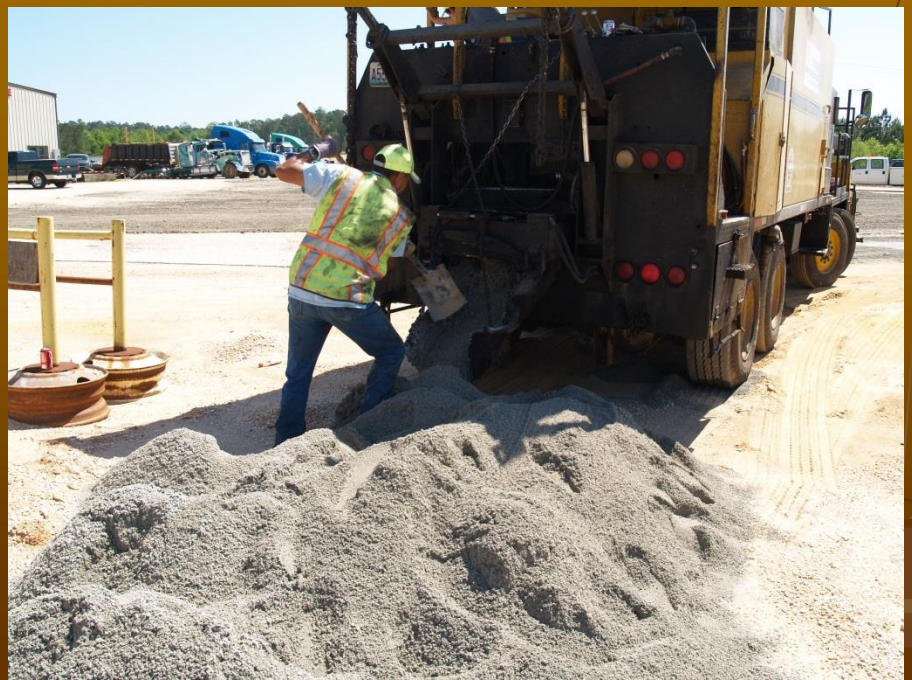
Calibration

Rex Eberly, Bergkamp Inc.

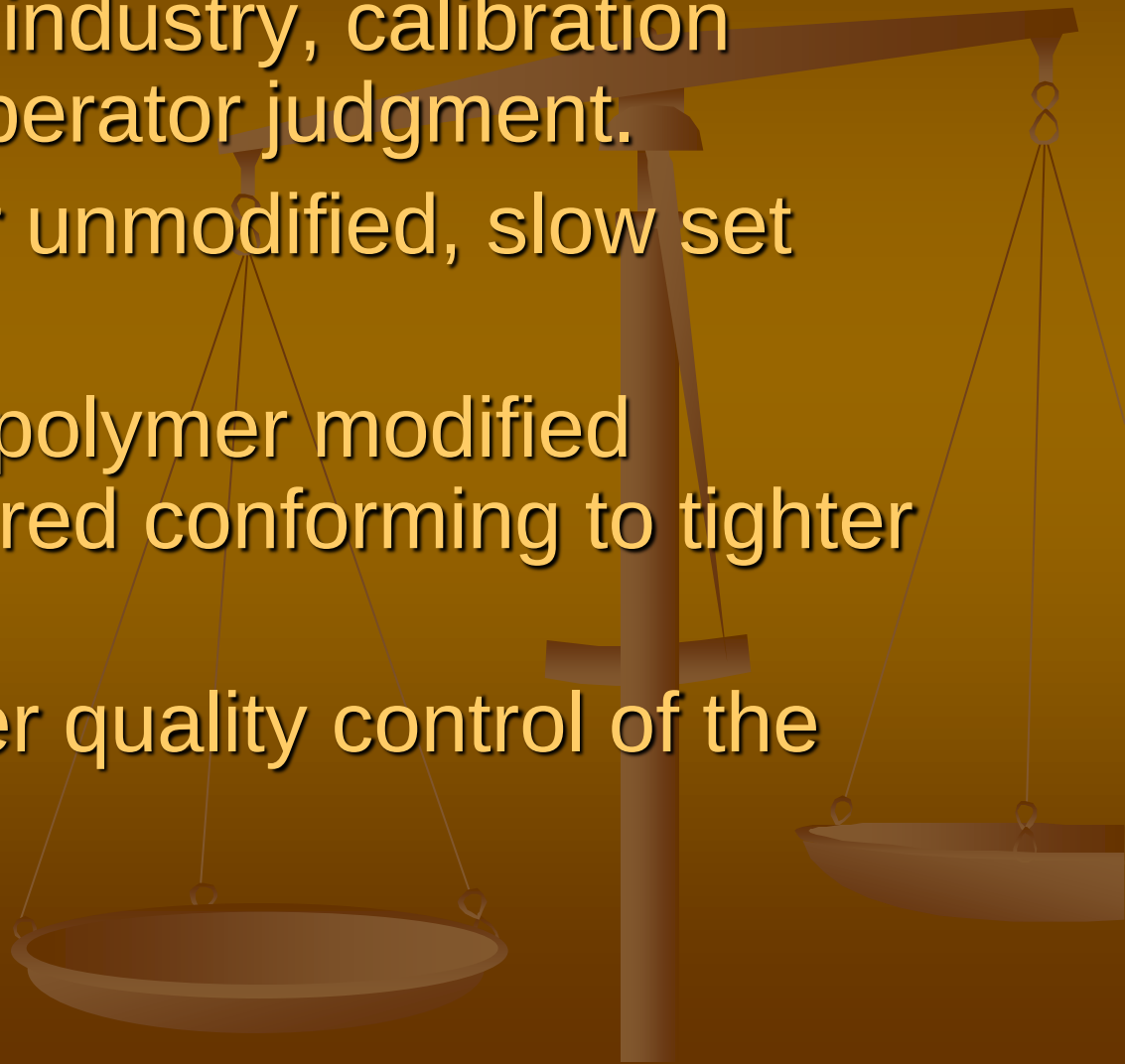
What will we cover?

- Basics of calibration
- Correlation to equipment operation
- Calculations



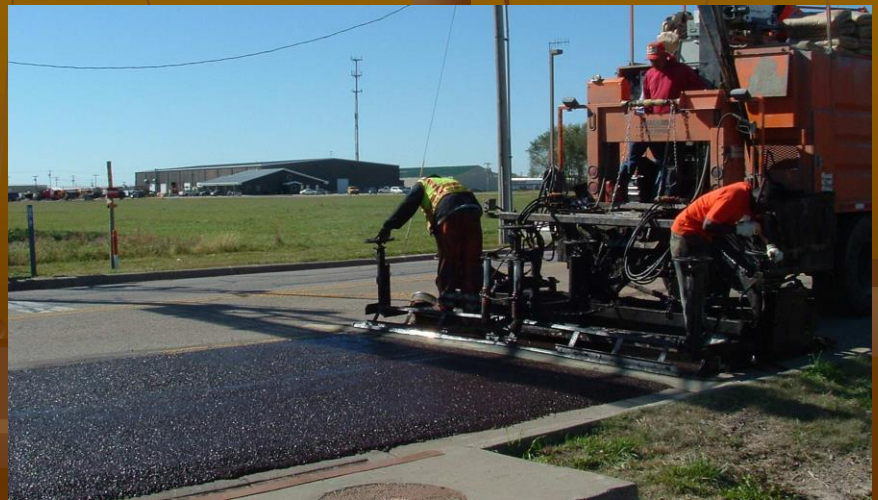
History of Calibration Process

- In early days of industry, calibration performed by operator judgment.
- Worked fine for unmodified, slow set slurry.
- Introduction of polymer modified emulsions required conforming to tighter specifications.
- Results in better quality control of the product.



Why do we calibrate?

- Allow the machine to be set such that the ratios of aggregate, emulsion and fines stay fixed at a predetermined level.
- Ensure quality control of the system for the contractor and buying agency
- Both buyer agency and contractor have accurate forecasts and records of materials used.

