

**Technical Report Documentation Page**

<b>1. Report No.</b> R-1528	<b>2. Government Accession No.</b>	<b>3. MDOT Project Manager</b>	
<b>4. Title and Subtitle</b> Absorption Capacity of Coarse Aggregates for Portland Cement Concrete		<b>5. Report Date</b> February 2009	
		<b>6. Performing Organization Code</b>	
<b>7. Author(s)</b> John F. Staton, P.E., Joseph D. Anderson		<b>8. Performing Org. Report No.</b>	
<b>9. Performing Organization Name and Address</b> Michigan Department of Transportation Construction and Technology Division P.O. Box 30049 Lansing, MI 48909		<b>10. Work Unit No. (TRAIS)</b>	
		<b>11. Contract No.</b>	
		<b>11(a). Authorization No.</b>	
<b>12. Sponsoring Agency Name and Address</b> Michigan Department of Transportation Construction and Technology Division P.O. Box 30049 Lansing, MI 48909		<b>13. Type of Report &amp; Period Covered</b> Final	
		<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b>			
<p><b>16. Abstract</b></p> <p>This study was initiated by the Michigan Department of Transportation (MDOT) to investigate concerns raised by members of Michigan's aggregate industry regarding the validity of moisture conditioning methods employed by MDOT's freeze-thaw testing program for coarse aggregates used in Portland cement concrete.</p> <p>This absorption study is being conducted (with reference to concrete coarse aggregate) to determine whether various soaking periods will achieve saturation levels comparable to the department's vacuum saturation moisture condition method used in the Michigan Test Method, MTM 113.</p> <p>The absorption rate for each coarse aggregate tested in this study is dependent on the respective source. At 24 hours of soaking, the geologically natural (gravels and quarried) sources (ASN: 30-35, 58-08, 63-97, and 93-03) reported from 62- to 78 percent of their respective laboratory-induced vacuum saturated level of absorption. In contrast, the manufactured blast-furnace slag aggregate (ASN: 82-22) reported 33 percent of its respective vacuum saturated level of absorption. The soaking period necessary to attain approximately 90 percent of vacuum saturation was shown to be approximately 30 days for the four geologically natural materials compared to one year for the manufactured aggregate source. All geologically natural sources reported vacuum saturation levels of absorption after one year of continuous soaking. At three years of continuous soaking, the manufactured blast-furnace slag aggregate reported 98 percent of its respective vacuum saturated level of absorption.</p> <p>The findings also show that the naturally occurring in-situ moisture contents for each sampled source, regardless of their reference relative to the static water table, were nearly equivalent to their respective laboratory-induced vacuum saturated absorption levels. For one source (ASN: 63-48), the naturally occurring moisture content below the static water table reported 104 percent of its respective vacuum saturated level of absorption. Hence, it is shown by this study that vacuum saturated levels of absorption can be achieved naturally in-situ, without artificial means.</p> <p>Finally, the findings from this study show that the vacuum saturation method for moisture conditioning coarse aggregates prior to laboratory freeze-thaw testing does not alter the pore characteristics of the typical gravel, carbonate, or manufactured blast-furnace slag coarse aggregates historically used in MDOT concrete pavements.</p>			
<b>17. Key Words</b> coarse aggregate, moisture conditioning, freeze-thaw, vacuum saturation, concrete pavement, absorption		<b>18. Distribution Statement</b> No restrictions. This document is available to the public through the Michigan Department of Transportation.	
<b>19. Security Classification - report</b> Unclassified	<b>20. Security Classification - page</b> Unclassified	<b>21. No. of Pages</b> 54	<b>22. Price</b>

**MICHIGAN DEPARTMENT OF TRANSPORTATION  
MDOT**

**Absorption Capacity of Coarse Aggregates for  
Portland Cement Concrete**

**Final Report**

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Joseph D. Anderson**

**Testing and Research Section  
Construction and Technology Division  
Research Report R-1528**

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February 2009**

## **ACKNOWLEDGEMENT**

The author would like to acknowledge the technical and logistical support of Joe Anderson, Tom Miller, and Tom Woodhouse, research team members from the Michigan Department of Transportation's Materials Research Group. These individuals were primarily responsible for execution of all laboratory tasks and data acquisition for this study.

In addition, the author acknowledges the support from John Ollie of E.C. Levy Company, and Jim English of Grand Rapids Gravel Company for supplying aggregates for Task 2 of this study.

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## **OBJECTIVE**

This study was initiated by the Michigan Department of Transportation (MDOT) to investigate concerns raised by members of Michigan's aggregate industry regarding the validity of moisture conditioning methods employed by MDOT's freeze-thaw testing program for coarse aggregates used in Portland cement concrete.

This absorption study is being conducted (with reference to concrete coarse aggregate) to determine whether various soaking periods will achieve saturation levels comparable to the department's vacuum saturation moisture condition method used in the Michigan Test Method, MTM 113. The vacuum saturated level of absorption for a typical coarse aggregate is estimated to be approximately 91 percent of the aggregates ultimate absorption capacity.

Task 1 of this study documents the rate of laboratory absorption for the five coarse aggregates incorporated into the US-23 Aggregate Test Road over a period of three years of continuous soaking in water. Each absorption level is reported as a percentage of its respective material's laboratory-induced vacuum saturated absorption level.

Task 2 of this study is intended to address industry concerns that absorption levels achieved by the department's laboratory-induced vacuum saturation method for moisture conditioning are excessive compared to those which would otherwise be observed in nature. In other words, it is hypothesized that a typical naturally occurring geologic formation will never achieve vacuum saturation levels of moisture, even when submerged below the static water table for a significant geologic period of time.

Task 3 of this study is intended to document whether (or not) the department's laboratory-induced vacuum saturation moisture conditioning method artificially stresses the inner macrostructure of manufactured blast-furnace slag coarse aggregate; hence, altering the ultimate absorption potential for the aggregate samples use to fabricate laboratory freeze-thaw test specimens.

## **INTRODUCTION**

The method for moisture conditioning coarse aggregates prior to cyclic laboratory freeze-thaw testing has been an issue of concern, from the aggregate producer's perspective, for many years. Aggregate producer's concerns stem from questions raised as to whether the actual absorbed moisture content of the coarse aggregate within the in-service concrete pavement achieves "critical saturation". In addition, some aggregate producers have expressed concerns that the department's vacuum saturation method for moisture conditioning may artificially stress the inner macrostructure of some aggregate types. This study addresses these concerns.

It is expected that this project will progress in three tasks over three years, beginning in late fall, 2004.

## BACKGROUND

MDOT initiated its freeze-thaw testing program in 1954. This program is designed as an accelerated method to numerically rate coarse aggregates used for Portland cement concrete. The objective of this testing program is not intended to produce results that directly correlate to actual field performance. Rather, it is a tool used as an accelerated means to quantify the risk to the department against the potential for premature freeze-thaw related concrete deterioration. The ASTM C-666 test method titled “*Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing*” reinforces this principle by stating that “This standard testing method is not intended to provide a quantitative measure of the length of service that may be expected from a type of concrete”. Subsection 3.2 of the ASTM C-666 test method states the following:

“It is assumed that the procedures will have no significant damaging effects on frost-resistant concrete which may be defined as: (1) concrete not critically saturated with water (that is, not sufficiently saturated to be damaged by freezing), and (2) concrete made with frost resistant aggregates and having an adequate air-void system that has achieved appropriate maturity and thus will prevent critical saturation by water under common conditions.”

The MDOT standard freeze-thaw testing program uses the ASTM C-666 as its platform. In addition, three Michigan Test Methods (MTM 113, 114, and 115) were developed to institute particular requirements for preparation, testing, and evaluation of the specimens, which are otherwise not detailed in the ASTM C-666 test method. The associated Michigan Test Methods are briefly described as follows:

MTM 113 - *Michigan Test Method for Selection and Preparation of Coarse Aggregate Samples for Freeze-Thaw Testing*: This method covers the procedures for securing samples of coarse aggregate, methods of processing and conditioning for freeze-thaw testing in concrete, and related tests required to provide detailed information about the aggregate under consideration.

MTM 114 - *Michigan Test Method for Making Concrete Specimens for Freeze-Thaw Testing of Concrete Coarse Aggregate*: This method describes the procedure for making concrete beams to be tested according to MTM 115, for determining the durability of concrete coarse aggregate in freezing and thawing. The method includes criteria for design of the concrete mixture, testing of the freshly mixed concrete, fabrication of specimens, and tests for strength of hardened concrete.

MTM 115 - *Michigan Test Method for Testing Concrete for Durability by Rapid Freezing in Air and Thawing in Water*: This method describes the procedure for testing concrete beams to evaluate their durability in rapid freezing and thawing, specifically for the evaluation of coarse aggregate used in the concrete. The method uses concrete beam specimens prepared according to MTM 114 and describes the freeze thaw cycling and

evaluation of the beams by length change (dilation) procedures. This method conforms to the general requirements of ASTM C-666, Procedure B.

