Aggregate Calibration Charts

Job: ______________________________ Date: ______________________________

Machine No: ______________________________ Measured By: ______________________________

Aggregate Type: ____

Aggregate Moisture%: ______________________________

Aggregate Calibration

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Aggregate Type: _____

Aggregate Moisture%: _____

Aggregate Calibration

Aggregate Gate Setting	in(cm)	4					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		61580	58040	54560		
Light Weight	lbs (Kg)		58040	54560	51080		
Aggregate Unloaded	lbs (Kg)		3540	3480	3480		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		70.8	69.6	69.6	210.0	

Aggregate Gate Setting	in(cm)	5					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		62180	57760	63720		
Light Weight	lbs (Kg)		57760	53340	59180		
Aggregate Unloaded	lbs (Kg)		4420	4420	4540		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		88.4	88.4	90.8	267.6	

Aggregate Gate Setting	in(cm)	6					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		63760	58340	52980		
Light Weight	lbs (Kg)		58340	52880	47400		
Aggregate Unloaded	lbs (Kg)		5420	5460	5580		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		108.4	109.2	111.6	329.2	

Aggregate Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Aggregate Type: _____

Aggregate Moisture%: _____

Aggregate Calibration

Aggregate Gate Setting	in(cm)	4					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		61580	58040	54560		
Light Weight	lbs (Kg)		58040	54560	51080		
Aggregate Unloaded	lbs (Kg)		3540	3480	3480		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		70.8	69.6	69.6	210.0	70.0

Aggregate Gate Setting	in(cm)	5					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		62180	57760	63720		
Light Weight	lbs (Kg)		57760	53340	59180		
Aggregate Unloaded	lbs (Kg)		4420	4420	4540		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		88.4	88.4	90.8	267.6	89.2

Aggregate Gate Setting	in(cm)	6					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		63760	58340	52980		
Light Weight	lbs (Kg)		58340	52880	47400		
Aggregate Unloaded	lbs (Kg)		5420	5460	5580		
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		108.4	109.2	111.6	329.2	109.7

How to Calculate Dry Agg. Weight/Count

- Moisture Factor = decimal equivalent of your moisture % + 1.00
  - For Example:
    - Agg. with moisture content of 2%

    Moisture Factor = .02 + 1.00 = 1.02

- Dry Aggregate Weight per Count = average Agg. weight per count divided by moisture factor.

$$\frac{70.00}{1.02} = 68.63$$

Aggregate Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Aggregate Type: _____

Aggregate Moisture%: 2%

Aggregate Calibration

Aggregate Gate Setting	in(cm)	4						
	UNITS		Trial #1	Trial #2	Trial #3			
Heavy Weight	lbs (Kg)		61580	58040	54560			
Light Weight	lbs (Kg)		58040	54560	51080			
Aggregate Unloaded	lbs (Kg)		3540	3480	3480			
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average	w/o Moisture
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		70.8	69.6	69.6	210.0	70.0	68.63

Aggregate Gate Setting	in(cm)	5						
	UNITS		Trial #1	Trial #2	Trial #3			
Heavy Weight	lbs (Kg)		62180	57760	63720			
Light Weight	lbs (Kg)		57760	53340	59180			
Aggregate Unloaded	lbs (Kg)		4420	4420	4540			
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average	w/o Moisture
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		88.4	88.4	90.8	267.6	89.2	87.45

Aggregate Gate Setting	in(cm)	6						
	UNITS		Trial #1	Trial #2	Trial #3			
Heavy Weight	lbs (Kg)		63760	58340	52980			
Light Weight	lbs (Kg)		58340	52880	47400			
Aggregate Unloaded	lbs (Kg)		5420	5460	5580			
Head Shaft Revolutions	Rev counts		50.0	50.0	50.0	SUM	Average	w/o Moisture
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		108.4	109.2	111.6	329.2	109.7	107.55

Emulsion Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Emulsion Type: _____