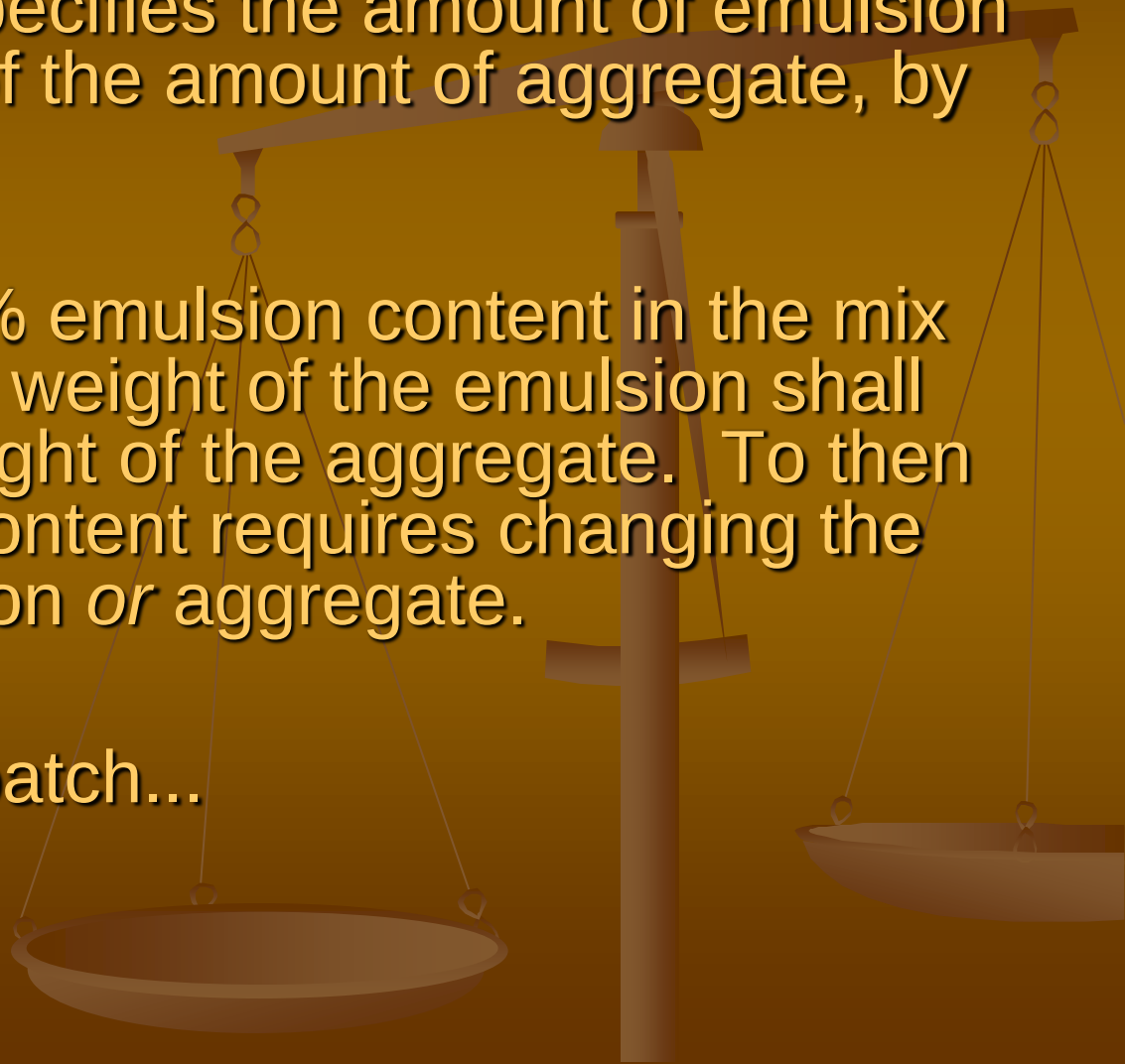


What is calibration?

- Process of measuring by weight
  - Actual output of:
  - Aggregate
  - Emulsion
  - Mineral filler (cement) - dependent on brand of paver.
- Correlated to revolutions of the aggregate belt

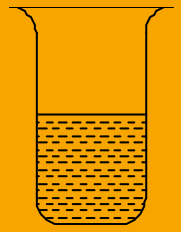
How do we calibrate?

- The mix design specifies the amount of emulsion as a percentage of the amount of aggregate, by weight.
- For example, 10% emulsion content in the mix design means the weight of the emulsion shall be 10% of the weight of the aggregate. To then switch to a 12% content requires changing the quantity of emulsion *or* aggregate.
- If we mixed in a batch...

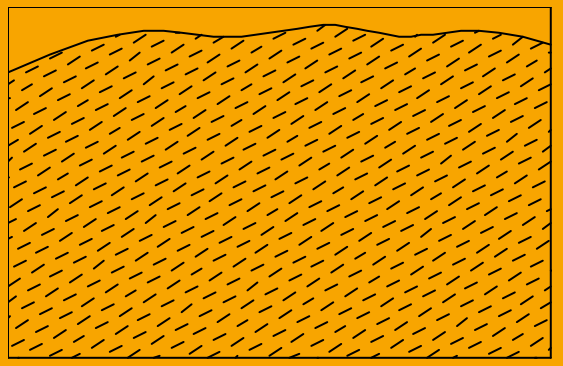


How do we calibrate?

