

Comparison of T-84, CoreLok, and SS Detect

Idaho Asphalt Conference

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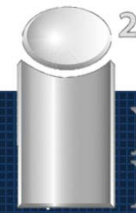


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Goal

Review of the assumptions, areas of subjectivity and procedural difficulties for different Aggregate specific gravity determination Methods

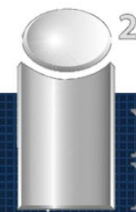


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Parameters of Interest

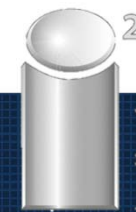
- Apparent Specific Gravity:
- Bulk Specific Gravity:
- % Absorption:




AASHTO T-84



- Procedure in a Nutshell
 - Dry and soak sample (Assumptive)
 - Obtain SSD condition of sample (Subjective/Procedural)
 - Measure specific gravity of SSD sample (Subjective)
 - Calculate absorption from Dry weight and SSD weight (Assumptive)
 - Calculate specific gravity of dry aggregate

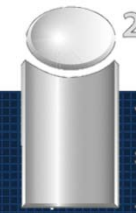




AASHTO T-84

Dry and Soak Sample

- Assumptive
 - Rests on the idea that the soak period is sufficient for the aggregate pores to be sufficiently saturated.
 - Known that wet materials from the field can display higher absorptions than oven dried



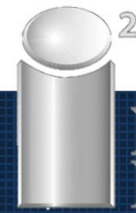
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AASHTO T-84

Obtain SSD



- Subjective/Procedural
 - Operator determines SSD condition and is defined as “when the fine aggregate slumps slightly”.
 - Slightly can be defined differently by different organizations.
 - Such as when it slumps
 - Or it slumps such that the top remaining portion is the size of a dime
 - Another SSD condition used is the change in color of the pan during dry back.

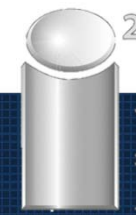




AASHTO T-84

Measure SSD Specific Gravity

- Subjective
 - Volume of added water is at the calibration mark.
 - Especially if foam is present and must be removed by adding alcohol.



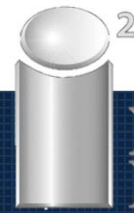
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AASHTO T-84

Calculate Absorption



- Assumptive
 - Water does not change the physical nature of the aggregate

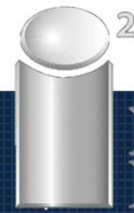


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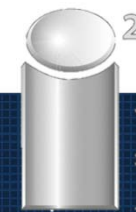
AASHTO T-84



- Advantage
 - Inexpensive
 - Requires a tray, a cone and tamp, and other standard laboratory items.
- Disadvantage
 - Requires a significant time investment, at least one full day soak,
 - time for drying the aggregate back.
 - Operator dependent.



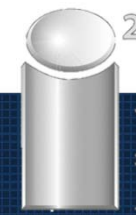
CoreLok: ASTM D7370



CoreLok: ASTM D7370



- Procedure in a Nutshell
 - Split dried sample into two portions (Assumptive)
 - Place one portion into CoreLok bag, apply vacuum, and seal
 - Obtain apparent density of that portion by CoreLok (Procedural)
 - Obtain apparent bulk density of second portion using volumeter (Assumptive/Procedural)
 - Calculate absorption from apparent bulk density and apparent density $a = \left(\frac{\rho_v - \rho_u}{\rho_v \rho_u} \right) \rho_w \times 100$
 - Calculate bulk specific gravity SSD basis
 - Calculate bulk specific gravity dry basis



CoreLok

Split dried sample into two portions

- Assumptive
 - It is assumed that the two portions are representative of the same sample and will behave identically. This is a reasonable assumption.



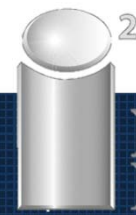
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CoreLok

Obtain apparent density



- Procedural
 - There is a procedure to this in that the operator must keep the sealed sample and bag completely submerged,
 - cut open the bag,
 - remove any air bubbles,
 - and make sure the sample has been saturated with water.
 - This must be done carefully.

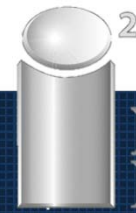




CoreLok

Obtain apparent bulk density

- Assumptive/Procedural
 - It is assumed that the water will not readily infiltrate the pores. This is based on the criteria for 15 to 19 hour soak time as prescribed by AASHTO T-84. If the measurement of dry specific gravity using a volumeter is short there will be no significant infiltration of the water into the pores.