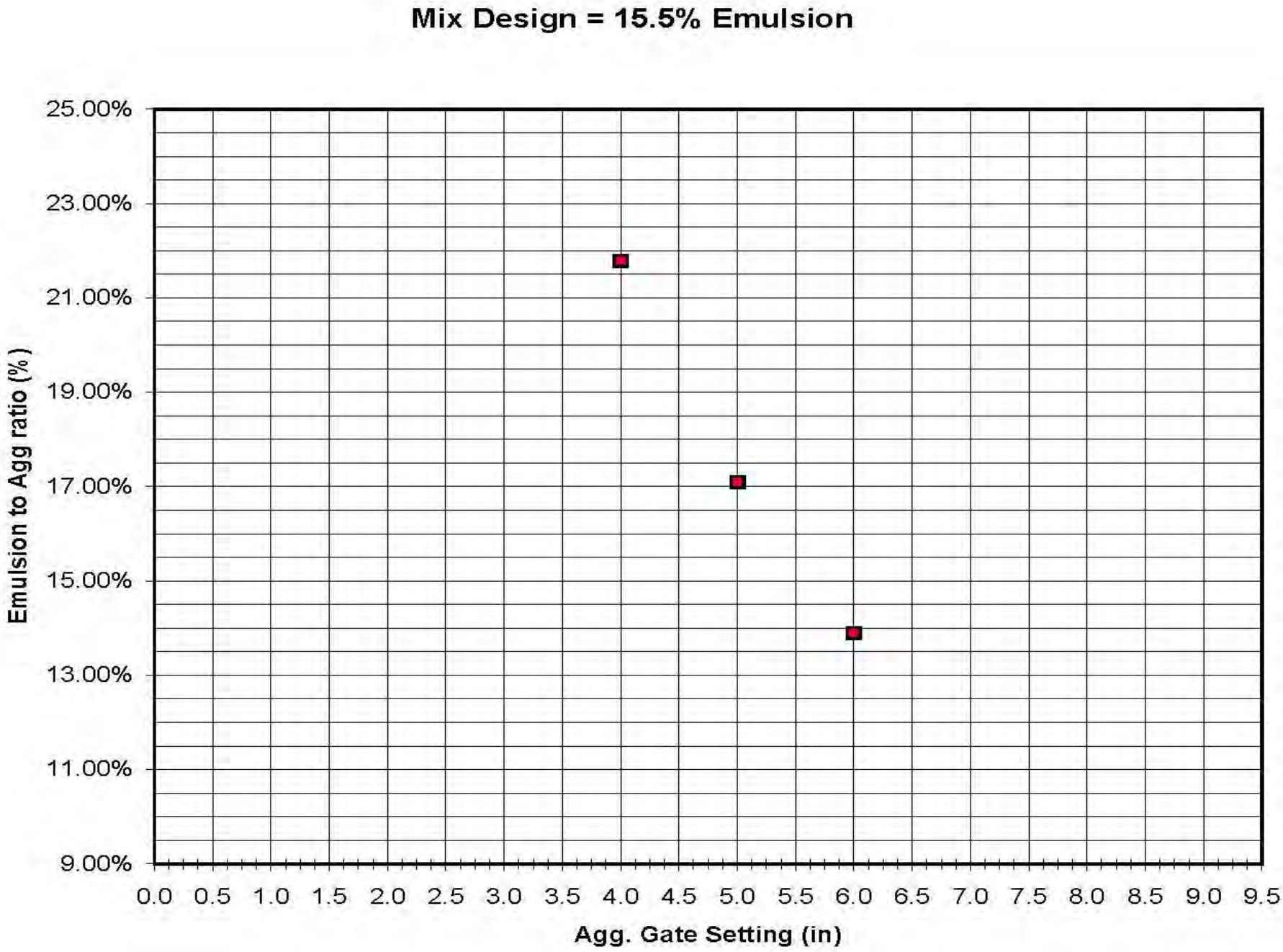
Emulsion Temperature: _____

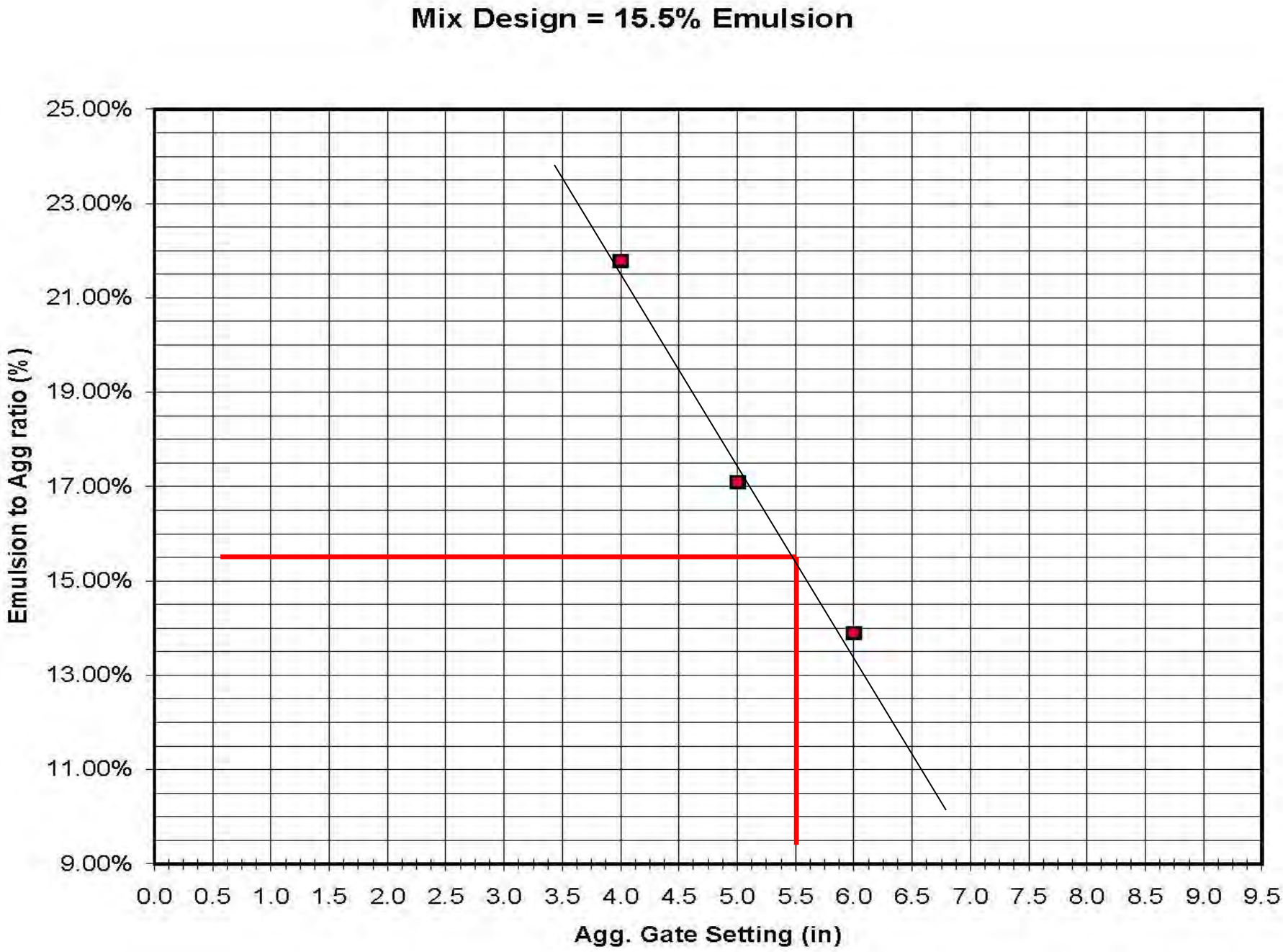
Emulsion Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)	43100	41620	40100		
Light Weight	lbs (Kg)	41620	40100	38640		
Emulsion Pumped	lbs (Kg)	1480	1520	1460		
Head Shaft Revolutions	Rev counts	100	100	100	SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)	14.8	15.2	14.6	44.60	14.87

