



Testing Fine Aggregates According to AASHTO T-84 and the CoreLok Device

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Acknowledgements

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 - Kyle Holman (FHWA)
 - Mike Santi
 - Mark Wheeler



Longitudinal



Transverse



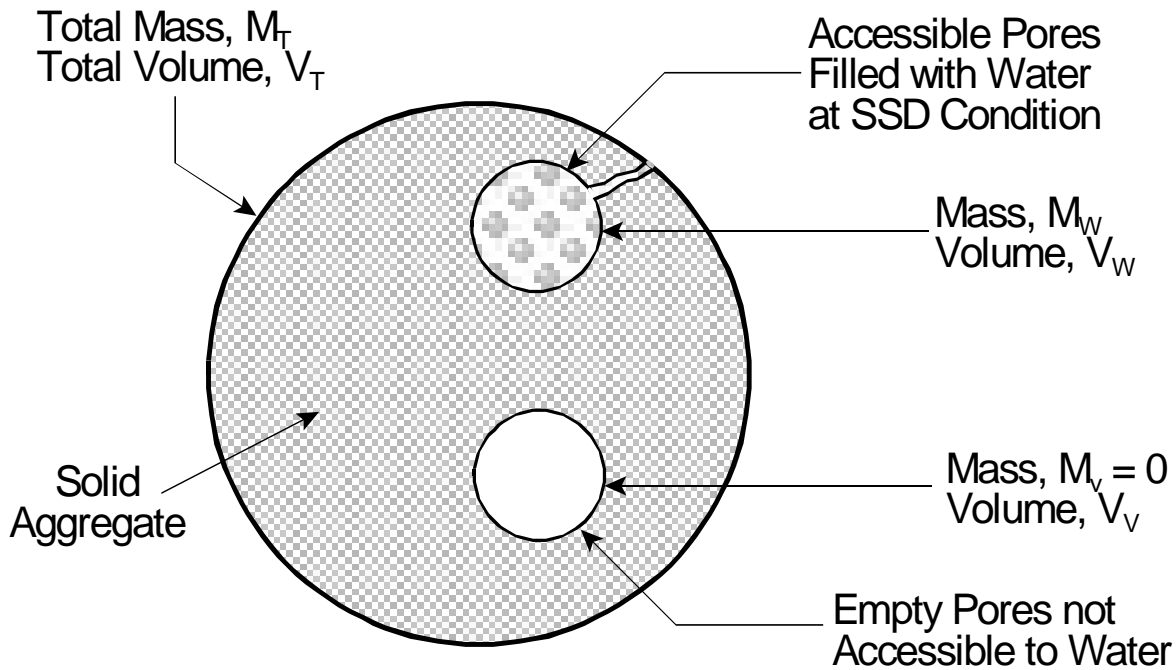
Raveling



Rutting

ASPHALT Mix Design

- Bulk Specific Gravity, G_{sb}
 - Need accurate value for HMA design
 - Used to calculate the percentage of voids in mineral aggregates
 - Determine amount of asphalt absorbed by the aggregates



Volume of Solid, $V_S = V_T - V_V - V_W$

Mass of Solid, $M_S = M_T - M_W$

Aggregate Particle & Voids

Apparent SG	$G_{sa} = \frac{M_T}{V_S}$
Bulk Dry SG	$G_{sb,Dry} = \frac{M_T - M_W}{V_T}$
Bulk SSD SG	$G_{sb,SSD} = \frac{M_T}{V_T}$
Absorption	$Abs = \frac{M_W}{M_T - M_W} \times 100\%$



Fine Aggregates, < #4:

- AASHTO T-84, and
- Idaho IT-144
(CoreLok Method)