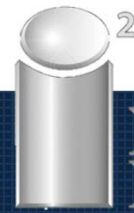


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CoreLok



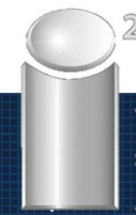
- Advantage
 - Fast
 - Measurements may be made in less than a 30 minutes
 - Real Time
 - Removes major subjectivity
- Disadvantage
 - More cost



SSDetect: ASTM D7172



- In a Nutshell
 - Obtain two portions of a sample (Assumptive)
 - Place sample in flask, wait 5 minutes, fill to calibration and obtain a first volume (Subjective/Procedural)
 - Apply vacuum to flask, refill to calibration and obtain a second volume (Subjective/Procedural)
 - Obtain difference in weights and calculate Film Coefficient (Assumptive)
 - Place other portion in test bowl
 - SSDetect injects water and mixes aggregate until infrared detects surface water, infrared absorbed by surface water (Assumptive)

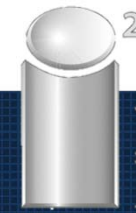


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CoreLok, T-84, SSDetect Comparison Data Compilation



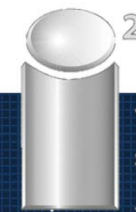
- Grouped data from different aggregates and absorptions
 - Procedure from E691
- Pooled the standard deviations
 - Interpreted as uncertainty in the measurement
- References
 - Implementation of Testing Equipment for Asphalt Materials, FHWA/LA. 09/458 (King, Kabir, and Mohammad)
 - Round Robin Evaluation of New Test Procedures for Determining the Bulk Specific Gravity of Fine Aggregate, NCAT Report 05-07 (Prowell and Baker)
 - Automated Laboratory Testing Methods for Specific Gravity and Absorption Verified to Match the Current Method Results, Ohio State Job No. 134302 (Rajagopal)



Gsb Fine Aggregate Comparison of CoreLok and T-84 and SSDetect



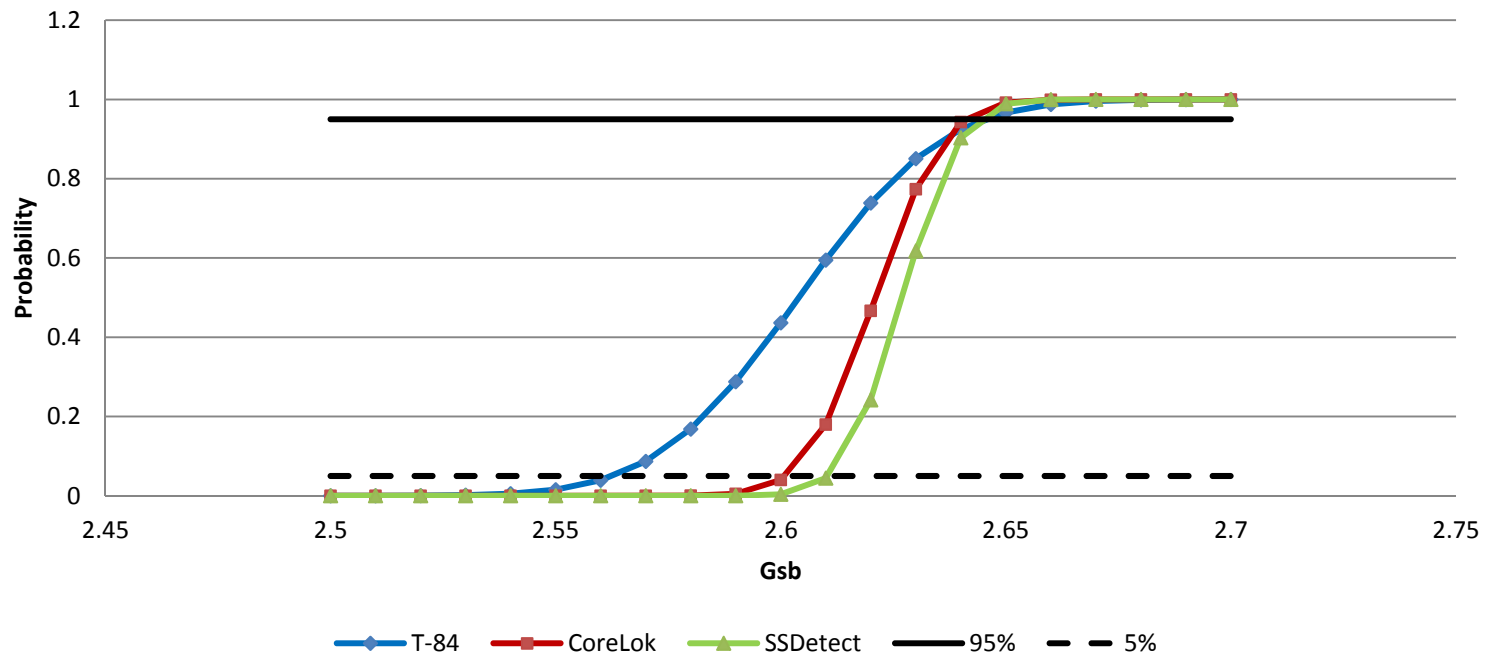
Gsb	N	T-84	CoreLok	SSDetect
Average	20	2.604	2.621	2.627
Pooled SD	22	0.025	0.012	0.010
Difference		T-84 – CL	T-84 – SS	CL - SS
Gsb Diff SD		0.040	0.045	0.035



Gsb Fine Aggregate Comparison of CoreLok and T-84 and SSDetect



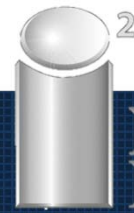
Cumulative Probability Comparison T-84, CoreLok, SSDetect