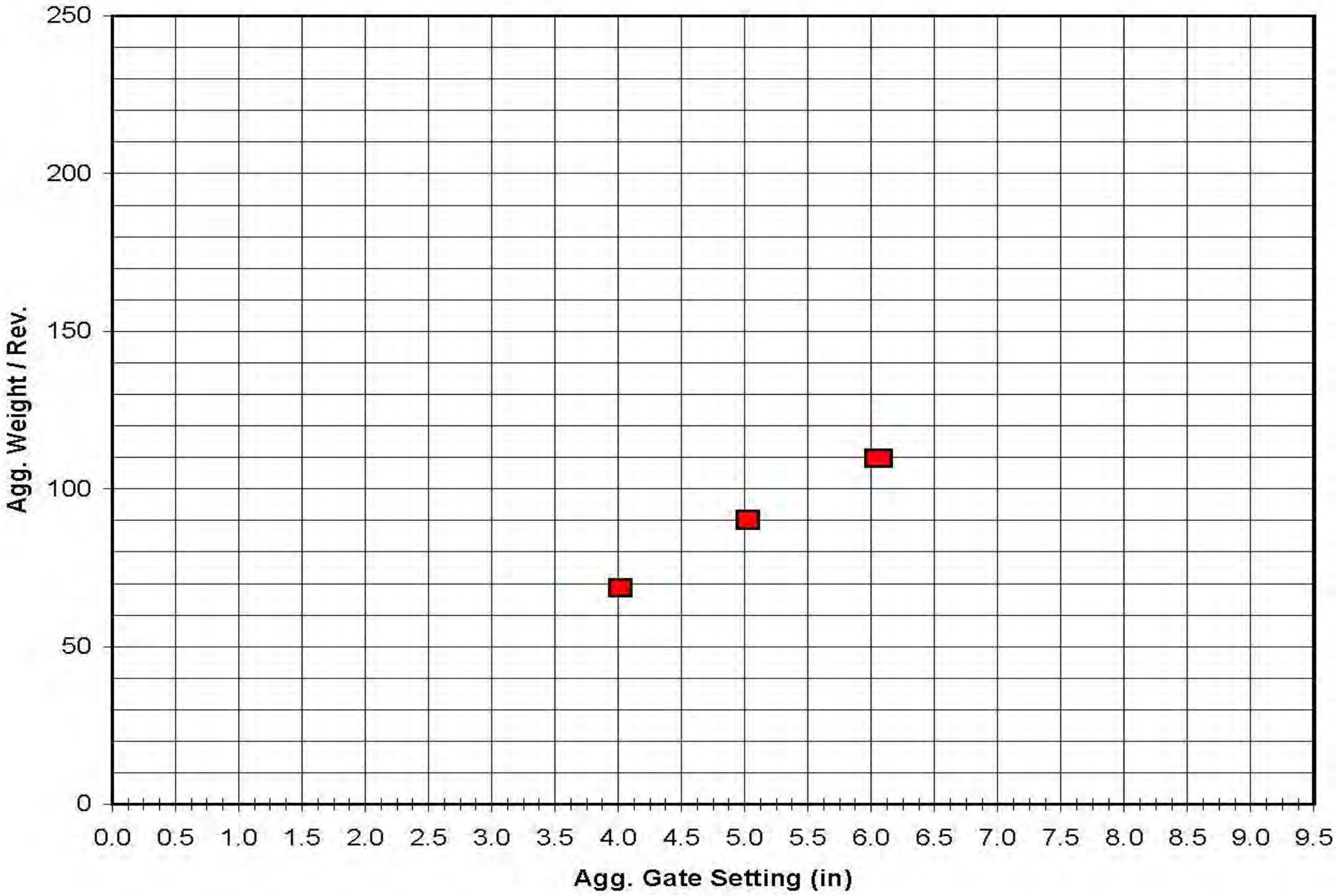
% Emulsion to Aggregate Ratio

	UNITS		Gate Setting	
Agg. Gate Setting	in. (cm)	4	5	6
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)	14.87	14.87	14.87
Ave Agg. / Rev	lbs/Rev (Kg/Rev)	68.63	87.45	107.55
Emulsion to Agg.		.2166	.1700	.1383
% Emulsion to Agg Ratio	%	21.66	17.00	13.83