10%

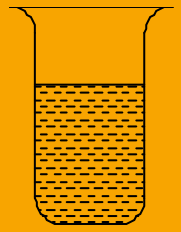


Emulsion
10 lbs

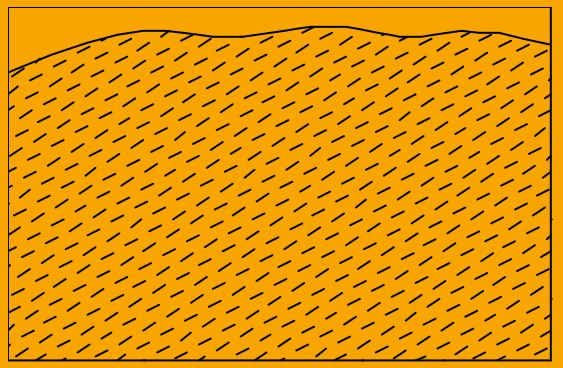


Rock – 100 lbs

12%

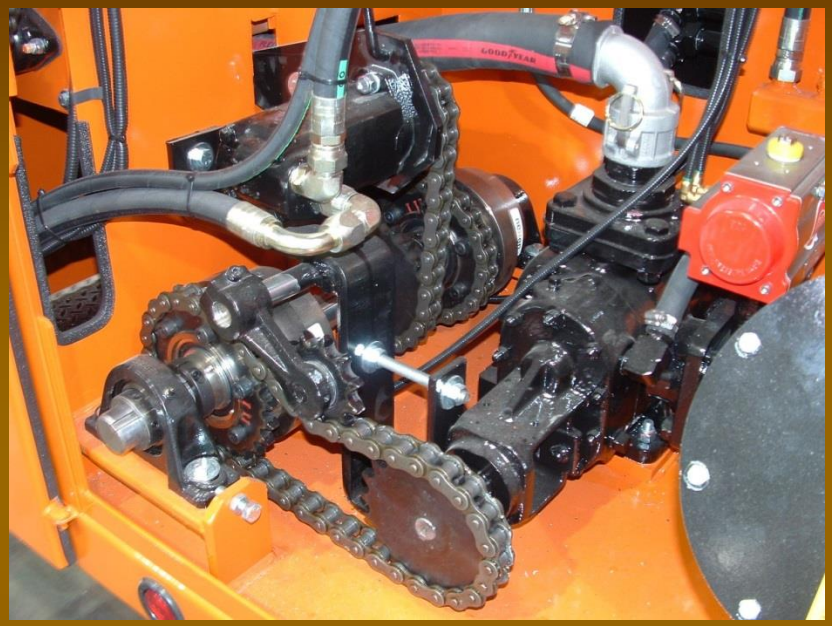


Emulsion
12 lbs



Rock – 100 lbs

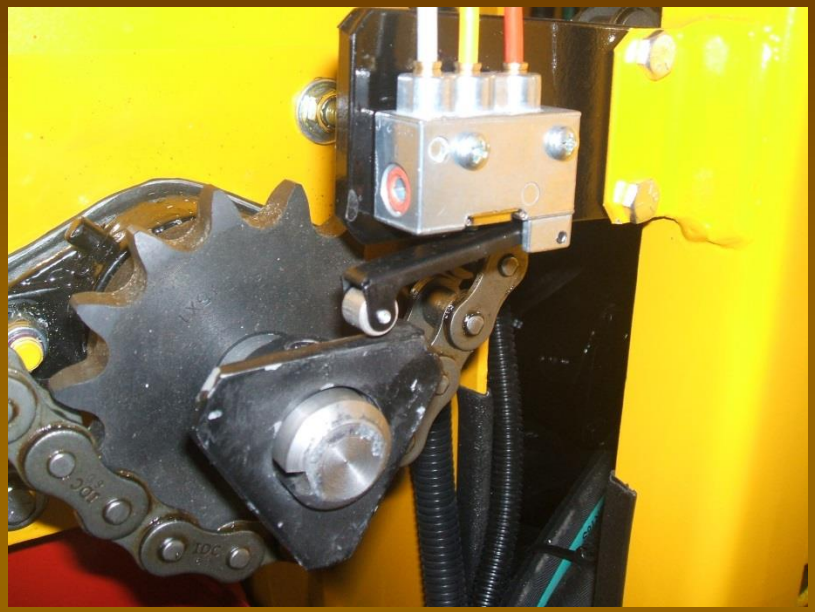
Machine Calibration



Since we have a continuous feed operation, we must match the aggregate delivery to the emulsion pump delivery.

This is done with “counters” in the calibration process.

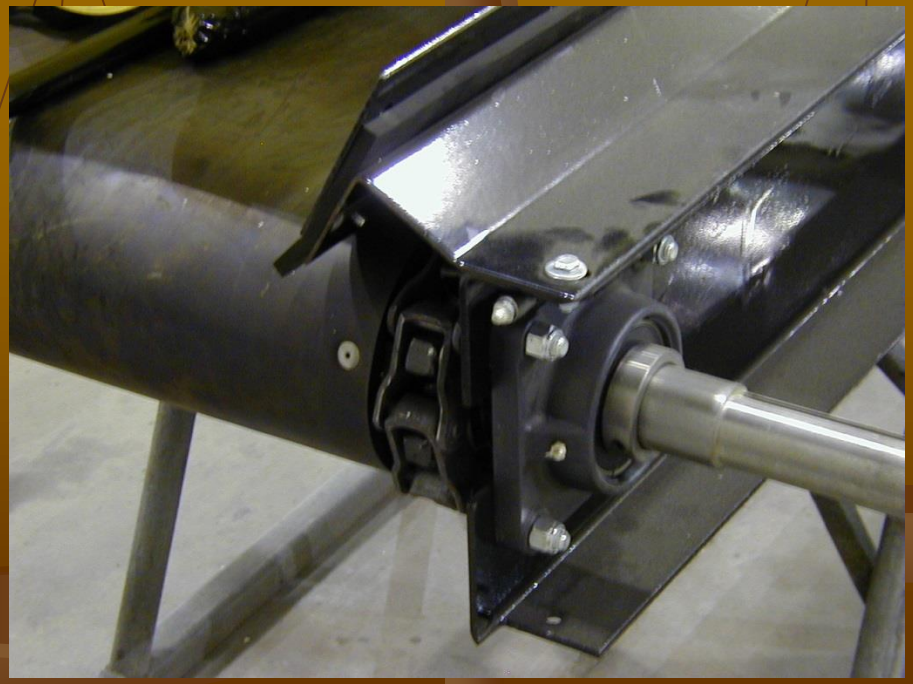
Counters



- Count, or totalize the revolutions of a shaft, pulley or sprocket.
- In some applications, counts fractions of a revolution.
- Counters are not rate dependent.

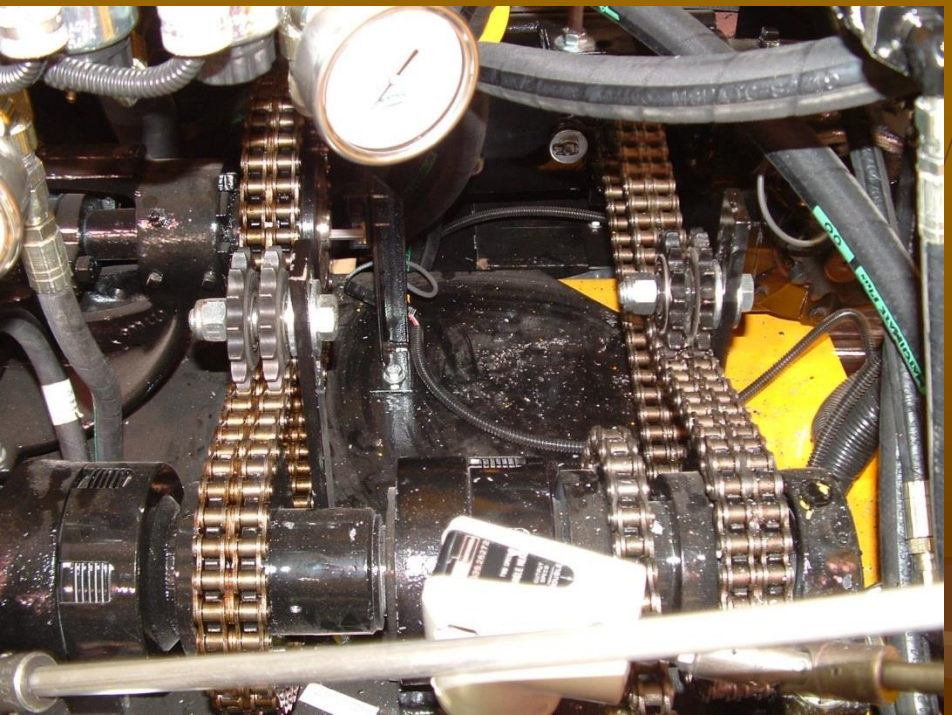
Machine Operation

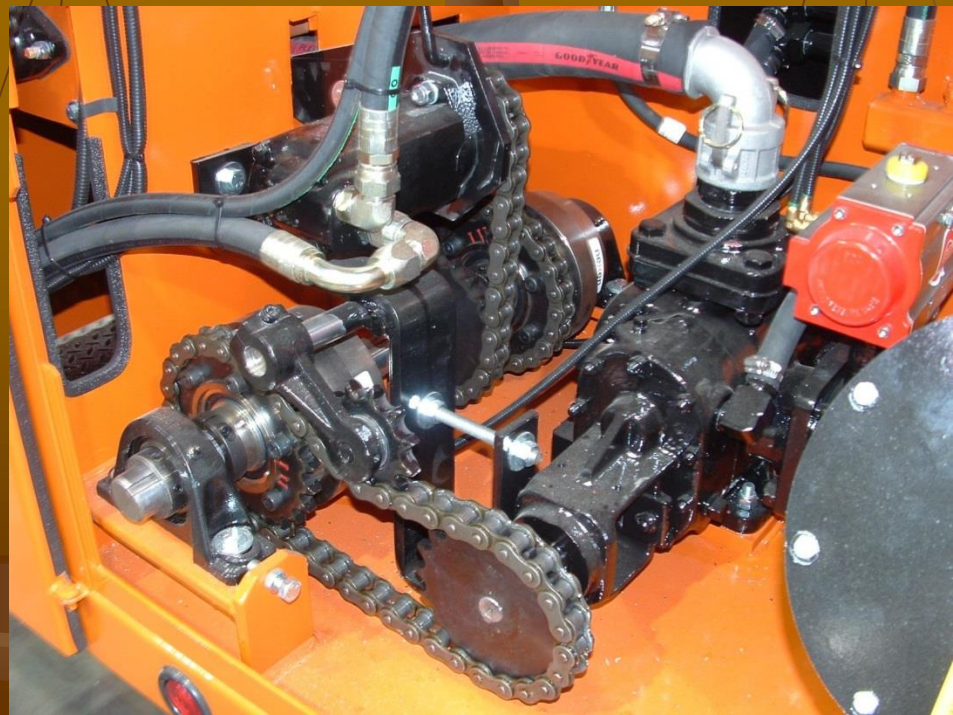
The aggregate is delivered by a conveyor belt, delivering a consistent amount of aggregate per revolution (at a given gate setting) from the hopper into the pugmill.