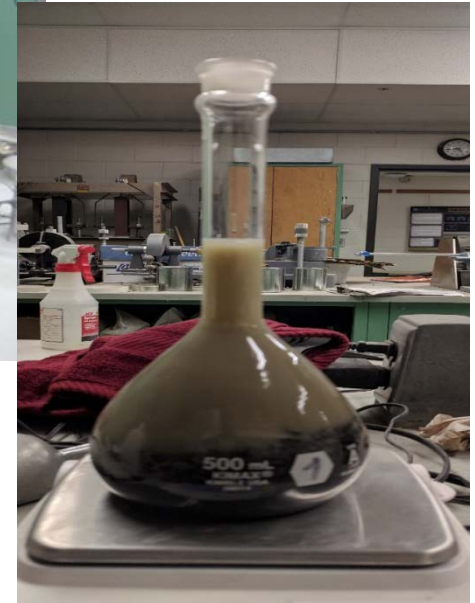
AASHTO T-84 Method

- Soaking period – 15 to 19 hours
- Samples starts at 6% water content
- Keep drying until SSD condition
- Several attempts

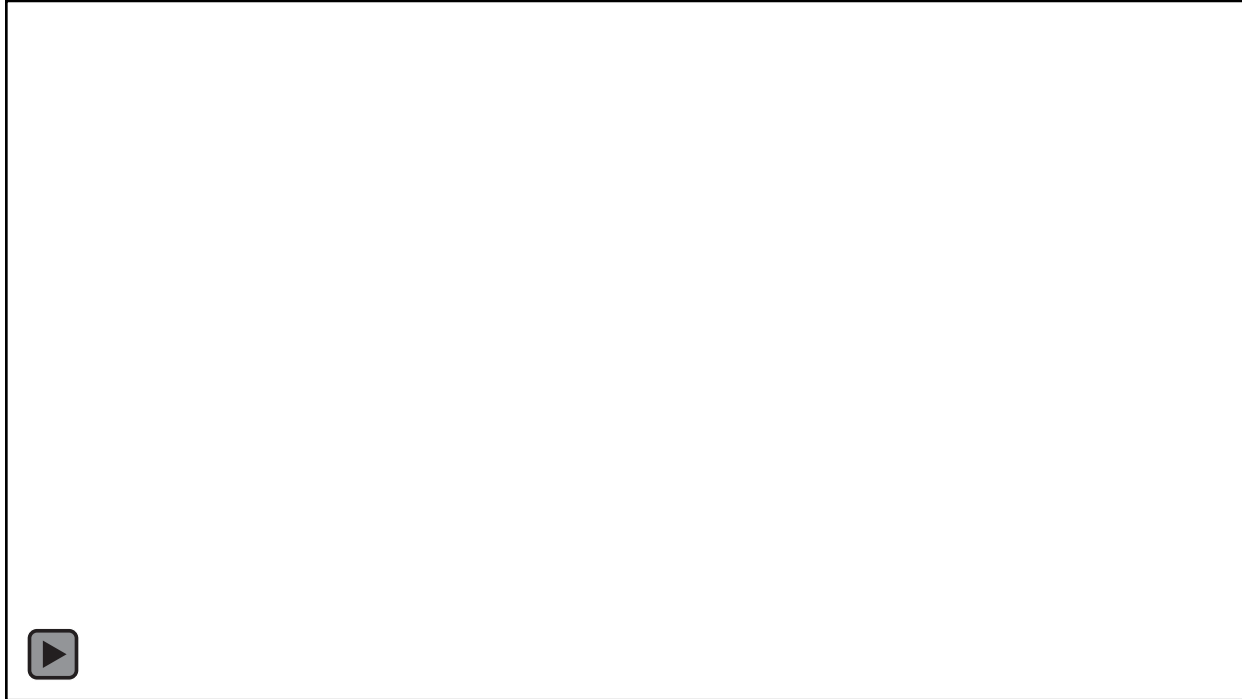
AASHTO T-84 – Takes up to 3 days

AASHTO T-84

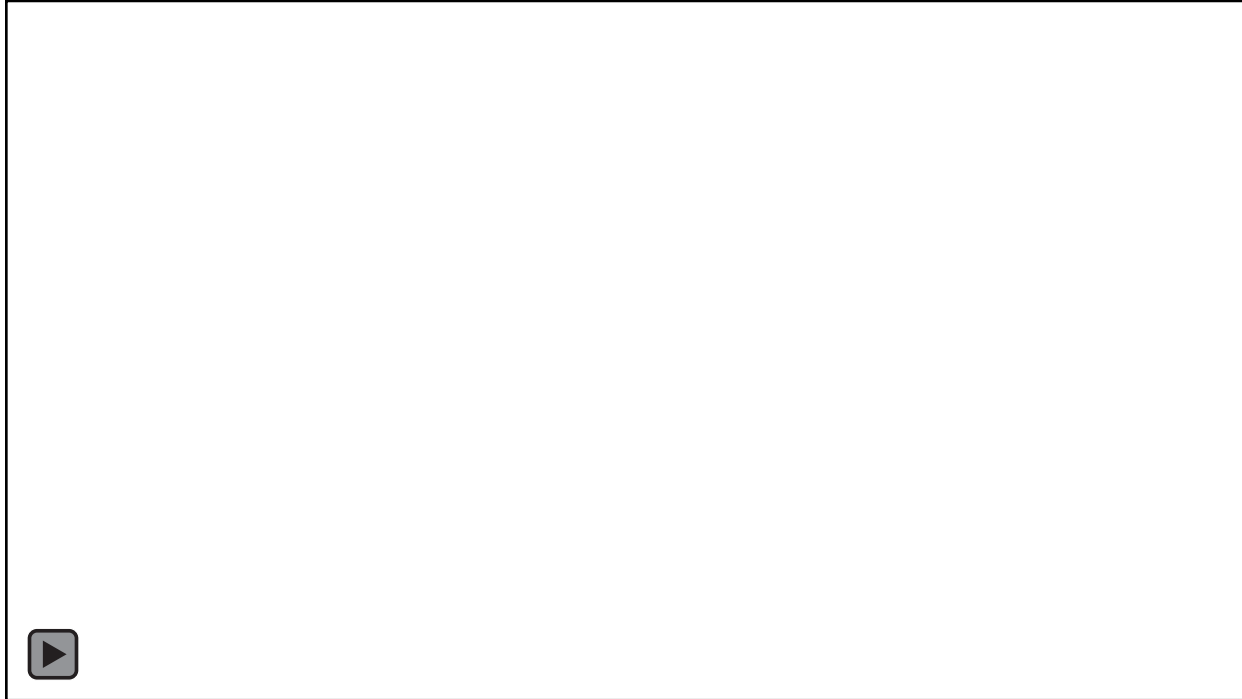
- Sample soaking and drying
- Cone test and SSD
- Agitation and de-airing



Drying of Samples

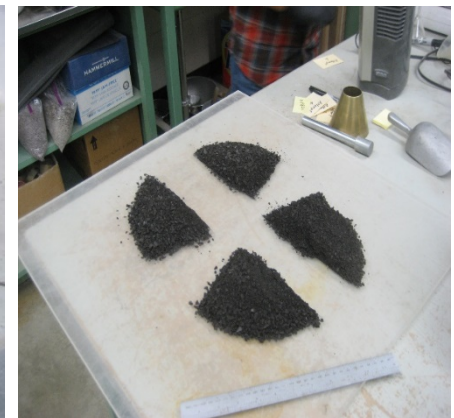


Cone Test



- Preparing cone
- SSD Condition
- Looking for dime shape on cone

Very subjective



- 25 drops
- Drop height = 5mm
- SSD condition
 - Start of raveling
 - Dime size
- Quartering
- De-airing



VARIABILITY

- SSD Condition
 - Start of raveling
 - Dime size
- Agitation and de-airing wait time (20 minutes or 16 hours)
- Sample weight equilibrium after drying in oven
- Tamper drop height
- Water temperature - maintained at constant $23 \pm 1.7^{\circ}\text{C}$
- Flask Size (500 mL or 1000 mL)



Limitations of AASHTO T-84

- Determining the saturated-surface dry (SSD) conditions may vary from one operator to another
- Requires a *long time* (including soaking time)
- Angular fine aggregates with rough surface may not readily slump at SSD conditions
- Alternative method that is quick, reliable, portable, and provides repeatable results is needed!