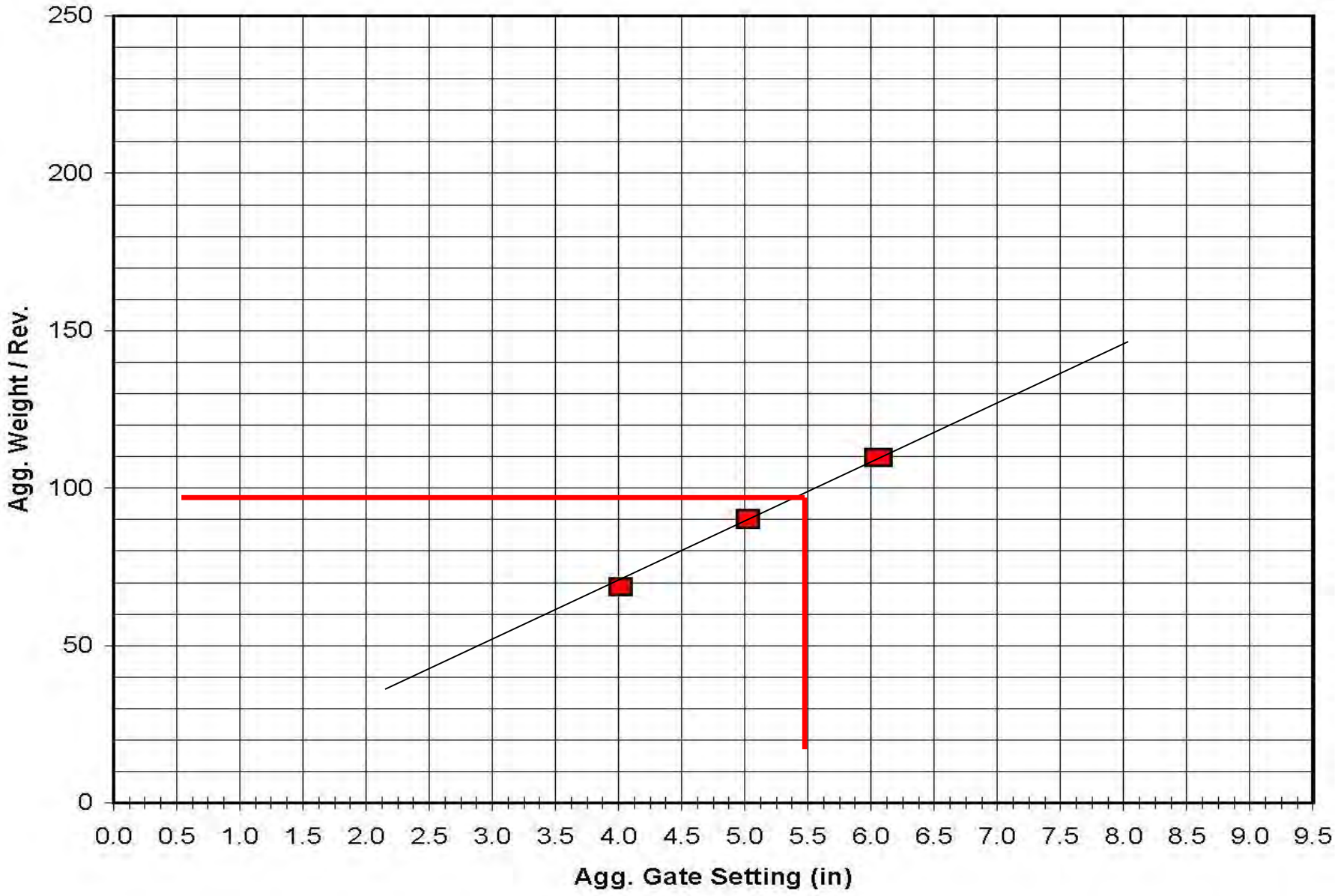




Pounds Per Count



Pounds Per Count = 96 pounds



Fines Calibration Charts

Job:_____ Date:_____

Machine No:_____ Measured By:_____

Fines Type:_____

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)					
Empty Weight	lbs (Kg)					
Fines Unloaded	lbs (Kg)					
Auger Shaft Revolutions	Rev counts				SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)					

% Fines to Aggregate Ratio

	UNITS	
Desired Fines to Agg. Ratio	%	
Aggregate / Rev	lbs/Rev (Kg/Rev)	
Ave. Fines / Rev	lbs/Rev (Kg/Rev)	
Fines / Agg.	lbs/Rev (Kg/Rev)	
Speed Ratio		