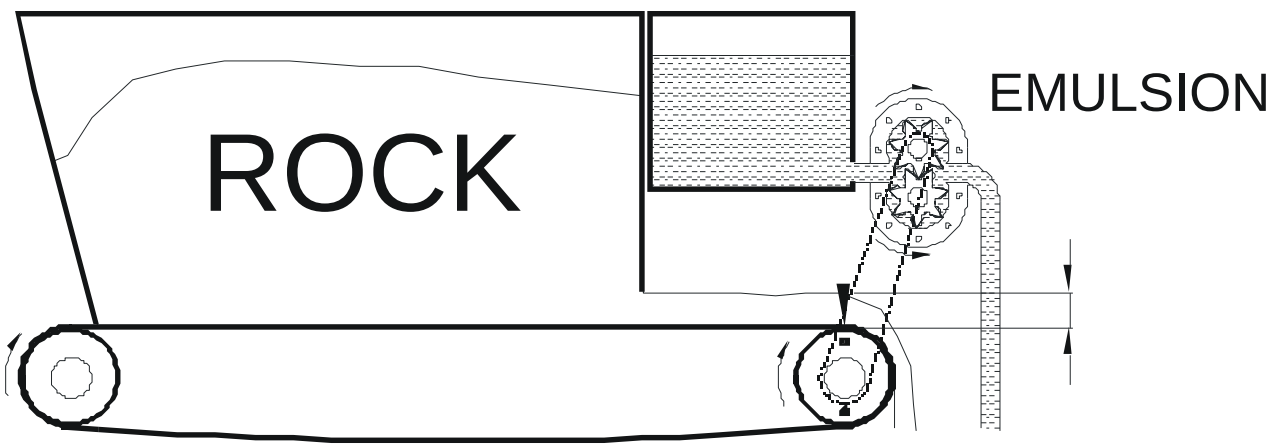
Machine Operation

The aggregate belt and the emulsion pump are mechanically tied together to ensure a consistent mix.





Machine Operation



Machine Operation

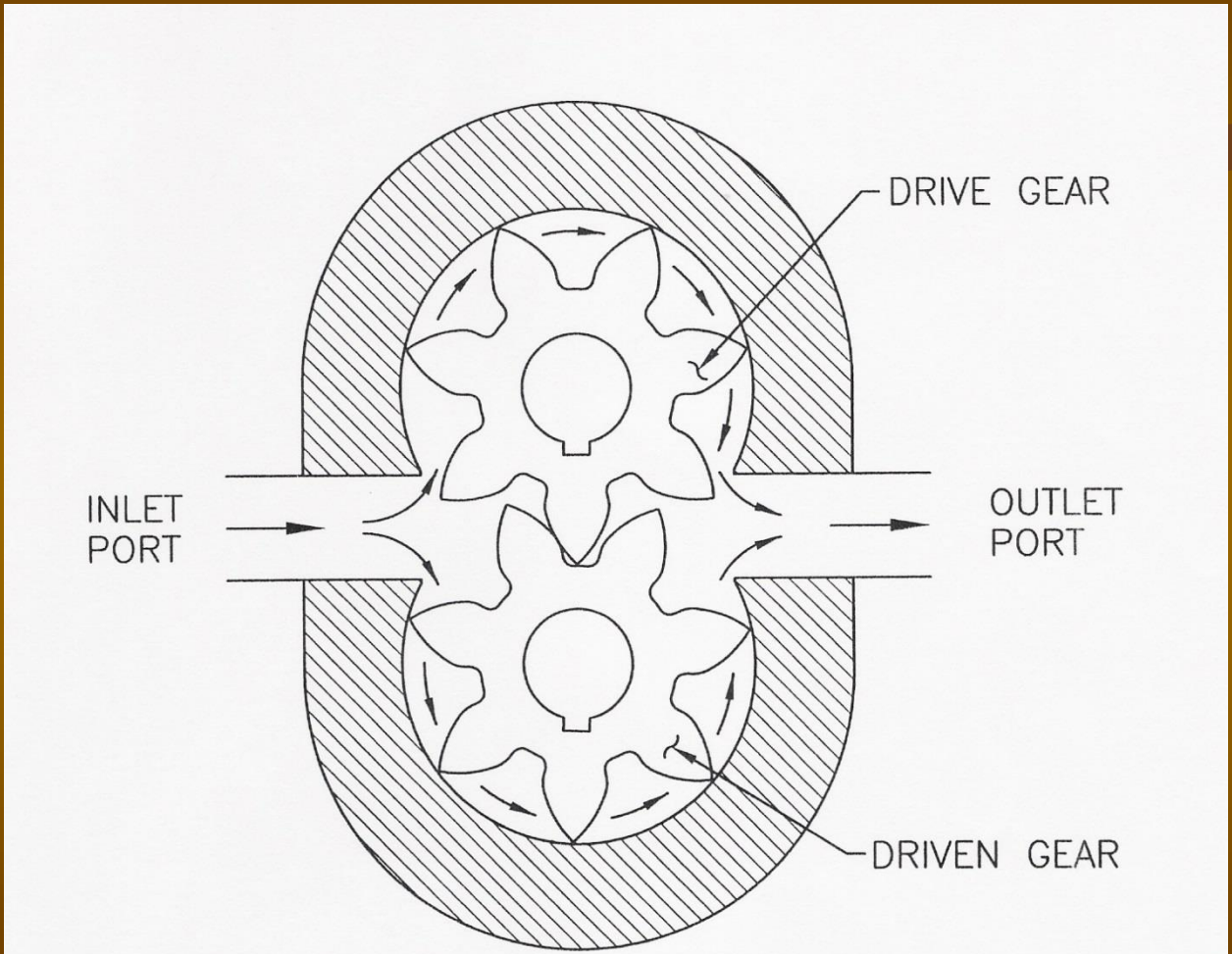
Emulsion is delivered by a pump, of which there are several types.

- Positive Displacement
  - Gear Pump
- Variable Displacement
  - Rotary Piston Pump