The MTM 113 describes the procedures for moisture conditioning coarse aggregate prior to their incorporation into concrete freeze-thaw test specimens. The basis for utilizing the vacuum saturation method for moisture conditioning is to ensure that all aggregate sources are being evaluated at the same approximate benchmark (critically saturated) level of absorption, which is approximately 91 percent of an aggregate's ultimate absorption capacity. Hence, the rate of an aggregate's absorption will determine its level of saturation if only permitted to soak for a finite period of time.

The moisture conditioning procedures vary depending on whether the coarse aggregate is a naturally originating material or a manufactured blast furnace slag product. If the coarse aggregate is gravel, crushed stone, or crushed concrete, the material is enclosed in a chamber and subjected to a vacuum equivalent to 96.2 kPa for one hour. The chamber is then flooded with water while maintaining a minimum vacuum of 94.6 kPa until the aggregate is completely immersed. The vacuum is then released and the aggregate is soaked for 23 hours. At the end of the 24 hour period, the excess water is drained and the concrete is batched. However, if the coarse aggregate is blast furnace slag, moisture conditioning consists of only the standard 24-hour soaking method not subjected to vacuum. At the end of the 24 hour period, the excess water is drained and the concrete is batched.

The department's current minimum threshold limits for freeze-thaw durability were validated through a study conducted around 1980 by the Research Laboratory which evaluated the field performance of selected pavements constructed in the 1960's. This study of 20 year old vintage pavements indicated that some built with aggregates only marginally exceeding the freeze-thaw durability factor of 20 (maximum 0.067 percent dilation per 100 cycles) required essentially 100 percent joint replacement due to freeze-thaw action. It was also found that while these in-service pavements were experiencing holistic joint deterioration, similar pavements constructed with aggregates with a high freeze-thaw durability factor of 70, or greater (maximum 0.013 percent dilation per 100 cycles) reported almost no freeze-thaw damage after 20 years. These findings corroborated the long-standing position held by the department regarding the validity of the laboratory freeze-thaw durability factor of 20 (maximum 0.067 percent dilation per 100 cycles) and its relationship to a minimum allowable threshold for adequate 20 year field performance. Since adoption of these specification requirements, it is clear that the department has been successful toward containing and controlling the risks associated with D-cracking in concrete pavements.

However, throughout the past decade, it has been observed by the department's technical experts that several concrete pavements are not performing up to expectations. These deficiencies in performance have not only been in terms of reduced anticipated pavement service life, but also have been relative to the extent of unanticipated repairs necessary to maintain safe travel for the motoring public. Although the visual characteristics of current deterioration may not explicitly resemble

classic D-cracking, it is clear that the root cause(s) for the observed premature failure, as well as the prognosis in terms of reduced performance, indicate that these pavements may be critically saturated.

Threshold limits for freeze-thaw dilation, as part of the standard specifications for concrete coarse aggregate freeze-thaw quality, are directly influenced by the aggregate's porosity, permeability, structural toughness, as well as the moisture content. The vacuum saturation method for moisture conditioning, as described above, has been a part of the department's standard procedures for laboratory freeze-thaw testing since the program's inception in 1954. This method of moisture conditioning provides a means of rapidly achieving critical saturation. If modifications to the moisture conditioning protocol are instituted without complete correlation of its impact toward measurable dilation results after 300 cycles of freezing and thawing, all current department specification limits for concrete coarse aggregate freeze-thaw quality would also need to be modified through correlated study. This would leave the department without a test method for concrete coarse aggregate freeze-thaw durability, nullifying its historically enforceable specification requirements.

## **RESEARCH PLAN BY TASKS**

It is anticipated that this study will encompass the following tasks. The duration for the entire study is estimated to be approximately three years.

Task 1: The five coarse aggregate sources (which were incorporated into the southbound US-23 Aggregate Test Road in Monroe County) were secured by the department at the time of the pavement's reconstruction in 1992. Several cubic yards of each material were obtained from the project. These five aggregates were then transported to the Construction and Technology Laboratory, and sealed in independent weather-tight bins for future use. The five bin sources (two quarried carbonates: France Stone (Silica), ASN: 93-03, and Holloway Sand and Gravel/Rockwood Stone, ASN: 58-08; two gravels: Bundy Hill, ASN: 30-35, and American Aggregates (Milford), ASN: 63-97; and one blast furnace slag: McClouth Steel/Levy Plant #4, ASN: 82-22) will be subjected to varying periods of soaking for this task.

Each aggregate source will be sampled, oven dried, then split into five representative specimens of approximately 4000 grams for each test (soaking period). It is anticipated that the soaking periods will include 1-day, 7-days, 30-days, 90-days, 180-days, 1-year, and 3-years. An additional five representative specimens from each aggregate source will be vacuum saturated as a basis for comparison. Table 1 describes the allocation of test specimens for each soaking period.

Task 2: Two gravel sources which are geologically located both above and beneath the static water table will be selected for sampling and tested to determine their naturally occurring in-situ moisture contents.



Each aggregate source will be sampled and immediately sealed in air tight containers so as to preserve its respective inherent moisture content. For the aggregate materials naturally immersed beneath the static water table, care will be taken to ensure that the samples are fully immersed in water at all times. The sealed sample containers will then be transported to the Construction and Technology Laboratory for further testing and evaluation.

At the laboratory, representative materials from each of the two gravel sources which were mined beneath the static water table will be individually wet-sieved through the 1-inch and No. 4 sieves to selectively capture representative particle sizes constituting approximately that of a typical concrete coarse aggregate gradation. The wet-sieved samples from each of the two aggregate sources will then be immediately portioned into five specimens of approximately 4000 grams each. Each specimen will be immediately towel-dried to remove free moisture, then weighed. Remaining materials will also be wet-sieved, as described above, oven-dried, then processed into specimens for long-term soaking in the same manner as described in Task 1. In addition, five representative specimens from each of the two sources will be vacuum saturated as a basis for comparison. Table 1 describes the allocation of test specimens for each soaking period.

Representative materials sampled from the gravel sources which were mined above the static water table will be individually sieved through the 1-inch and No. 4 sieves to selectively capture representative particle sizes constituting approximately that of a typical concrete coarse aggregate gradation. The sample will then be immediately portioned into five specimens of approximately 4000 grams each. If there is evidence of free moisture on the aggregate particle's surface, the specimens will be towel-dried prior to weighing. Remaining materials will also be sieved, as described above, oven-dried, then processed into specimens for long-term soaking in the same manner as described in Task 1. In addition, five representative specimens from each of the two sources will be vacuum saturated as a basis for comparison. Table 1 describes the allocation of test specimens for each soaking period.

**Table 1: Aggregate Source Test Specimens versus Soaking Period**

Task	Source	Soaking Period							
		1-Day $t_1$	7-Day $t_7$	30-Day $t_{30}$	90-Day $t_{90}$	180-Day $t_{180}$	1-Year $t_{360}$	3-Year $t_{1080}$	Vac.Sat.
1	30-35b	5	5	5	5	5	5	5	5
1	58-08b	5	5	5	5	5	5	5	5
1	63-97b	5	5	5	5	5	5	5	5
1	82-22b	5	5	5	5	5	5	5	5
1	93-03b	5	5	5	5	5	5	5	5
2	41-16 <sub>above</sub>	5	5	5	5	5	5	5	5
2	63-48 <sub>above</sub>	5	5	5	5	5	5	5	5
2	41-16 <sub>below</sub>	5	5	5	5	5	5	5	5
2	63-48 <sub>below</sub>	5	5	5	5	5	5	5	5
Total		45	45	45	45	45	45	45	45

Task 3: This task is intended to measure whether the department's vacuum saturation moisture conditioning method artificially stresses the inner macrostructure of blast furnace slag coarse aggregate.

Thirty specimens of blast furnace slag (ASN: 82-22) of approximately 4000 grams will be oven-dried to equilibrium. Each specimen will then be moisture conditioned using the 24-hour soaking method (first cycle). After 24 hours, the specimens will be towel-dried and weighed. They will then be oven-dried to determine their percent absorption (24-hour soak method). The oven-dried specimens will then be moisture conditioned using the department's vacuum saturation method. After vacuum saturation, the specimens will be oven-dried to equilibrium. Each specimen will again be moisture conditioned using the 24-hour soaking method (second cycle). After 24 hours, the specimens will be towel-dried and weighed. They will then be oven-dried to determine their percent absorption (24-hour soak method). The percent absorptions between the first and second cycles of moisture conditioning (24-hour soak method) will be statistically analyzed to determine whether vacuum saturation artificially altered the inner macrostructure of the aggregate particles. In addition, the four geologically natural sources will also be tested, as described above.

Task 4: The data generated from Tasks 1 through 3 will be compiled, statistically analyzed, and reported. Interim reports will be presented after the 90- day soaking period results are compiled and analyzed, and also at one year. A final report will be issued at the end of three years.

### **IMPLEMENTATION OF RESULTS**

If it is found that vacuum saturated moisture content levels for concrete coarse aggregates can be achieved in the laboratory using a soaking period other than 24 hours, the department's standard procedures for moisture condition (as described in MTM 113) could potentially be modified to reflect test method uniformity for all aggregate types, regardless of their origin. However, any potential modifications to the department's current protocol for concrete aggregate freeze-thaw testing would have to be indisputably justified, and, further, would require thorough investigation through correlation testing.