Fines Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Fines Type: _____

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)	21.66	21.86	21.74		
Empty Weight	lbs (Kg)	1.85	1.85	1.85		
Fines Unloaded	lbs (Kg)	19.81	20.01	19.89		
Auger Shaft Revolutions	Rev counts	10	10	10	SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)	1.981	2.001	1.989	5.97	1.99

Fines Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Fines Type: _____

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)	21.66	21.86	21.74		
Empty Weight	lbs (Kg)	1.85	1.85	1.85		
Fines Unloaded	lbs (Kg)	19.81	20.01	19.89		
Auger Shaft Revolutions	Rev counts	10	10	10	SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)	1.981	2.001	1.989	5.97	1.99

% Fines to Aggregate Ratio

	UNITS	
Desired Fines to Agg. Ratio	%	1
Aggregate / Rev	lbs/Rev (Kg/Rev)	96.0
Ave. Fines / Rev	lbs/Rev (Kg/Rev)	1.99
Fines / Agg.	lbs/Rev (Kg/Rev)	0.9600
Speed Ratio		0.48

How To Determine Flow Rate of liquids

- Before determining flow rates, determine weight of aggregate per minute.
- Gearbox that drives the conveyor has a 15:1 ratio, so at emulsion pump speed of about 450 RPM the conveyor will be turning at 30 RPM.

Gate Opening: 5.52” giving us 96 lbs/count

96lbs/count x 30 RPM = 2880 lbs/minute

How To Determine Flow Rate continued

Example:

Additive specific gravity = 11.15 lbs/gallon

Water specific gravity = 8.4 lbs/gallon

% (from mix design) x weight/minute = weight/minute

$$\text{Flow Rate} \quad \frac{\text{weight/minute}}{\text{Specific gravity}} = \text{gpm}$$

* Can be measured liters or kilograms

WRAPP Western Regional Association for Pavement Preservation

-- Dedicated to the improvement and promotion of the industry

Water Example

- Gearbox that drives the conveyor has a 15:1 ratio, so at emulsion pump speed of 450 RPM the conveyor will be turning at 30 RPM.

- At a gate setting of 5.52”, the aggregate output is:

  96 lbs/count x 1 count/rev x 30 RPM = 2880 lbs/minute

  *Other machines count/rev will vary

- With water requirement of 10%, the flow rate required is:

  .10 x 2880 = 288 lbs/minute

- Assuming the water specific gravity is 8.34 lbs/gallon, then the flow rate is:

$$\frac{288 \text{ lbs/minute}}{8.4 \text{ lbs/gallon}} = 34.28 \text{ GPM}$$

*Calculated using a Centrifugal pump with flow meter

Liquid Additive Example

- Gearbox that drives the conveyor has a 15:1 ratio, so at emulsion pump speed of 450 RPM the conveyor will be turning at 30 RPM.

- At a gate setting of 5.52”, the aggregate output is:

  96 lbs/count x 1 count/rev x 30 RPM = 2880 lbs/minute

  *Other machines count/rev will vary

- With an additive requirement of 1%, the flow rate required is:

  .01 x 2880 = 28.8 lbs/minute

- Assuming the additive specific gravity is 11.15 lbs/gallon, then the flow rate is:

$$\frac{28.8 \text{ lbs/minute}}{11.15 \text{ lbs/gallon}} = 2.58 \text{ GPM}$$

*Calculated using a Centrifugal pump with flow meter

Positive Displacement Additive Pumps

•Determine the lbs/count (net weight) of your additive by weighing what you pumped from your machine and then subtracting the weight of your container (Empty Weight).

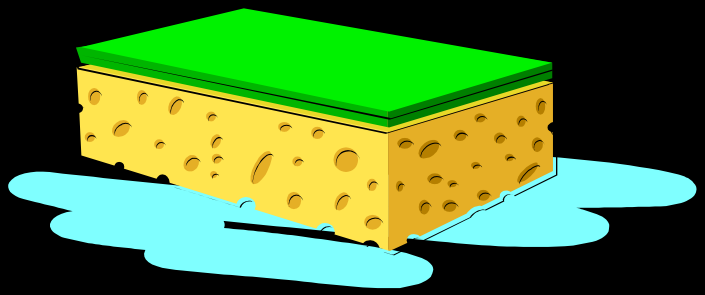
Full Weight – Empty Weight = Net Weight

•Next, take your net weight and divide it by the number of counts from your meter to get your lbs/count of additive.

$$\frac{\text{Net Weight}}{\text{\# of counts}} = \text{lbs/count}$$

*Consult owners manual for specific directions on how to calculate Flow and set your positive displacement pump.