CoreLok Testing – Step 1



CoreLok Chamber

Placing bag with
sample into
vacuum chamber



Determine “Gsa”

CoreLok Testing – Step 2



Metal pycnometer



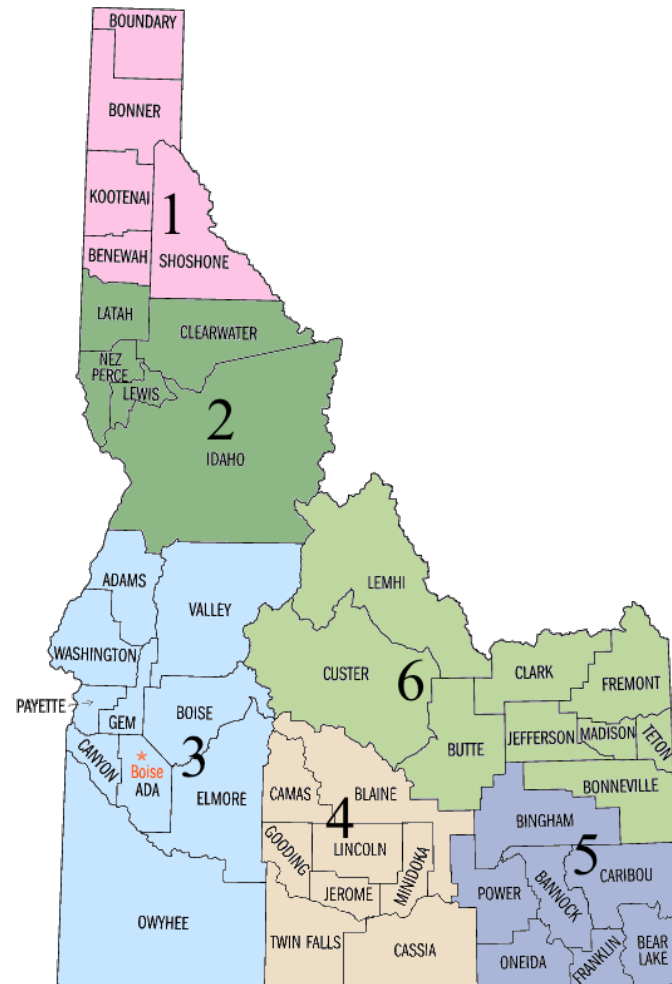
Determine “Gsb”,
Followed by final SGs
through a correlation

Objectives

- Perform T-84 and IT-144 tests
- Find correlation between tests for typical Idaho aggregates

Samples

- Representative samples selected
- 70-80 kg samples per aggregate source
- Samples from 5 out of 6 ITD Districts
- **22 Aggregate Samples**



Sample preparation

1. Initial Drying
2. Splitting
3. Sieving to remove plus #4
4. Washed to remove minus #200
5. Washed samples dried
6. Split to testing size
 - 2 kg for IT-144
 - 1.5 kg for T-84

ITD-District	Samples
1	3
2	4
3	4
5	4
6	7
Total	22

Aggregate Testing

Initial Testing at UI

1. Training and Evaluation at ITD Lab in Boise
2. Round Robin Experiment
 - UI, ALLWEST, STRATA
 - 5 aggregate samples from 4 different districts

Conclusions

- Results were comparable and very close
- Agreed with ITD to follow similar procedure for further testing