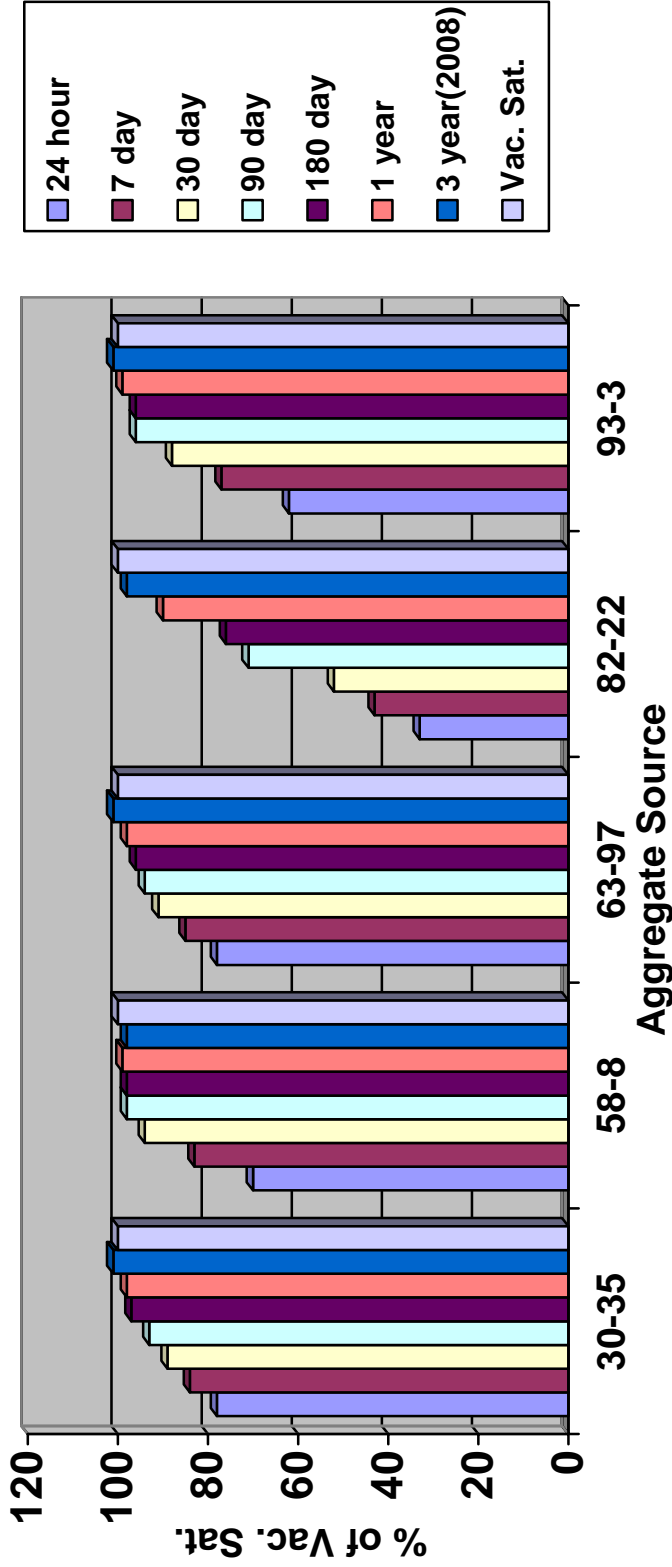
## RESEARCH FINDINGS

### Task 1: Absorption Testing of Bin Sources

The five coarse aggregate bin sources representing the US-23 Aggregate Test Road were tested in accordance with the work plan. Figure 1 shows the relationships between each aggregate source's absorption results at each of the designated soaking periods.

As shown in Figure 1, the absorption rate for each coarse aggregate tested in this study is unique to its respective source. At 24 hours of soaking, the geologically natural (gravels and quarried) sources (ASN: 30-35, 58-08, 63-97, and 93-03) reported from 62- to 78 percent of their respective laboratory-induced vacuum saturated level of absorption. In contrast, the manufactured blast-furnace slag aggregate (ASN: 82-22) reported 33 percent of its respective vacuum saturated level of absorption at 24 hours of soaking. The soaking period necessary to attain approximately 90 percent of vacuum saturation was shown to be approximately 30 days for the four geologically natural materials compared to one year for the manufactured blast-furnace slag aggregate. All geologically natural sources reported vacuum saturation levels of absorption after one year of continuous soaking. At three years of continuous soaking, the manufactured blast-furnace slag aggregate reported 98 percent of its respective vacuum saturated level of absorption.

Figure 1: Task 1: Summary of Percent Vacuum Saturation



Source	30-35		58-8		63-97		82-22		93-3	
Soaking Period	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.
24-h	0.91	78	2.38	70	1.18	78	2.34	33	2.42	62
7-d	0.97	84	2.80	83	1.29	85	3.07	43	2.99	77
30-d	1.03	89	3.19	94	1.37	91	3.70	52	3.39	88
90-d	1.07	93	3.32	98	1.41	94	5.08	71	3.71	96
180-d	1.12	97	3.33	98	1.45	96	5.44	76	3.74	96
1-y	1.14	98	3.35	99	1.48	98	6.43	90	3.82	99
3-y	1.17	101	3.33	98	1.52	101	6.98	98	3.92	101
Vac. Sat	1.16		3.39		1.51		7.13		3.87	

## **Task 2: Absorption Testing of Gravel Sources Above and Below the Static Water Table**

The two gravel sources selected for this task were chosen based on the availability of materials to be sampled from both above and below the static water table. The intent of this task was to quantify whether there is correlation between a natural aggregate's laboratory-induced vacuum saturated level of absorption and its naturally occurring in-situ moisture content attained over extended geologic time.

The findings from this task show that the naturally occurring in-situ moisture contents for each sampled source, regardless of their reference relative to the static water table, were nearly equivalent to their respective laboratory-induced vacuum saturated absorption levels. For one source (ASN: 63-48), the naturally occurring moisture content below the static water table reported 104 percent of its respective vacuum saturated level of absorption. Hence, it is shown by this study that vacuum saturated levels of absorption can be achieved naturally in-situ, without artificial means.

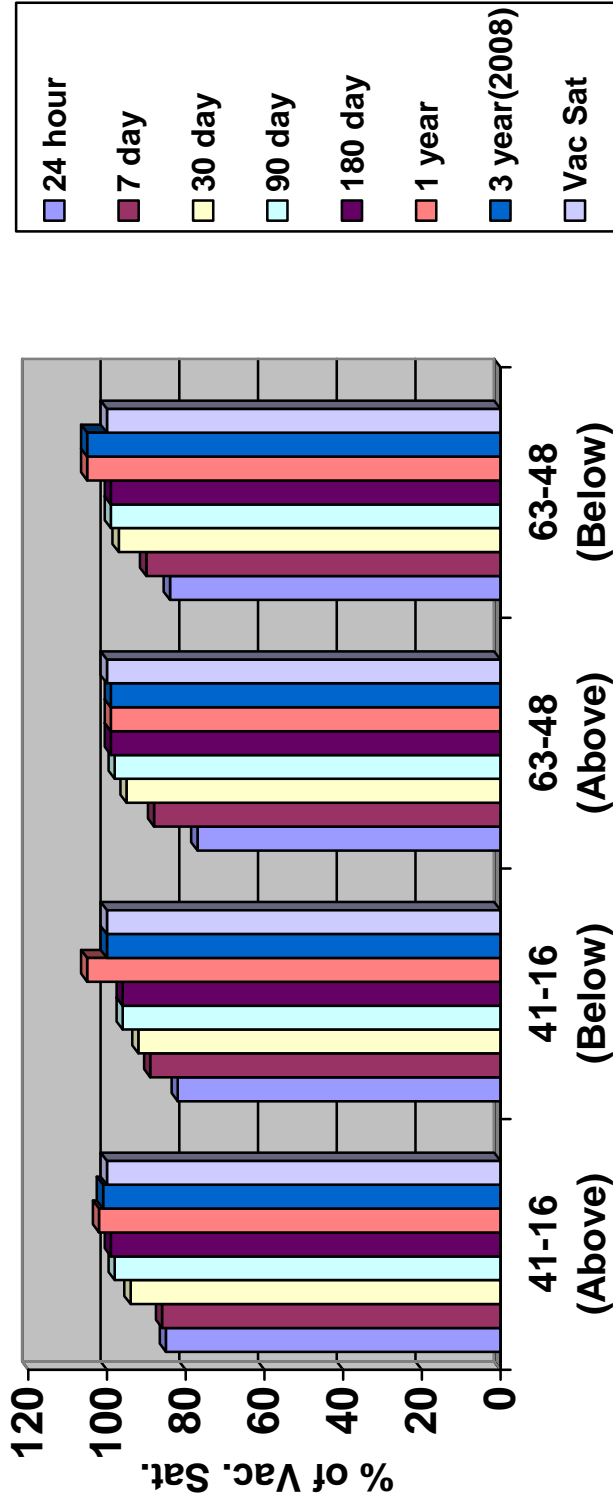
Figure 2 graphically documents the rate of absorption for the two aggregate sources, each sampled from above, as well as below, static water table locations. Figure 3 compares the as-sampled in the field moisture content versus the respective laboratory-induced vacuum saturated level of absorption. It was noted that the vacuum saturated absorption results reported for ASN: 41-16 were nearly identical for both the above and below the static water table samples. This indicates that the two samples for this aggregate source were geologically similar. However, it was noted that the two vacuum saturated absorption results reported for ASN: 63-48 were quite different. This would indicate that there may be geologic variations between the two samples for this aggregate source. Although not documented, it is surmised that the material corresponding to the above water table sample for ASN: 63-48 could have contained a disproportion of higher absorptive particles compared to the sample extracted from below the water table. Therefore, the respective above and below static water table absorption results for ASN: 63-48 could not be compared. Regardless, it was shown that the as-sampled in the field moisture contents for each sample were nearly equivalent to their respective vacuum saturated levels of absorption. Hence, documenting that vacuum saturated absorption content levels can be achieved naturally in-situ, without artificial means.