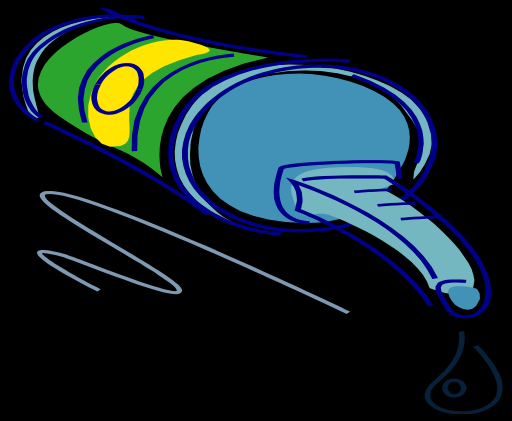
Advanced Calibrations Factors



- Bulking Effect:

  Moisture makes the aggregate expand like a sponge changing the density.

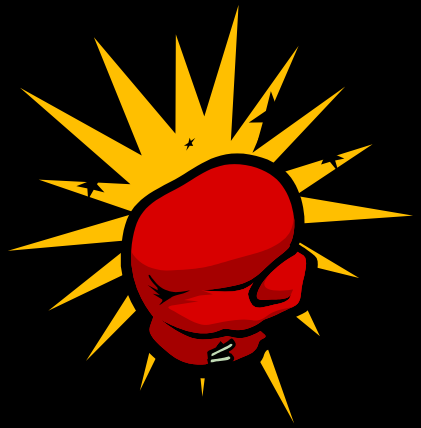
Advanced Calibrations Factors



- Calibration by percent residual asphalt:

  The amount of asphalt that is in your emulsion.

Advanced Calibrations Factors



- Variable Displacement Pumps vs. Fixed Displacement Pumps.

Calibration is done! Now what?

- Are your materials staged?
- Is your personnel ready?
- Is your equipment set to the calibration?

Spread Rate

- Performance of the slurry system is directly related to the proper application rate of the materials
- ISSA recommends that a minimum of four spread rate checks be performed daily.
- Used to ensure that the specified application rate is being met
- Utilize the factors determined during the calibration process
- Application rates are based upon dry aggregate pounds per square (ft. or yd.)

Calculating Spread Rate

- SR = spread rate or application rate
  - Typical units are pounds per square yard or kilograms per square meter
- Agg. lbs per count - from calibration calculations on slide 44
- Agg. Counts – read off the slurry machine
- BW = Box Width – measured
- LOP = Length of Pass - measured

$$SR = \frac{\text{Agg. lbs/count x Agg. Counts}}{\text{BW x LOP}}$$

Spread Rate continued

Breakdown of Spread Rate (SR) equation:

- Agg. lbs/count is determined by your calibration data (shown on slide 44)
- Agg. counts are from the machine
- Box Width
- Length of pass

Spread Rate Example

$$SR = \frac{\text{Agg. lbs/count x Agg. Counts}}{\text{BW x LOP}}$$

- SR = spread rate/application rate
- Agg. lbs per count = ????
- Agg. Counts = 100
- BW = Box Width = 12 Feet (4 yards)
- LOP = Length of Pass = 504 Feet (168 yards)

$$SR = \frac{?? \text{ lbs/count x } 100}{4 \text{ yd x } 168 \text{ yd}} = ????$$

Spread Rate = ????