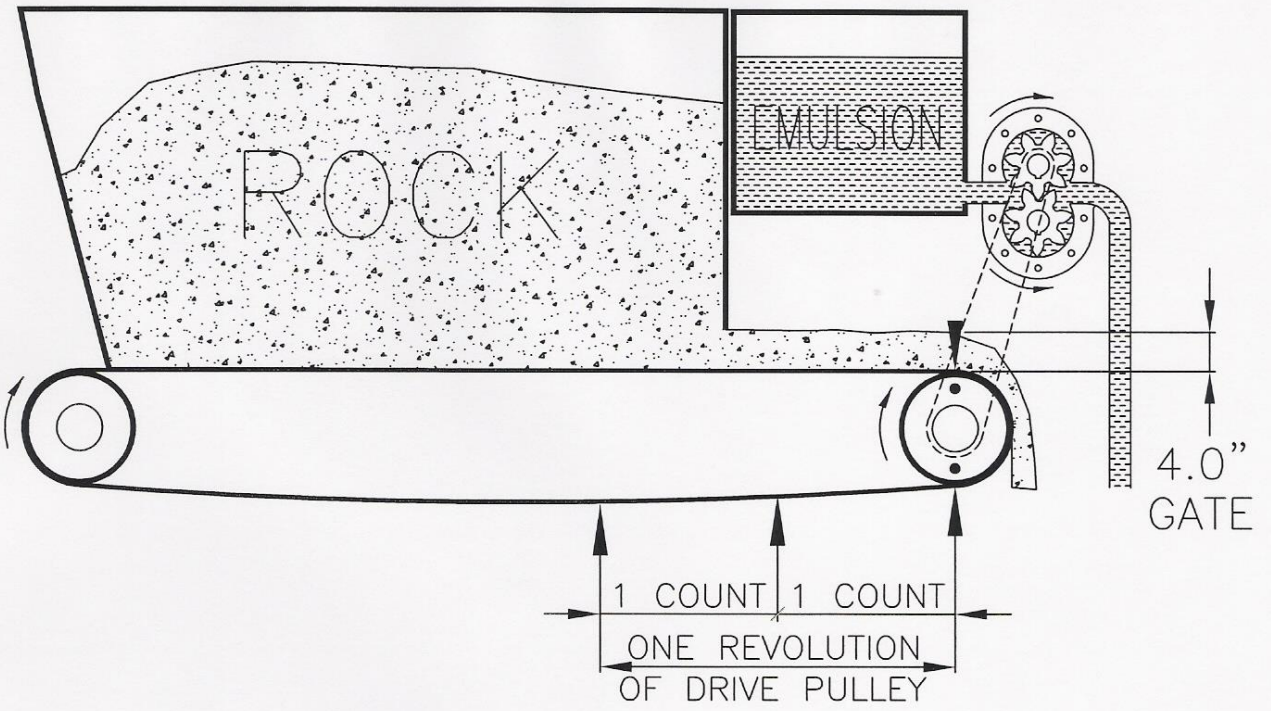
Gear Pump with strainer

Rotary Piston Pump

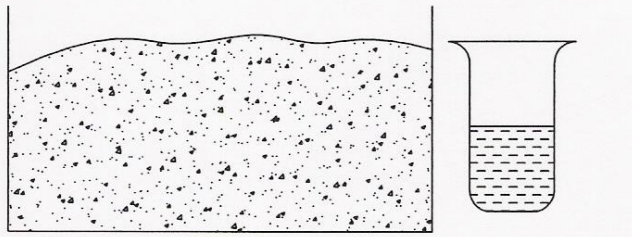
Gear Pump (Positive Displacment)



Machine Operation

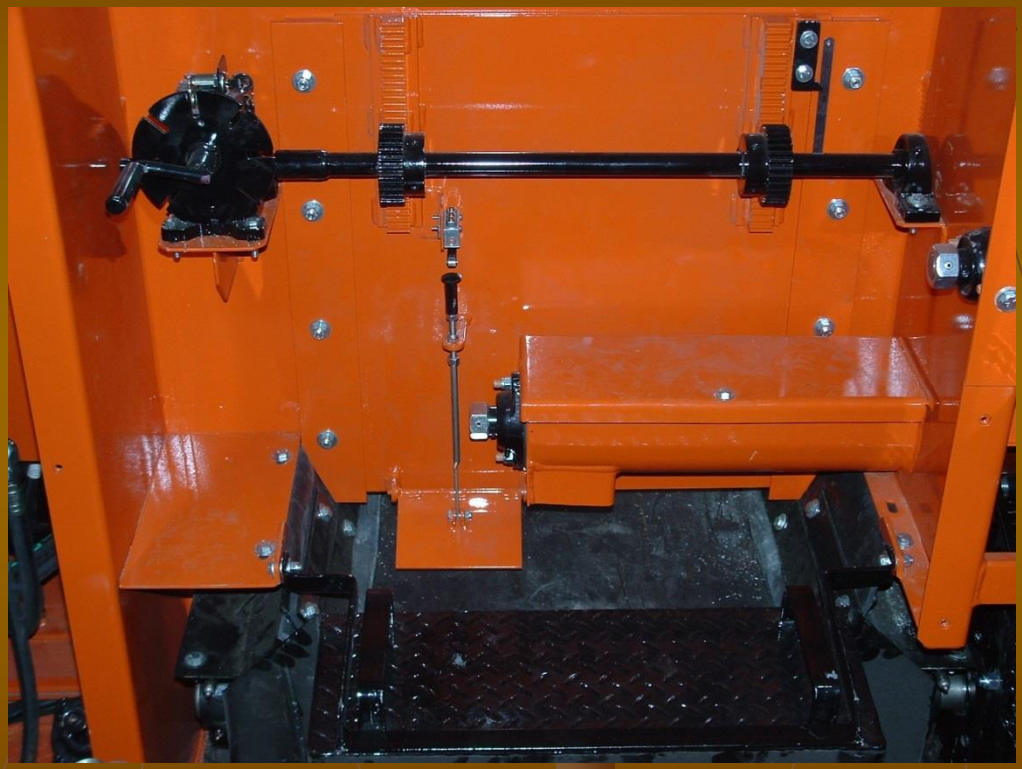


10 lbs emulsion / 100 lbs rock = 10%

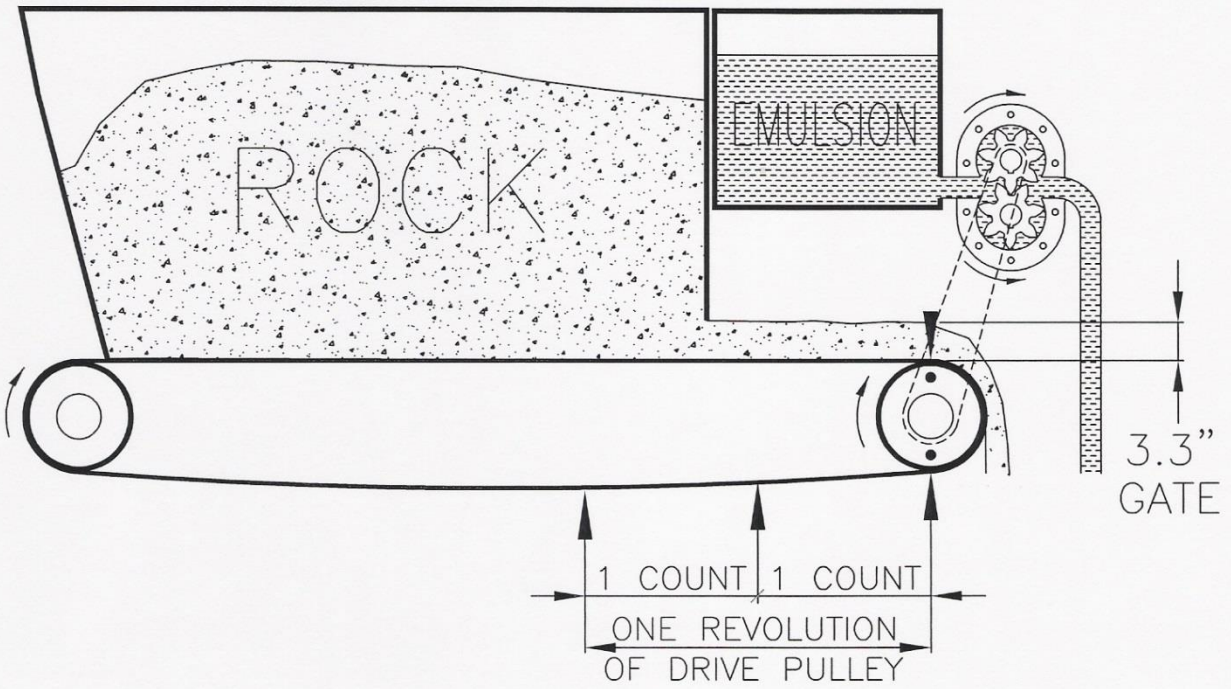


How do we calibrate?

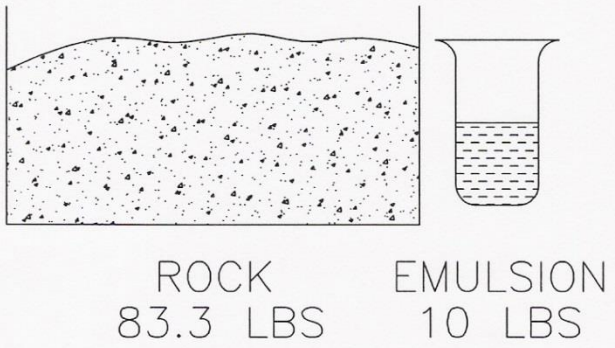
- **For systems with positive displacement pumps, the gate setting of the hopper is varied to achieve different emulsion/aggre-gate ratios.**



How do we calibrate?