## **Task 3: Absorption Testing Slag Before and After Vacuum Saturation**

For comparison, all five aggregate sources including the manufactured blast-furnace slag were evaluated under this task.

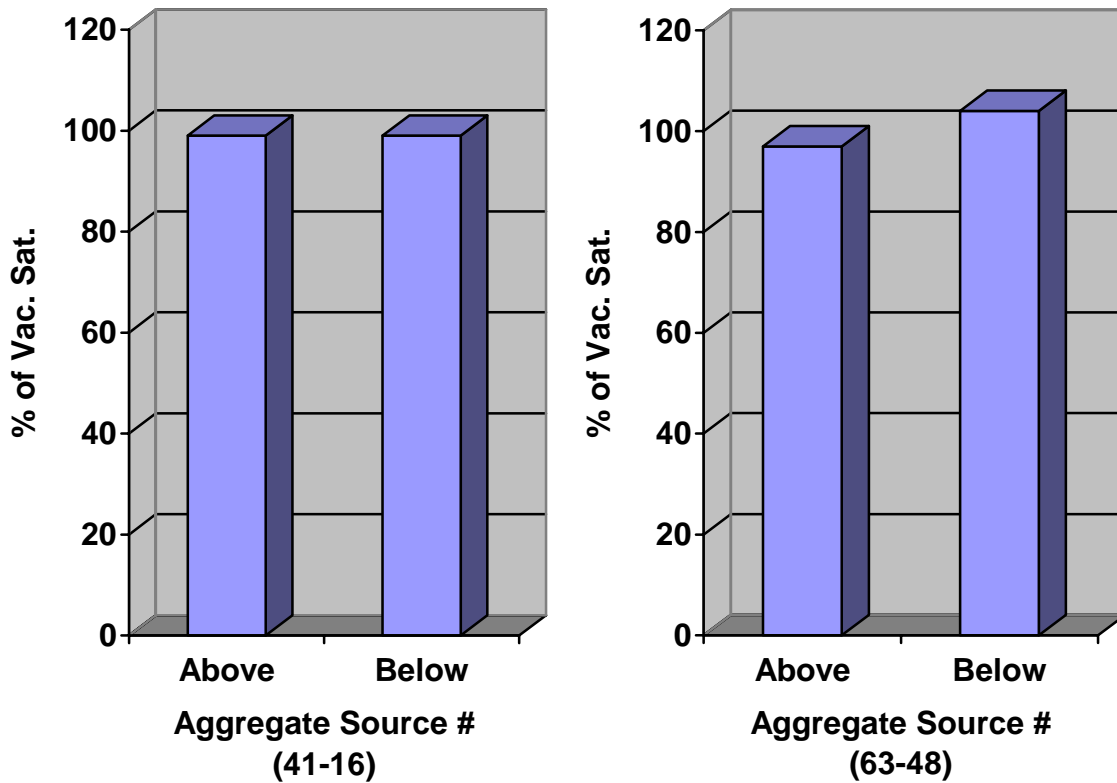
The findings from this task show that the vacuum saturation method for moisture conditioning coarse aggregates prior to laboratory freeze-thaw testing does not alter the pore characteristics of the typical gravel, carbonate, or manufactured blast-furnace slag coarse aggregates historically used in MDOT concrete pavements.

**Figure 2: Task 2: Summary of Percent Vacuum Saturation  
(Sources Sampled Above and Below Static Water Table)**



Source	41-16(Above)		41-16(Below)		63-48(Above)		63-48(Below)	
Soaking Period	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.	Abs. %	% of Vac. Sat.
24-h	1.18	85	1.16	82	1.29	77	1.09	84
7-d	1.20	86	1.26	89	1.46	88	1.17	90
30-d	1.30	94	1.30	92	1.57	95	1.26	97
90-d	1.36	98	1.36	96	1.62	98	1.28	99
180-d	1.38	99	1.36	96	1.65	99	1.29	99
1-y	1.41	102	1.49	105	1.64	99	1.36	105
3-y	1.40	101	1.41	100	1.64	99	1.37	105
Vac. Sat	1.39		1.41		1.66		1.30	

**Figure 3: Task 2: As Sampled Absorption Percent of Vacuum Saturation Sampled Above and Below Static Water Table**

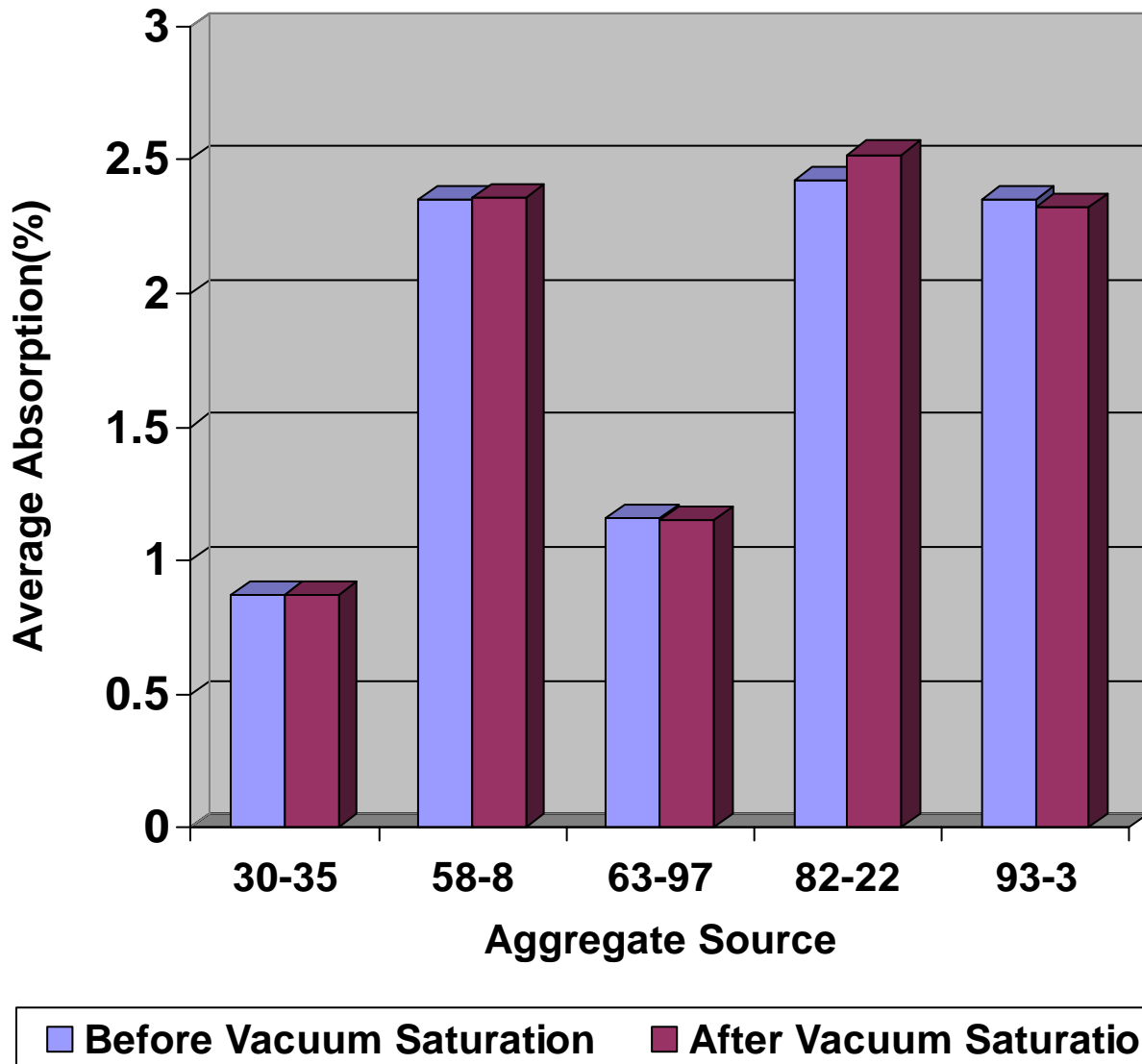


41-16 (Above)		41-16 (Below)		63-48* (Above)			63-48 (Below)		
<i>Abs.</i> %	<i>% of</i> <i>Vac. Sat.</i>	<i>Abs</i> %	<i>% of</i> <i>Vac. Sat.</i>	<i>Abs</i> %	<i>Vac.</i> <i>Sat. Abs.</i> %	<i>% of</i> <i>Vac.</i> <i>Sat.</i>	<i>Abs</i> %	<i>Vac. Sat.</i> <i>Abs. %</i>	<i>% of</i> <i>Vac.</i> <i>Sat.</i>
1.38	99	1.39	99	1.61	1.66	97	1.35	1.30	104

\*The material representing “Above” the static water table for this aggregate source was sampled from a location within the pit with slightly different physical properties than the material sampled from “Below” the static water table.