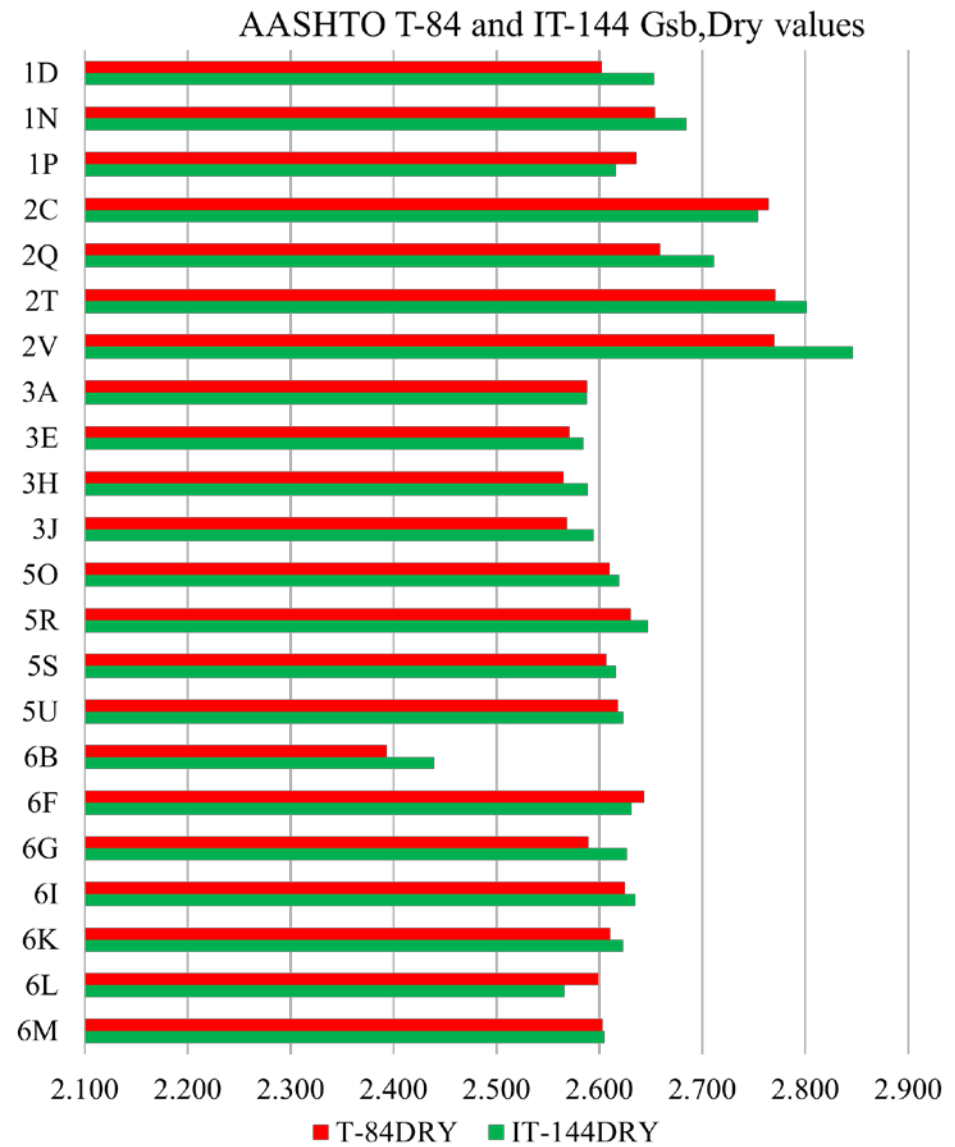
Aggregate Testing & Results

Test by	Number of Tests	
	AASHTO T-84	IT-144
UI	68	65
ALLWEST	21	21
STRATA	1	1
ITD	8	8

Difference between the two tests:

- Limit of 0.015 adopted for SGs
- Extra tests performed for greater D2S

Some Results



Some Results

Paired t-test

- Statistical difference between results from two test methods
- Results significantly different for all SGs and Absorption