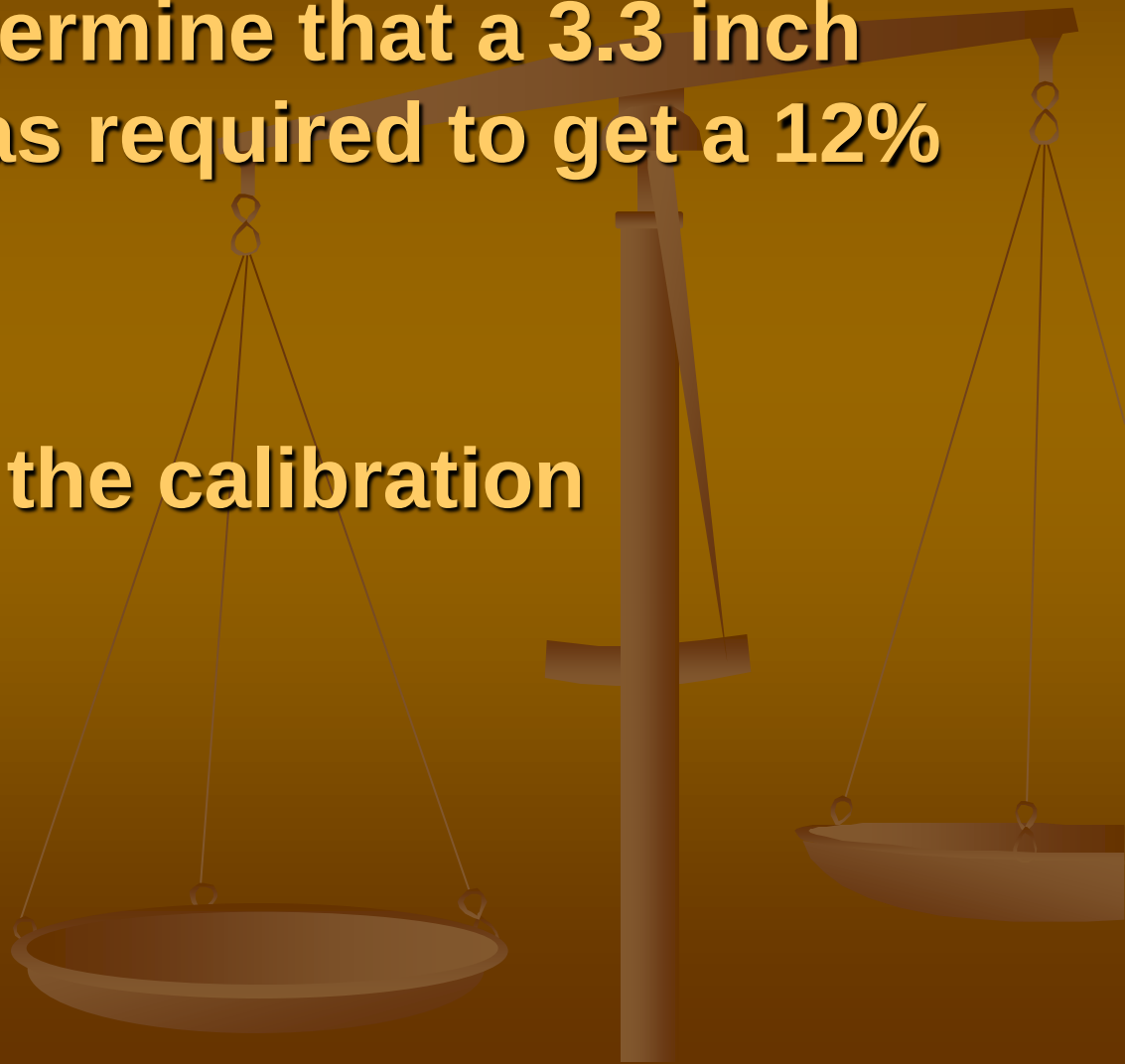


$$\frac{\text{10 lbs emulsion}}{\text{83.3 lbs rock}} = 12\%$$



How do we calibrate?

- **How do we determine that a 3.3 inch gate setting was required to get a 12% mix design?**
- **By performing the calibration procedure.**



Emulsion and Cement

Field Calibration Procedure Worksheet

Job # 301 Unit# 102 Date 5/1/2015

Emulsion Calibration

Emulsion	Full Weight LBS	Empty Weight LBS	Net Weight LBS (=Full-Empty)	No. of Counts	LBS per Count
Sample 1	260	0	260	50	5.20
Sample 2	270	0	270	50	5.40
Sample 3	180	0	180	35	5.20

Avg. Lbs / Count of Emulsion 5.26

Desired Emulsion % 12 %

5.26 P.C. / .12 = 43.8 Agg P.C.

Data must be entered in the Full Weight, Empty Weight, and Number of Counts Columns.
Desired emulsion percentage must also be entered.
DON'T FORGET TO ENTER DATE & UNIT NUMBER

Cement / Fines Calibration

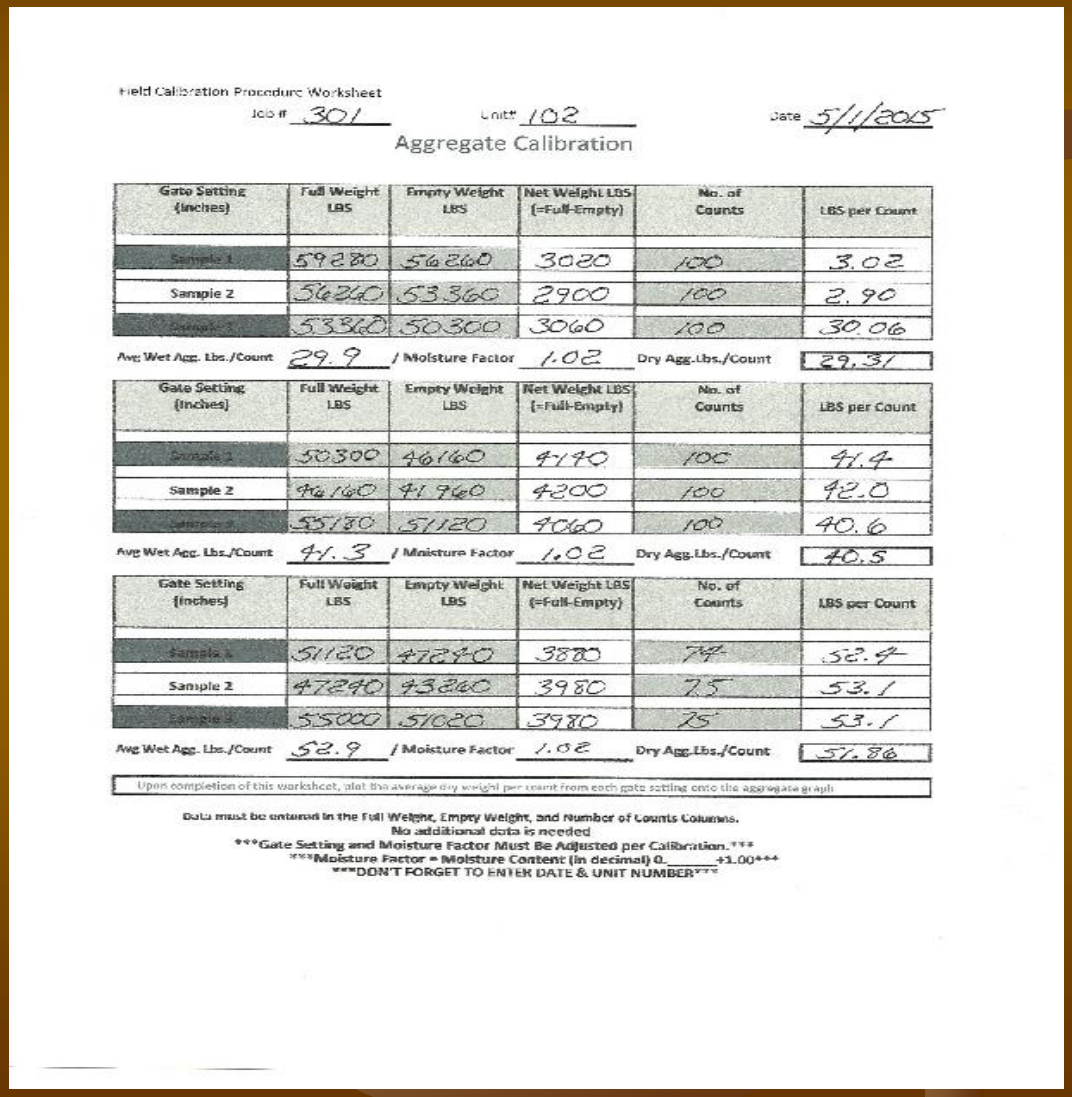
Cement / Fines	Full Weight LBS	Empty Weight LBS	Net Weight LBS (=Full-Empty)	No. of Counts	LBS per Count
Sample 1					
Sample 2					
Sample 3					