Figure 4 shows the graphical representation of the differences between the before and after vacuum saturation absorptions capacities (24-hour soaking method) for the five aggregate sources.

**Figure 4: Task 3: 24 Hr. Absorption Results Before and After Vacuum Saturation**



Data Averages					
Source	30-35	58-8	63-97	82-22	93-3
<i>Before Vac.Sat.</i>	0.87	2.35	1.16	2.42	2.35
<i>After Vac. Sat</i>	0.87	2.36	1.15	2.52	2.32



As documented below, it was shown that the difference between the absorption capacities (24-hour soaking, before vacuum saturation versus after vacuum saturation) are statistically insignificant, regardless of the aggregate type or source used in this study. Hence, this study documents that the laboratory-induced vacuum saturation method for moisture conditioning does not alter the pore characteristics of the typical gravel, carbonate, or blast-furnace slag coarse aggregates historically used in MDOT concrete pavements.

A reasonable assumption can be made that the mean values representing each of the two data sets are expected to be related and within the same bound of variation. With this in mind, the statistical analysis method selected for this task was the Standard Error of Difference Between Means.

$$SE(diff) = \sqrt{\left(\frac{\sigma_1^2}{n_1}\right) + \left(\frac{\sigma_2^2}{n_2}\right)}$$

The 95 percent confidence interval ( $z = 1.96$ ) for the difference in means is represented by the following equation:

$$\Delta \bar{x} \pm z(SE)$$

**Source: Bundy Hill (Natural Gravel), ASN: 30-35**

Statistical Analysis of BVS

$X_{bvs} = 0.87$   
 $\sigma = 0.06073$   
 Med. = 0.86

Statistical Analysis of AVS

$X_{avs} = 0.87$   
 $\sigma = 0.05662$   
 Med. = 0.88

$$SE(diff) = 0.0107$$

$$\Delta \bar{x} = 0.00$$

$$\Delta \bar{x} \pm z(SE) = 0.00 \pm 1.96(0.0107) = -0.02 \text{ and } 0.02$$

This represents that there is a 95 percent confidence that the data and sample means will vary from -0.02 to 0.02 percent. For the purpose of the data for BVS vs. AVS, this is insignificant and practically the same result may be obtained from either data set. Hence, the analysis shows that there is no statistical significance between the two data sets and that the vacuum saturation method for moisture conditioning did not artificially alter the absorption capacity as represented by the 24-hour soaking method for ASN: 30-35.

**Source: Holloway/Rockwood Stone (Quarried Carbonate), ASN: 58-08**

Statistical Analysis of BVS

X = 2.35  
 $\sigma = 0.0687$   
Med. = 2.35

Statistical Analysis of AVS

X = 2.36  
 $\sigma = 0.0686$   
Med. = 2.37

$$SE(diff) = 0.0125$$

$$\Delta \bar{x} = 0.01$$

$$\Delta \bar{x} \pm z(SE) = 0.01 \pm 1.96(0.0125) = -0.01 \text{ and } 0.03$$

This represents that there is a 95 percent confidence that the data and sample means will vary from -0.01 to 0.03 percent. For the purpose of the data for BVS vs. AVS, this is insignificant, and practically the same result may be obtained from either data set. Hence, the analysis shows that there is no statistical significance between the two data sets and that the vacuum saturation method for moisture conditioning did not artificially alter the absorption capacity as represented by the 24-hour soaking method for ASN: 58-08.

**Source: American Aggregate (Milford) (Natural Gravel), ASN: 63-97**

Statistical Analysis of BVS

X = 1.16  
 $\sigma = 0.0735$   
Med. = 1.15

Statistical Analysis of AVS

X = 1.15  
 $\sigma = 0.0755$   
Med. = 1.16

$$SE(diff) = 0.0136$$

$$\Delta \bar{x} = 0.01$$

$$\Delta \bar{x} \pm z(SE) = 0.01 \pm 1.96(0.0136) = -0.02 \text{ and } 0.04$$

This represents that there is a 95 percent confidence that the data and sample means will vary from -0.02 to 0.04 percent. For the purpose of the data for BVS vs. AVS, this is insignificant, and practically the same result may be obtained from either data set. Hence, the analysis shows that there is no statistical significance between the two data sets and that the vacuum saturation method for moisture conditioning did not artificially alter the absorption capacity as represented by the 24-hour soaking method for ASN: 63-97.

**Source: McClouth Steel/Levy Plant #4 (Blast Furnace Slag), ASN: 82-22**

Statistical Analysis of BVS

X = 2.42  
 $\sigma = 0.0943$   
Med. = 2.41

Statistical Analysis of AVS

X = 2.52  
 $\sigma = 0.0616$   
Med. = 2.53

$$SE(diff) = 0.0145$$

$$\Delta \bar{x} = 0.10$$

$$\Delta \bar{x} \pm z(SE) = 0.10 \pm 1.96(0.0145) = 0.07 \text{ and } 0.13$$

Since both values are positive, it can be surmised that 0.07 is numerically equivalent to zero; thus, the mean for the BVS data set can also be considered the lower bound for this analysis.

This represents that there is a 95 percent confidence that the data and sample means will vary from 0.00 to 0.13 percent. For the purpose of the data for BVS vs. AVS, this is insignificant, and practically the same result may be obtained from either data set. Hence, the analysis shows that there is no statistical significance between the two data sets and that the vacuum saturation method for moisture conditioning did not artificially alter the absorption capacity as represented by the 24-hour soaking method for ASN: 82-22.

**Source: France Stone (Silica) (Quarried Carbonate), ASN: 93-03**

Statistical Analysis of BVS

X = 2.35  
 $\sigma = 0.0816$   
Med. = 2.35

Statistical Analysis of AVS

X = 2.32  
 $\sigma = 0.0704$   
Med. = 2.33

$$SE(diff) = 0.0139$$

$$\Delta \bar{x} = 0.02$$

$$\Delta \bar{x} \pm z(SE) = 0.02 \pm 1.96(0.0139) = -0.01 \text{ and } 0.05$$

This represents that there is a 95 percent confidence that the data and sample means will vary from -0.01 to 0.05 percent. For the purpose of the data for BVS vs. AVS, this is insignificant, and practically the same result may be obtained from either data set. Hence, the analysis shows that there is no statistical significance between the two data sets and that the vacuum saturation method for moisture conditioning did not artificially alter the absorption capacity as represented by the 24-hour soaking method for ASN: 93-03

## Appendix A: Procedures for Absorption Study By Task

### Apparatus

Shovel

Metal Friction-Top Pails (5 gallon) - Approximately 20

Large Oven

Mechanical Shaker

Shaker Frame

Balance (accurate to 0.5g or 0.1%)

Rectangular Drying Pans - Approximately 20

Absorptive Towels

300 Nalgene Wide Mouth Containers (1 gallon capacity) with water-tight lids.

5 Gallon Plastic Friction-Top Pails with Lids - Approximately 40

Distilled Water

Clear Sealable Zipper-Type Plastic Storage Bags (1 gallon) - 10

Vacuum Saturation Apparatus

Mason's Trowel

Definitions: ASN: MDOT Aggregate Source Number.

Sample: The numerical average of five specimens.

Specimen: One - 4000 gram aggregate portion.

### TASK 1: Absorption Testing of Bin Sources

Five coarse aggregate sources incorporated into the PCC pavement test sections on MDOT SB US-23 Aggregate Test Road, in Monroe County, were representatively sampled (approximately 5 cubic yards each) at the project site during initial pavement reconstruction in 1992. These five coarse aggregates were then transported to the C&T laboratory in Dimondale, MI, and secured in protective bins for possible future testing and evaluation (herein, referred to as "bin sources"). These five aggregate sources will be subjected to long-term absorption testing according to the schedule described in Table 1.

- Two quarried carbonates: France Stone (Silica), ASN: 93-03; and Holloway Sand and Gravel/Rockwood Stone, ASN: 58-08.
- One blast furnace slag: McClouth Steel/Levy Plant #4, ASN: 82-22.
- Two gravels: Michigan Aggregate Corp/Bundy Hill Gravel Company, ASN: 30-35; and American Aggregates (Milford), ASN: 63-97.