Simple Regression Analysis

- One dependent variable
- One independent variable

Multiple Regression Analysis

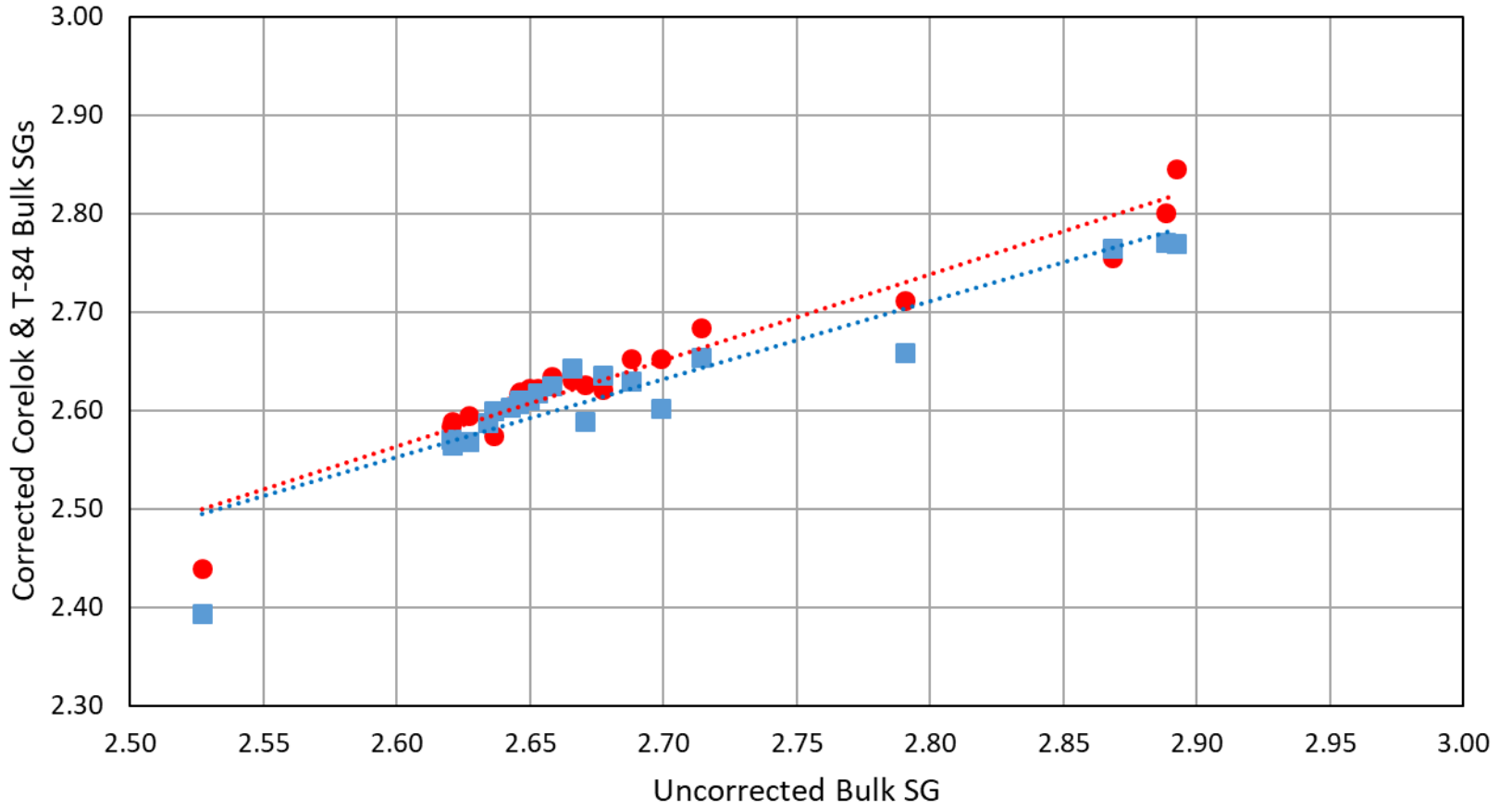
- One dependent variable
- Two or more independent variable

Final Objectives

- Investigate the currently programmed equation in the AggPlus software for calculating absorption, and hence G_{sb}
- Recommend a “better” equation for Idaho aggregates
- Recommend use of IT-144
- (retire the AASHTO T-84 method)