Avg. Lbs / Count of Fines

Desired Cement / Fines %

Data must be entered in the Full Weight, Empty Weight, and Number of Counts Columns.
Desired Cement / Fines percentage must also be entered.
DON'T FORGET TO ENTER DATE & UNIT NUMBER

Aggregate Calibration



Field Calibration Procedure Worksheet

Job # 301 Unit# 102 Date 5/1/2015

Aggregate Calibration

Gate Setting (inches)	Full Weight LBS	Empty Weight LBS	Net Weight LBS (=Full-Empty)	No. of Counts	LBS per Count
Sample 1	59280	56260	3020	100	3.02
Sample 2	56260	53360	2900	100	2.90
Sample 3	53360	50300	3060	100	30.06

Avg Wet Agg. Lbs./Count 29.9 / Moisture Factor 1.02 Dry Agg.Lbs./Count 29.31

Gate Setting (inches)	Full Weight LBS	Empty Weight LBS	Net Weight LBS (=Full-Empty)	No. of Counts	LBS per Count
Sample 1	50300	46160	4140	100	41.4
Sample 2	46160	41960	4200	100	42.0
Sample 3	55180	51120	4060	100	40.6

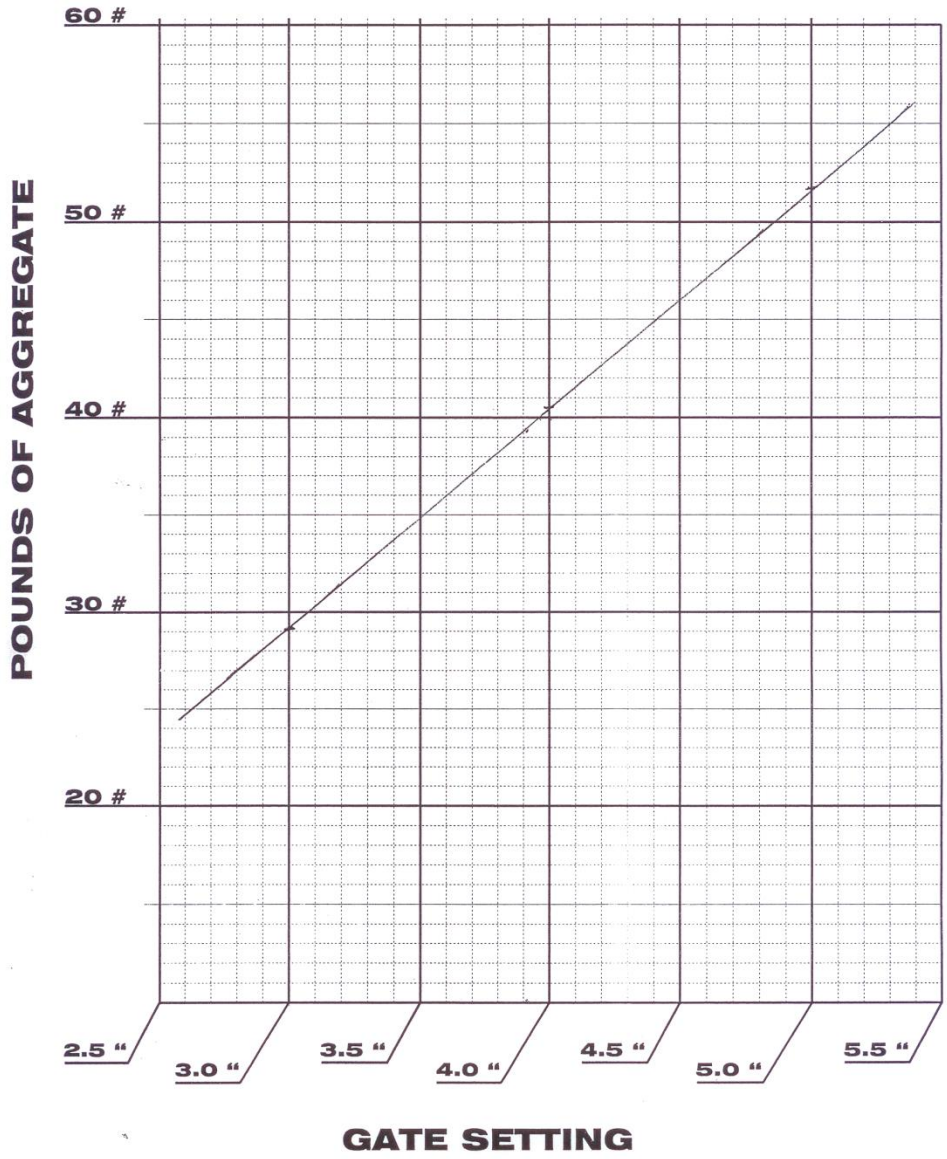
Avg Wet Agg. Lbs./Count 41.3 / Moisture Factor 1.02 Dry Agg.Lbs./Count 40.5

Gate Setting (inches)	Full Weight LBS	Empty Weight LBS	Net Weight LBS (=Full-Empty)	No. of Counts	LBS per Count
Sample 1	51120	47240	3880	74	52.4
Sample 2	47240	43260	3980	75	53.1
Sample 3	55000	51020	3980	75	53.1

Avg Wet Agg. Lbs./Count 52.9 / Moisture Factor 1.02 Dry Agg.Lbs./Count 51.86

Upon completion of this worksheet, plot the average dry weight per count from each gate setting onto the aggregate graph

Data must be entered in the Full Weight, Empty Weight, and Number of Counts Columns.
No additional data is needed
Gate Setting and Moisture Factor Must Be Adjusted per Calibration.
Moisture Factor = Moisture Content (in decimal) 0._____+1.00
DON'T FORGET TO ENTER DATE & UNIT NUMBER



- Presented as an example only, an actual calibration must be performed!

How do we calibrate?

- For systems using a variable displacement pump, the pump is set at one setting, then the same calibration process as for a positive displacement pump is followed. If the resulting gate setting is very high or very low for the mix design required, the pump setting is changed, then calibrated.

Tri-Rotor volume control 0-100%

Effects of water on rock calibration.

- **Moisture content describes the amount of moisture in the rock. When calibrating, we want to weigh only the rock.**

$$\text{Moisture content} = \frac{\text{(weight of wet rock – weight of dry rock)}}{\text{(weight of wet rock)}}$$

Moisture Content

- Obtain sample
  - Representative sample, not from outside of pile.

Moisture Content

- Weigh it
  - Must zero scale, or subtract the container weight.