**Table 1: Aggregate Source Test Specimens versus Soaking Period**

Task	Source	Soaking Period							
		1-Day $t_1$	7-Day $t_7$	30-Day $t_{30}$	90-Day $t_{90}$	180-Day $t_{180}$	1-Year $t_{360}$	3-Year $t_{1080}$	Vac.Sat.
1	30-35b	5	5	5	5	5	5	5	5
1	58-08b	5	5	5	5	5	5	5	5
1	63-97b	5	5	5	5	5	5	5	5
1	82-22b	5	5	5	5	5	5	5	5
1	93-03b	5	5	5	5	5	5	5	5
2	63-48 <sub>above</sub>	5	5	5	5	5	5	5	5
2	41-16 <sub>above</sub>	5	5	5	5	5	5	5	5
2	63-48 <sub>below</sub>	5	5	5	5	5	5	5	5
2	41-16 <sub>below</sub>	5	5	5	5	5	5	5	5
Total		45	45	45	45	45	45	45	45

b = US-23 Aggregate Test Road Bin Sources.

above/below = Sampled above and below static water table, respectively.

### Sampling/Sample Preparation

1. Shovel aggregates from the bin into metal friction-top pails.
2. Oven-dry the aggregates at 110 degrees Celsius for a minimum of 12 hours.
3. Remove the aggregates from the oven and allow them to cool to laboratory temperature.
4. Utilizing the following sieve sizes: (1",  $\frac{3}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{8}$ ", No. 4 and pan), sieve each aggregate source according to ASTM C-136.
5. Separate the following aggregate particle sizes ( $\frac{3}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{8}$ ", and No. 4) into individual friction-top pails. Continue sieving until approximately 150 pounds of each aggregate particle size is obtained.
6. Combine 1000 grams of each of the four aggregate particle sizes into each of 45 - one gallon Nalgene wide-mouth containers (i.e. 45 – 4000gram specimens).
7. Label each specimen container with its respective ASN, Soaking Period, Date, and Time.
8. Fill each container (representing the respective aggregate source) with distilled water to a level one inch above the top of the aggregate specimen. (Note: Since the addition of water represents commencement of soaking, ( $t_0$ ), it is suggested that the number of specimens receiving water at  $t_0$  be limited to the number of specimens that can be reasonably processed for absorption testing during a typical Soaking Period day).
9. Seal each specimen container with its respective water-tight lid.
10. Place specimen containers on specimen storage shelf.

### Absorption Testing

1. Transfer the five specimens representing the respective soaking period sample from the specimen storage area to the work table.
2. Individually process each specimen according to steps 3 through 12, as follows:

3. Remove the lid from the specimen container. Place a No. 4 sieve over the opening of the container. Invert the container and sieve simultaneously, thus permitting the specimen to gently fall into the sieve. Allow the specimen to drain for two minutes.
4. Transfer the specimen from the sieve onto a dampened absorptive towel. Spread the specimen into a uniform circle approximately 2 feet in diameter. Using the edge of a mason's trowel, proportion the specimen into four approximately equal quarters.
5. Combine the opposing quadrants of the quartered specimen, thus producing two representative specimen half-portions; A and B. Immediately cover specimen half-portion B with a damp towel to prevent moisture loss while processing the specimen half-portion A, as follows:
6. Towel-dry the specimen half-portion by rolling it in a dry absorptive towel until all visible water is removed from the aggregate particle surfaces. Some particles may need to be individually dried.
7. Immediately weigh the towel-dried specimen half-portion to the nearest 0.5 grams. Record this weight as the SSD weight for the specimen half-portion.
8. Repeat steps 6 and 7 for the remaining specimen half-portion.
9. Oven-dry the two specimen half-portions at 110 degrees Celsius for a minimum of 12 hours.
10. Remove the specimen half-portions from the oven and allow them to cool to laboratory temperature.
11. Weigh each of the two individual specimen half-portions to the nearest 0.5 grams. Record these oven dry weights as Oven Dry Weights A and B, for the respective specimen half-portion.
12. Calculate Absorption percent for the individual specimen half-portions:  $\text{Absorption Percent} = (\text{SSD weight} - \text{Oven Dry Weight}) / \text{Oven Dry Weight}$ . Average the two individual Absorption percent test results for each specimen half-portion and report this value as the Absorption percent for the respective specimen.
13. Repeat steps 2 through 12 for the remaining four specimens representing the soaking period sample for the respective aggregate source.
14. Repeat steps 1 through 13 for each respective aggregate source.
15. Repeat steps 1 through 14 for each respective soaking period.

## **TASK 2: Absorption Testing of Gravel Sources Above and Below the Static Water Table**

Two gravel aggregate sources which are geologically being mined above, as well as below the static water table will be selected for sampling and tested to determine their naturally occurring in-situ moisture contents. In addition, these two aggregate sources will be subjected to long-term absorption testing according to the schedule described in Table 1.

- E.C. Levy Company, Natural Aggregate Div. (Milford #2), ASN: 63-48.
- Grand Rapids Gravel, ASN: 41-16.

### **Sampling/Test Procedure (Below Static Water Table)**

1. Wet-sieve the gravel aggregate on-site as it is being dredged from below the static water table using a portable shaker frame configured with 1" and No. 4 sieves.
2. Transfer the gravel aggregate retained on the No. 4 sieve into 20 - water filled 5 gallon friction-top plastic pails, ensuring that the materials are continuously submerged in water after wet-sieving. Fill each pail approximately 2/3 full with gravel aggregate. Fill the remaining one-third of the pail with water obtained from the excavation site.
3. Seal each pail with its respective friction-top lid.
4. Transport sealed containers to the laboratory for further material processing.
5. In the laboratory, wet sieve enough material to produce five 4000g specimens (1000grams of each particle size  $\frac{3}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{8}$ " and No. 4), ensuring that the materials are maintained in a saturated or submerged environment at all times.
6. Determine the in-situ moisture content of the aggregate source using the procedure for *Absorption Testing*, described in *Task 1*.
7. Process the remaining gravel aggregate from the 20 pails for long-term absorption testing using the procedures for *Sampling/Sample Preparation* and *Absorption Testing*, at the schedule shown in Table 1, described in *Task 1*.
8. Repeat steps 1 through 7 for the remaining gravel source sampled below the static water table.

### **Sampling/Test Procedure (Above Static Water Table)**

1. Sieve gravel aggregate on-site using a portable shaker frame configured with 1" and No. 4 sieves.
2. Transfer the gravel aggregate retained on the No. 4 sieve into 20 - 5 gallon friction-top plastic pails.
3. Seal each pail with its respective friction-top lid to ensure that the materials retain their in-situ moisture.
4. In addition, secure five representative specimens of approximately 4000 grams each into individual clear plastic storage bags. Seal the bags to prevent loss of in-situ moisture.
5. Transport sealed containers to the laboratory for further material processing.
6. In the laboratory, immediately determine the in-situ moisture content for the five 4000 gram bagged specimens. Individually weight the entire content of each bag to the nearest 0.5 grams and record it as the In-Situ Weight.
7. Oven-dry the five specimens at 110 degrees Celsius for a minimum of 12 hours.
8. Remove the specimens from the oven and allow them to cool to laboratory temperature.
9. Individually weigh specimen to the nearest 0.5 grams and record these as the Oven Dry Weight for the respective specimen.
10. Calculate the In-Situ Moisture percent for each individual specimen: In-Situ Moisture percent =  $\frac{\text{In-Situ Weight} - \text{Oven Dry Weight}}{\text{Oven Dry Weight}}$

- Average the five individual In-Situ Moisture percent test results and report this value as the In-Situ Moisture percent for the respective gravel aggregate source.
11. Process the remaining gravel aggregate from the 20 pails for long-term absorption testing using the procedures for *Sampling/Sample Preparation* and *Absorption Testing*, at the schedule shown in Table 1, described in *Task 1*.
  12. Repeat steps 1 through 11 for the remaining gravel aggregate source sampled above the static water table.

### **TASK 3: Absorption Testing Slag Aggregate Before and After Vacuum Saturation**

The blast-furnace slag “US-23 Aggregate Test Road Bin Source” will be used as the material candidate for this task.

- McClouth Steel/Levy Plant #4, ASN: 82-22.

#### **Sampling/Sample Preparation**

1. Shovel aggregate from the bin source into metal friction-top pails.
2. Oven-dry the aggregate at 110 degrees Celsius for a minimum of 12 hours.
3. Remove the aggregate from the oven and allow it to cool to laboratory temperature.
4. Utilizing the following sieve sizes (1”, ¾”, ½”, ⅜”, No. 4 and pan), sieve each aggregate source according to ASTM C-136.
5. Separate the following aggregate particle sizes (¾”, ½”, ⅜”, and No. 4) into individual friction-top pails. Continue sieving until approximately 150 pounds of each aggregate particle size is obtained.
6. Combine 1000 grams of each of the four aggregate particle sizes into each of 30 - 1 gallon Nalgene wide-mouth containers (i.e. 30 – 4000 gram specimens, or six groups of five specimens).
7. Label each container with the ASN and its respective Sample No. (1 thru 30).
8. Place specimen containers on specimen storage shelf until testing.