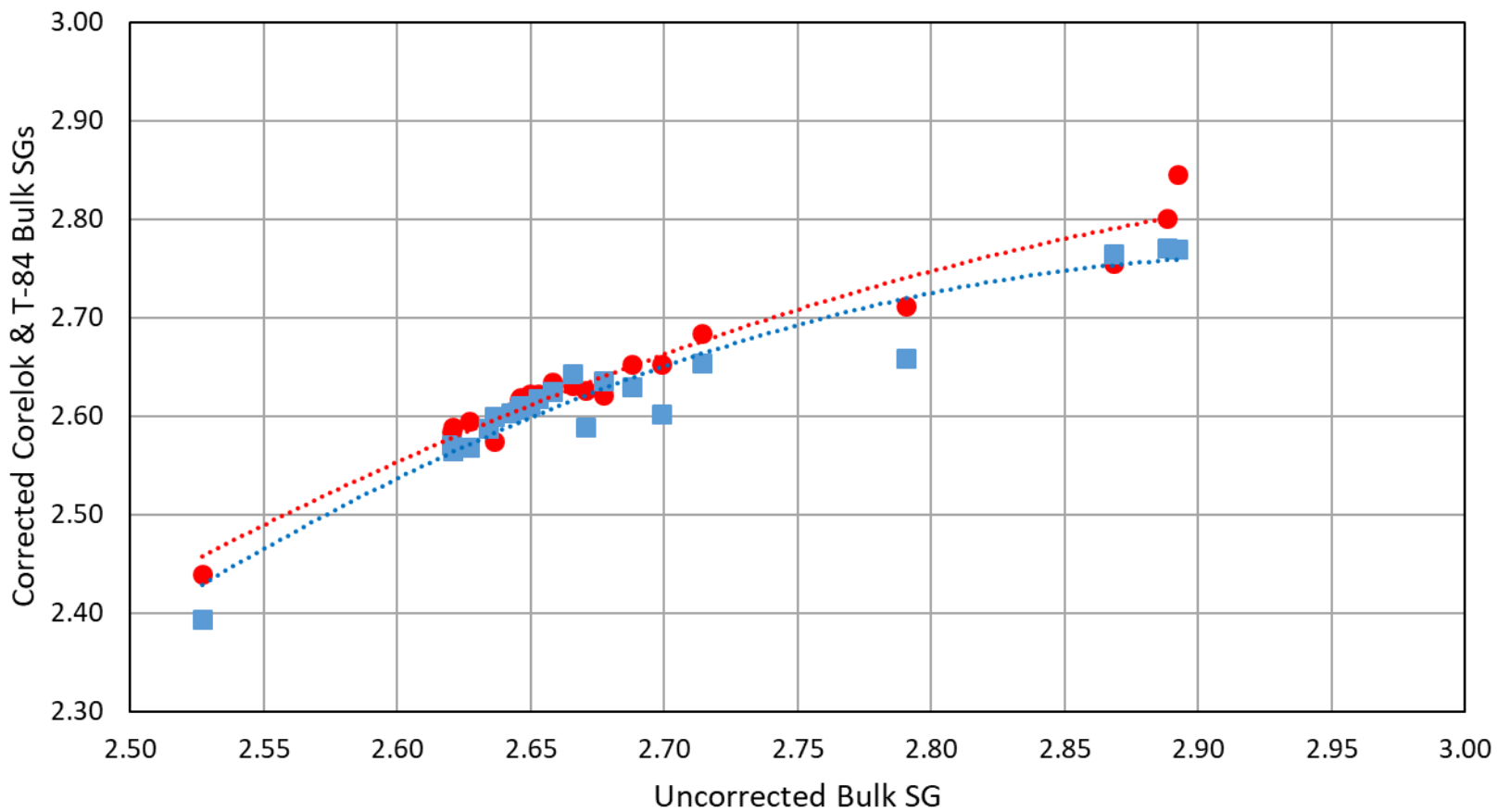
Comparison of Bulk SG Values

● CoreLok Data ■ T-84 Data Linear (CoreLok Data) Linear (T-84 Data)



Comparison of Bulk SG Values

● CoreLok Data ■ T-84 Data Poly. (CoreLok Data) Poly. (T-84 Data)



Thank You
Questions?