Spread Rate Example

$$SR = \frac{\text{Agg. lbs/count x Agg. Counts}}{\text{BW x LOP}}$$

- SR = spread rate/application rate
- Agg. lbs per count = 96 pound per count
- Agg. Counts = 100
- BW = Box Width = 12 Feet (4 yards)
- LOP = Length of Pass = 504 Feet (168 yards)

$$SR = \frac{\text{96 lbs/count x 100}}{\text{4 yd x 168 yd}} = 14.28$$

Spread Rate = 14.28 lbs/yd^2

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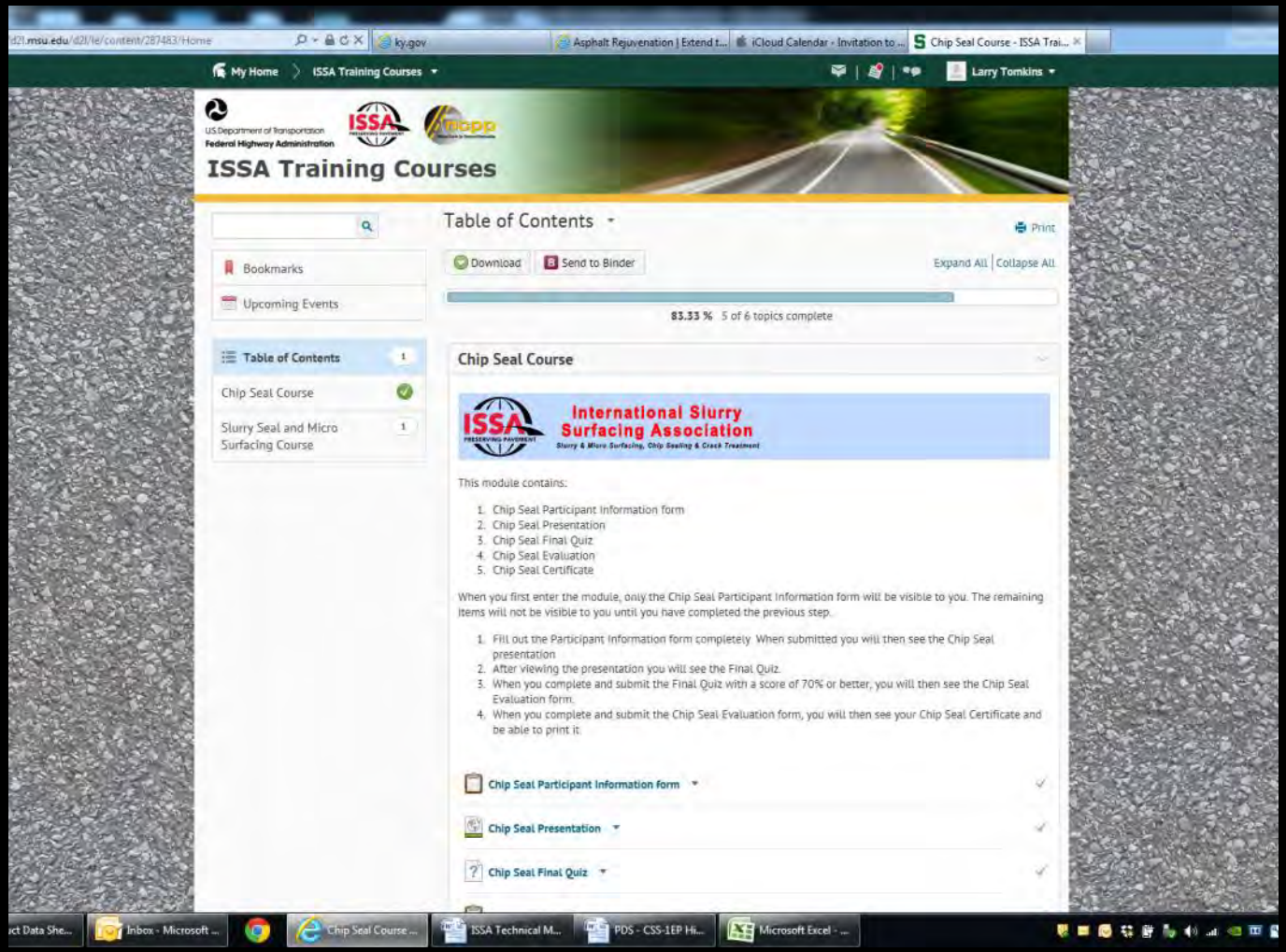

Thank You!

Good Info In = Good Product Out

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