#### **Test Procedure**

1. Remove a group of five specimens from the specimen storage shelf.
2. Fill each of the five specimen containers with distilled water to a level one inch above the top of the aggregate specimen. (Note: To facilitate scheduling of testing, offset immersion of the five specimens in distilled water by ½ hour each. Record the date and time of immersion onto each specimen container).
3. Seal each specimen container with its respective water-tight lid.
4. Soak specimens for 24 hours.
5. Remove the lid from one specimen container. Place a No. 4 sieve over the opening of the container. Invert the container and sieve simultaneously, thus permitting the specimen to gently fall into the sieve. Allow the specimen to drain for two minutes.



6. Transfer the specimen onto a dampened absorptive towel. Spread the specimen into a uniform circle approximately 2 feet in diameter. Using the edge of a mason's trowel, proportion the specimen into four approximately equal quarters.
7. Combine the opposing quadrants of the quartered specimen, thus producing two representative specimen half-portions; A and B. Immediately cover specimen half-portion B with a damp towel to prevent moisture loss while processing the specimen half-portion A, as follows:
8. Towel-dry the specimen half-portion by rolling it in a dry absorptive towel until all visible water is removed from the aggregate particle surfaces. Some particles may need to be individually dried.
9. Immediately weigh the towel-dried specimen half-portion to the nearest 0.5 grams. Record this weight as the  $SSD_{bvs}$  Weight (before vacuum saturation) for the specimen half-portion.
10. Repeat steps 8 and 9 for the remaining specimen half-portion.
11. Oven-dry the two specimen half-portions at 110 degrees Celsius for a minimum of 12 hours.
12. Remove the specimen half-portions from the oven and allow them to cool to laboratory temperature.
13. Weigh each of the two individual specimen half-portions to the nearest 0.5 grams. Record these oven dry weights as Oven Dry<sub>bvs</sub> Weights (before vacuum saturation) A and B, for the respective specimen half-portion.
14. Calculate the absorption before vacuum saturation, Absorption<sub>bvs</sub> percent, for the individual specimen half-portions:  $Absorption_{bvs} \text{ percent} = (SSD_{bvs} \text{ weight} - \text{Oven Dry}_{bvs} \text{ Weight}) / \text{Oven Dry}_{bvs} \text{ Weight}$ . Average the two individual Absorption<sub>bvs</sub> percent test results for each specimen half-portion and report this value as the Absorption<sub>bvs</sub> percent for the respective specimen.
15. Re-combine the two specimen half-portions for the specimen into its respective Nalgene wide-mouth container.
16. Repeat steps 5 through 14 for the remaining four specimens.
17. Transfer the five specimens from steps 1 through 15 into individual specimen containers suitable for inclusion into the vacuum saturation assembly.
18. Place the five specimens into the vacuum saturation vessel.
19. Vacuum saturate the five specimens according to the department's procedures for moisture conditioning, as described in Subsection 6.1.1 of the Michigan Test Method MTM 113.
20. When vacuum saturation is complete, drain excess water from each of the five specimens.
21. Oven-dry the five specimens at 110 degrees Celsius for a minimum of 12 hours.
22. Repeat steps 2 through 13. (Note: report the  $SSD_{avs}$  Weight (after vacuum saturation) and the Oven Dry Weight described in step 13 as the Oven Dry<sub>avs</sub> Weight (after vacuum saturation)).
23. Calculate the absorption after vacuum saturation, Absorption<sub>avs</sub> percent for the individual specimen half-portions:  $Absorption_{avs} \text{ percent} = (SSD_{avs} \text{ weight} - \text{Oven Dry}_{avs} \text{ Weight}) / \text{Oven Dry}_{avs} \text{ Weight}$ . Average the two individual Absorption<sub>avs</sub> percent test results for each specimen half-portion and report this value as the Absorption<sub>avs</sub> percent for the respective specimen.

24. Repeat steps 1 through 23 for each of the remaining groups of five specimens.
25. Identify outliers for each 30 specimen data group (Absorption<sub>bvs</sub> percent and Absorption<sub>avs</sub> percent) according to ASTM E 178.
26. Once outlier has been confirmed and eliminated, calculate the average Absorption percent for each data group.
27. Compare the absorption before vacuum saturation (Absorption<sub>bvs</sub> percent) to the absorption after vacuum saturation (Absorption<sub>avs</sub> percent).

## Appendix B: Comparison of Towel Method vs. Pan Method to Achieve Saturated Surface Dry for Coarse Aggregate

Two methods (Towel Method vs. Pan Method), commonly used by MDOT to establish saturated surface dry moisture condition for coarse aggregate were evaluated in an effort to select the standard method, which will be used throughout this study.

The coarse aggregates used for this laboratory exercise were three materials previously stockpiled and stored in weatherproof bins from the US-23 Aggregate Test Road in Monroe County. The three sources selected were ASN: 30-35 Bundy Hill (Natural Gravel), ASN: 58-8 Rockwood Stone (Crushed Limestone) and ASN: 82-22 E.C. Levy-Trenton (Blast furnace slag).

### Preparing Samples

Two hundred pounds of aggregate from each of the three bins was oven dried. The dried materials were then sieved into the four particle sizes (3/4", 1/2", 3/8", and No. 4) using a mechanical sieve shaker.

One thousand grams of each of the four sieve sizes were then combined to make a 4000 gram sample. Ten samples were assembled for each source. Five samples were tested using the "Towel Method" and five were tested using the "Pan Method". All samples were then moisture conditioned by soaking in water for 24 hours prior to testing.



Figure 1: Sample Containers

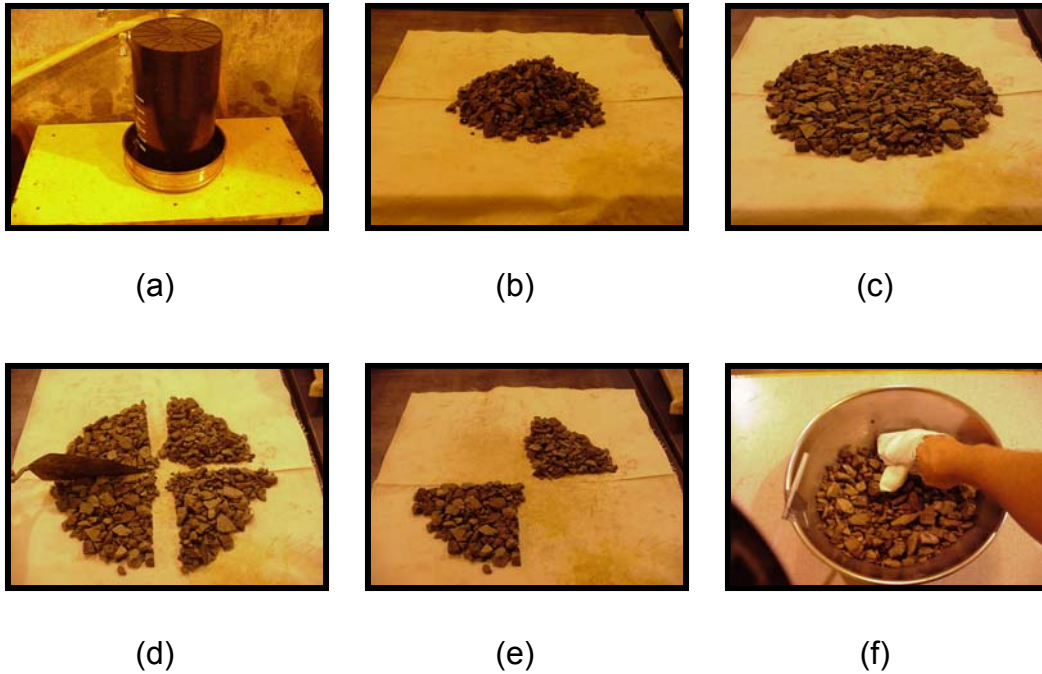
## **Towel Method**

- The five samples for each test were soaked for 24 hours prior to testing. Introduction of water to each sample was offset by ½ hour to accommodate the time needed for testing after soak. Each cylinder was labeled with the appropriate information/date and time (see Figure 1).
- Five minutes prior to testing, place a No. 4 sieve over the opening of the sample container, and inverted both units to permit the water to be drained from the sample (see Figure 2a).
- Carefully transfer the sample contents onto a damp towel. Uniformly spread it out in a circle, approximately 2 feet in diameter. Using the edge of a mason trowel, divided the sample into four approximately equal portions (see Figures 2b, c and d).
- Combine the two opposing quarters of the sample into a dry towel (see Figure 2e). Immediately cover the two remaining quartered portions with a damp towel to prevent the loss of moisture.
- Roll the half-sample in the dry towel until all visible surface water is removed. Hand dry individual particles, if necessary.
- Weigh the half-sample as soon as all visible surface water is removed. Record this as the SSD weight for half-sample 1.
- Repeated this sequence for the remaining half--sample and recorded the SSD weight for half-sample 2
- Oven dry the two half-samples overnight.
- The next day, record the dry weight for each half-sample. Calculate the absorption capacity for each individual half-sample. Average the two absorption capacity values and report this as the final absorption capacity for the sample.
- Repeat the above procedure for the remaining four samples

## **Pan Method**

- The five samples for each test were soaked for 24 hours prior to testing. Introduction of water to each sample was offset by ½ hour to accommodate the time needed for testing after soak. Each cylinder was labeled with the appropriate information/date and time (see Figure 1).