Moisture Content

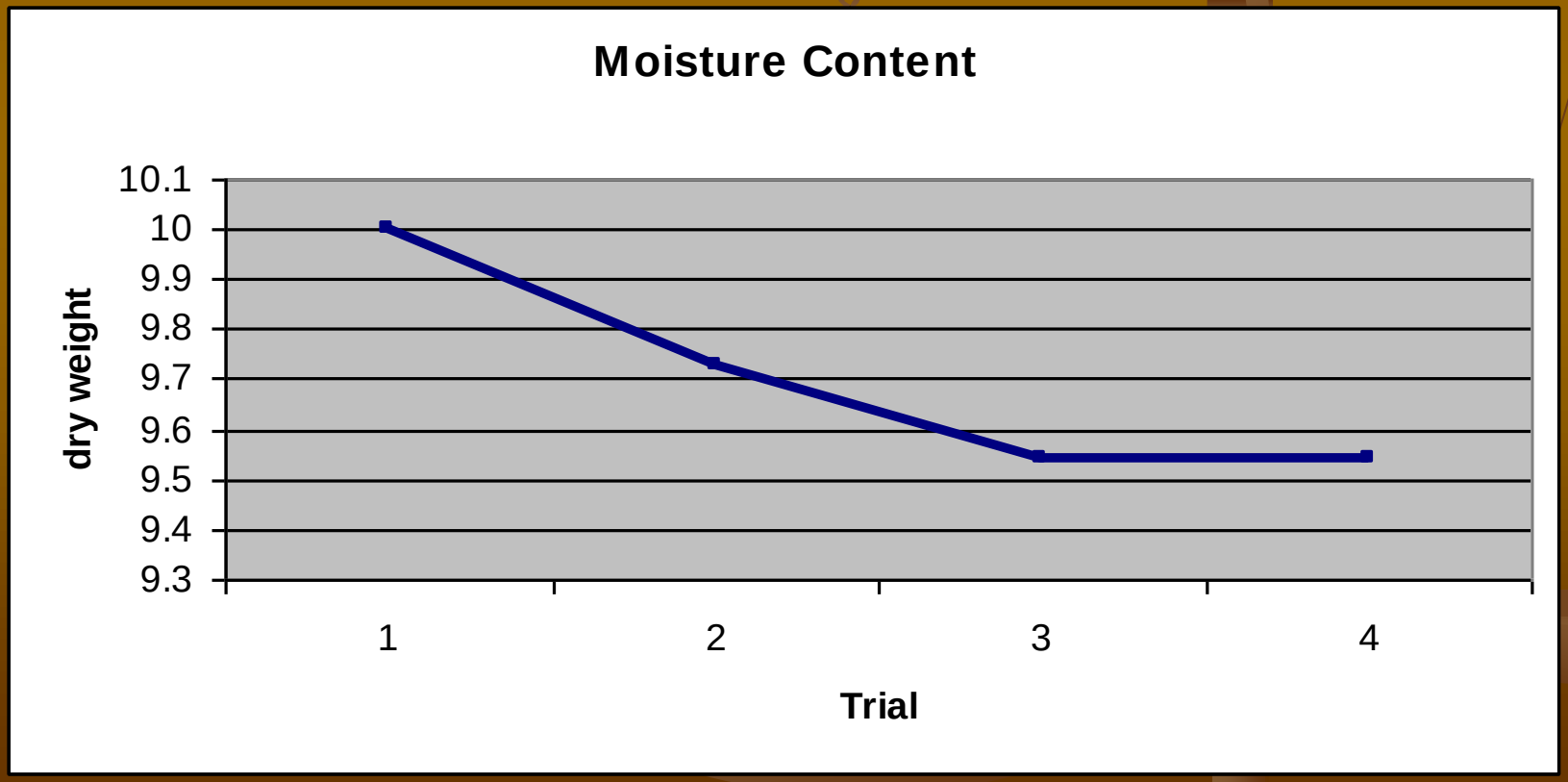
- Dry it out
  - Sunshine
  - Heat

Moisture Content

- Re-weigh until constant

Moisture Content

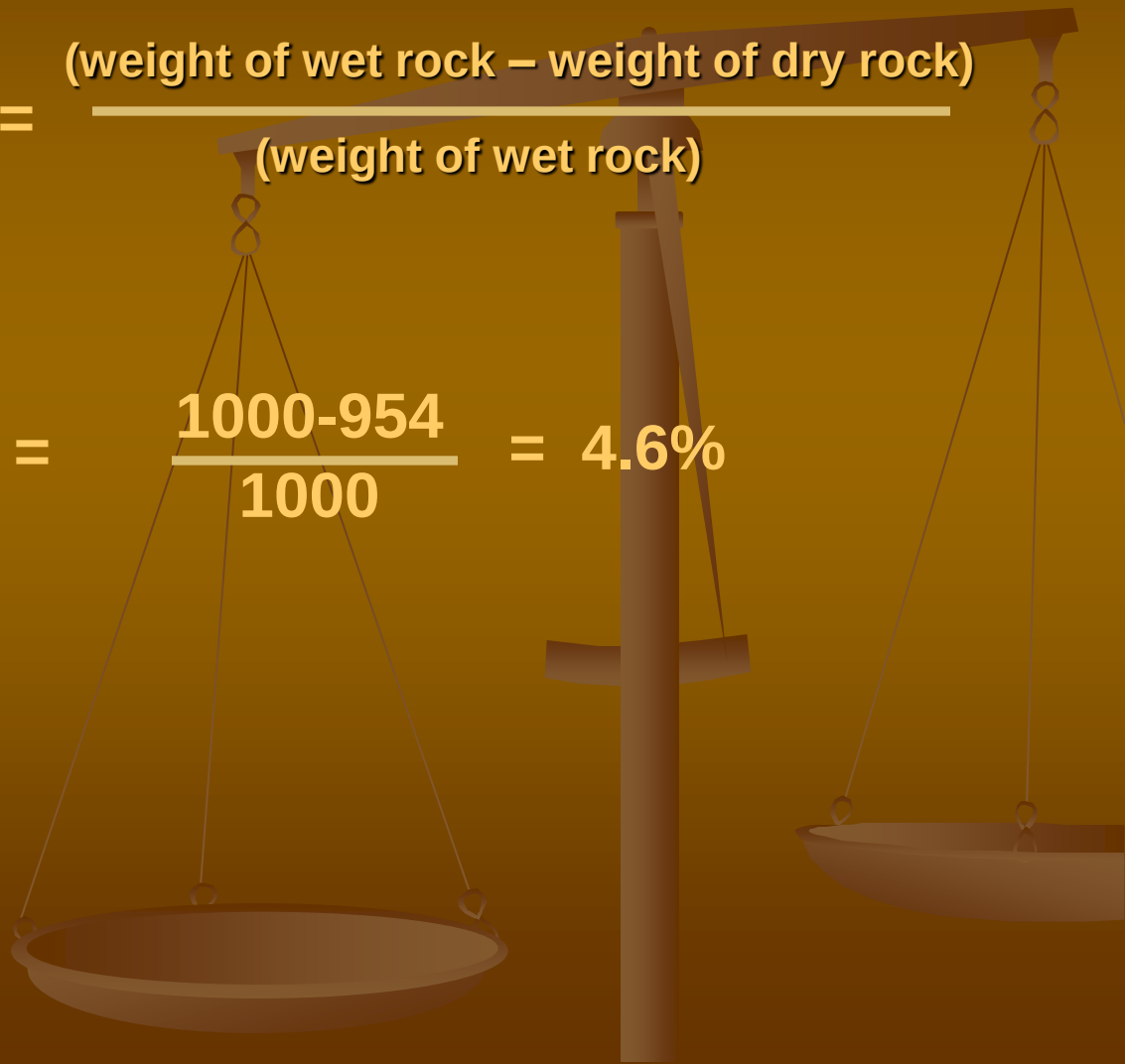
- Re-weigh it
  - Dry when two consecutive weights are the same.



Moisture Content

- **Calculate:**
  - **Moisture content =** $\dfrac{\text{(weight of wet rock – weight of dry rock)}}{\text{(weight of wet rock)}}$

- **From graph:**
  - **Moisture content =** $\dfrac{1000-954}{1000} = 4.6\%$



Calibration

Questions?

Thank You!