Gsb Fine Aggregate Comparison of CoreLok and T-84 and SSDetect



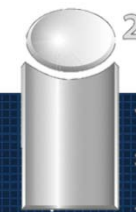
- Interpretation Gsb between 5% and 95% lines
 - You are 53% likely to obtain the results CoreLok would have obtained using T-84
 - There is 100% probability that the results of CoreLok would be a possible result of T-84
 - You are 34% likely to obtain the results SSDetect would have obtained using T-84
 - There is a 100% probability that the results of SSDetect would be a possible result of T-84



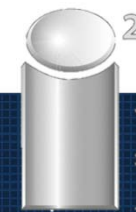
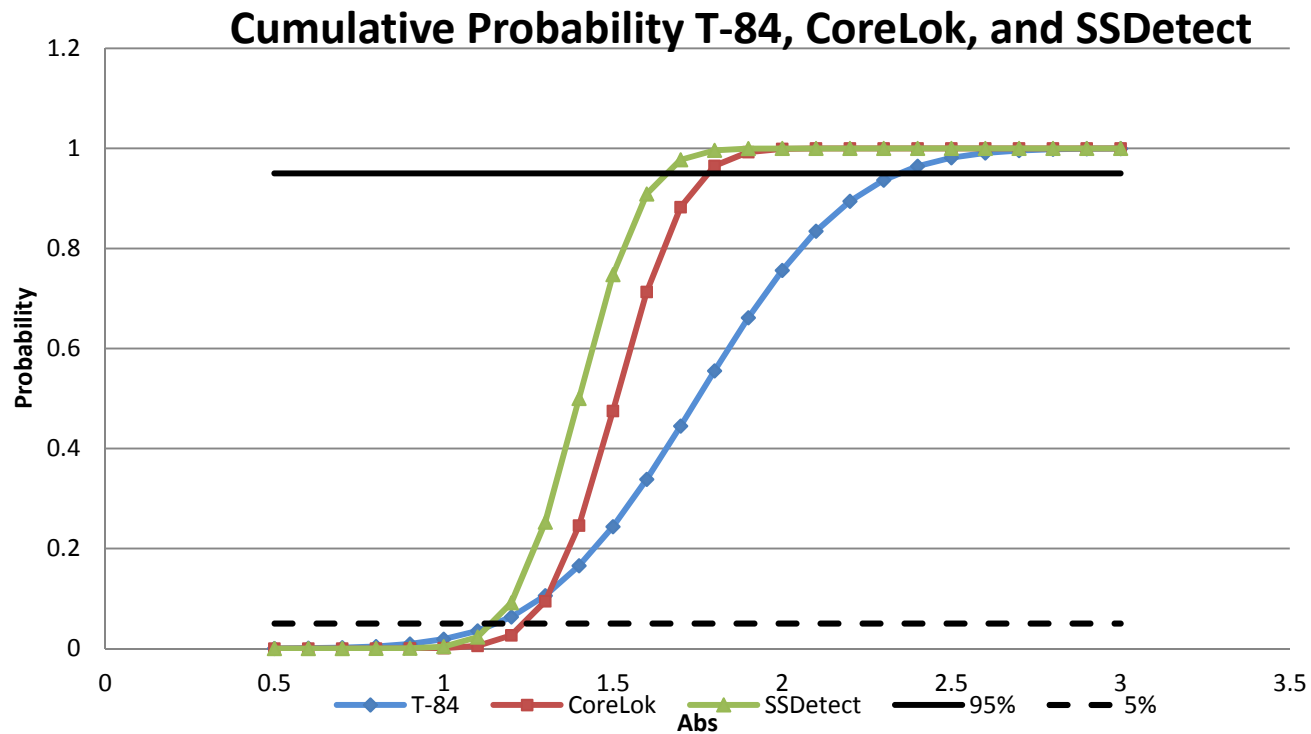
Absorption of Fine Aggregate, Comparison of CoreLok and T-84 and SSDetect



Abs	N	T-84	CoreLok	SSDetect
Average	20	1.75	1.51	1.40
Pooled SD	22	0.36	0.16	0.15
Difference		T-84 – CL	T-84 – SS	CL - SS
Abs Diff SD		0.89	0.88	0.80



Abs Fine Aggregate Comparison of CoreLok and T-84 and SSDetect



Abs Fine Aggregate Comparison of CoreLok and T-84 and SSDetect

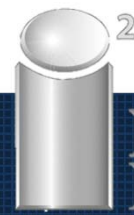


- Interpretation Abs between 5% and 95% lines
 - You are 45% likely to obtain the results CoreLok would have obtained using T-84
 - There is 100% probability that the results of CoreLok would be a possible result of T-84
 - You are 39% likely to obtain the results SSDetect would have obtained using T-84
 - There is a 100% probability that the results of SSDetect would be a possible result of T-84



Conclusions

- Based on the available data and considering the uncertainty in the test methods, CoreLok results are the same as the T-84 method.
- The uncertainty in the CoreLok measurements are better with better precision
- The CoreLok results can be obtained in a considerably shorter time than T84.





Thank You