- Five minutes prior to testing, place a No. 4 sieve over the opening of the sample container, and inverted both units to permit the water to be drained from the sample (see Figure 2a).
- Carefully transfer the sample contents onto a damp towel. Uniformly spread it out in a circle, approximately 2 feet in diameter. Using the edge of a mason trowel, divided the sample into four approximately equal portions (see Figures 2b, c and d).
- Transfer two opposing quarters of the sample into a stainless steel bowl for drying (see Figure 2f). Immediately cover the two remaining quartered portions with a damp towel to prevent the loss of moisture.
- Using a rag and a gentle air stream, stir the contents of the bowl in a circular manner (see Figure 2f). Direct the stream of air toward the upper inside of the bowl, rather than directly at the aggregate, in a manner to assist in the drying process
- The aggregate is considered to be saturated surface dry when there are no longer moisture streaks accumulated onto the bottom of the bowl when the aggregate is stirred.
- Immediately weigh the half-sample. Record this as the SSD weight for half-sample 1.
- Repeated this sequence for the remaining half-sample and recorded the SSD weight for half-sample 2
- Oven dry the two half-samples overnight.
- The next day, record the dry weight for each half-sample. Calculate the absorption capacity for each individual half-sample. Average the two absorption capacity values and report this as the final absorption capacity for the sample.
- Repeat the above procedure for the remaining four samples.



**Figure 2: Sample Testing**

### **Summary of Results**

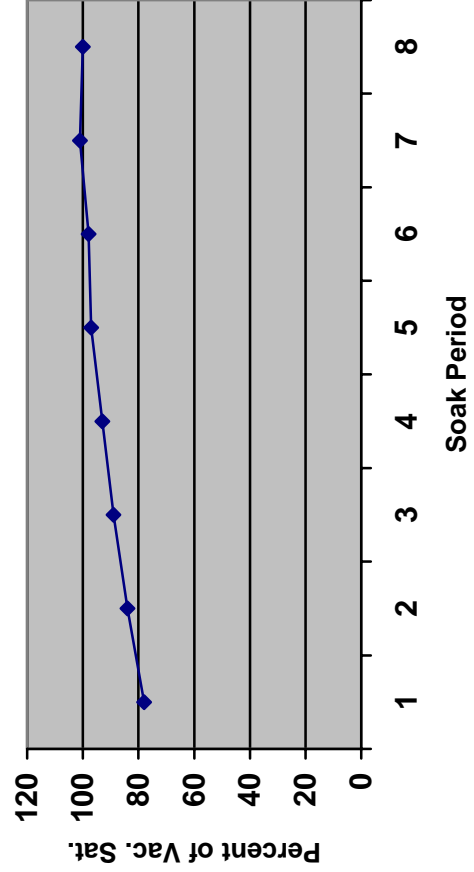
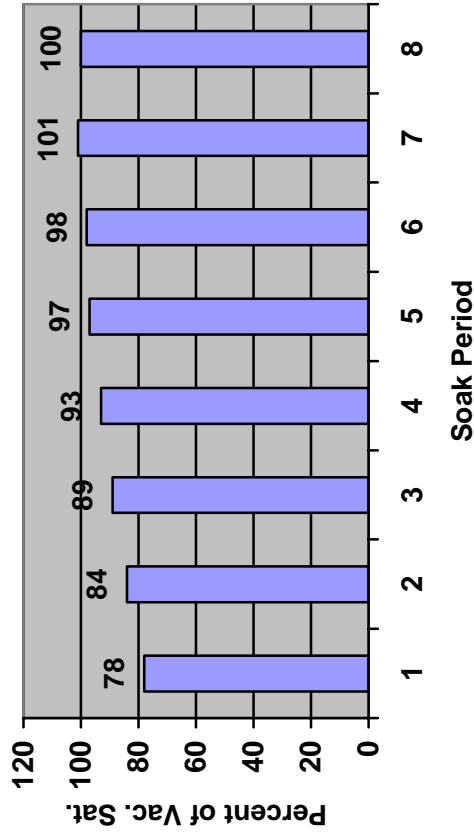
The difference between the two methods was slight, with less than 0.2 percent absorption capacity difference between methods for each of the three sources. Further, it was noted through iteration that the Towel Method was more predictable toward judging thresholds for SSD. Hence, the Towel Method was selected as the standard moisture determination procedure for this study. Table 1 shows the results from the comparison of Towel Method vs. Pan Method.

**Table 1. Comparison of Towel Method versus Pan Method**

Procedure Comparison													
Samp #	Source	ASN	Sp. Gr. (Dry)	Moist cond.	SSD 1 Weight	Dry 1 Weight	SSD 2 Weight	Dry 2 Weight	Split 1 abs.	Split 2 abs.	Ave. Abs. %	Towel/ Pan	Ave. of 5 tests
1	E.C. Levy (Slag)	82-22	2.31	24 Hr Soak	2108.8	2059.3	1935.7	1888.8	2.40	2.48	2.44	T	2.46
2		82-22	2.31		1985.9	1935.9	2030.0	1982.8	2.58	2.38	2.48	T	
3	82-22	82-22	2.31		1965.9	1920.7	2038.7	1990.1	2.31	2.44	2.38	T	
4		82-22	2.31		1952.7	1905.8	2042.6	1994.7	2.46	2.40	2.43	T	
5		82-22	2.31		2047.3	1997.0	1953.0	1903.0	2.52	2.63	2.57	T	
6		82-22	2.31		2047.3	1994.4	1961.3	1913.1	2.65	2.52	2.59	P	
7		82-22	2.31		1936.2	1886.0	2068.9	2016.0	2.66	2.62	2.64	P	
8	82-22	82-22	2.31		2040.7	1988.3	1955.1	1902.9	2.64	2.74	2.69	P	2.65
9		82-22	2.31		2075.6	2020.7	1912.9	1865.1	2.72	2.56	2.64	P	
10		82-22	2.31		1921.7	1870.5	2069.9	2017.1	2.74	2.62	2.68	P	
11		Bundy Hill 30-35	30-35	2.70	2035.8	2021.7	2050.8	2032.3	0.70	0.91	0.80	T	
12	30-35		2.70	2061.1	2042.8	1980.5	1965.2	0.90	0.78	0.84	T		
13	30-35		2.70	2066.9	2049.4	1947.6	1930.4	0.85	0.89	0.87	T		
14	30-35		2.70	2016.0	1998.0	1997.7	1983.1	0.90	0.74	0.82	T		
15	30-35		2.70	2086.6	2068.3	1933.8	1917.8	0.88	0.83	0.86	T		
16	30-35		2.70	2068.7	2050.2	2032.0	2014.9	0.90	0.85	0.88	P		
17	30-35		2.70	2022.8	2004.6	2026.6	2007.3	0.91	0.96	0.93	P		
18	30-35		2.70	2030.0	2011.4	1993.7	1974.8	0.92	0.96	0.94	P		
19	30-35		2.70	1991.0	1973.5	2031.9	2014.2	0.89	0.88	0.88	P		
20	30-35		2.70	1949.9	1933.3	2076.1	2056.8	0.86	0.94	0.90	P		
21	Rockwood Stone	58-8	2.60	1924.6	1880.9	2127.4	2078.5	2.32	2.35	2.34	T	2.38	
22		58-8	2.60	1896.0	1852.9	2151.6	2101.5	2.33	2.38	2.36	T		
23	58-08	58-8	2.60	2081.8	2031.7	1966.2	1920.0	2.47	2.41	2.44	T		
24		58-8	2.60	1968.0	1923.0	2074.8	2025.6	2.34	2.43	2.38	T		
25		58-8	2.60	2013.0	1964.6	2032.8	1987.0	2.46	2.30	2.38	T		
26		58-8	2.60	2061.4	2012.9	2000.0	1951.0	2.41	2.51	2.46	P		
27	58-8	58-8	2.60	2012.8	1964.3	2045.3	1995.2	2.47	2.51	2.49	P	2.54	
28		58-8	2.60	2012.4	1955.8	2056.1	2005.0	2.89	2.55	2.72	P		
29		58-8	2.60	1974.4	1927.1	2078.4	2027.0	2.45	2.54	2.50	P		
30		58-8	2.60	1962.2	1916.0	2094.7	2040.9	2.41	2.64	2.52	P		

# Appendix C: Long-Term Soaking of Coarse Aggregates

Task 1: Absorption Results, Bundy Hill – ASN: 30-35



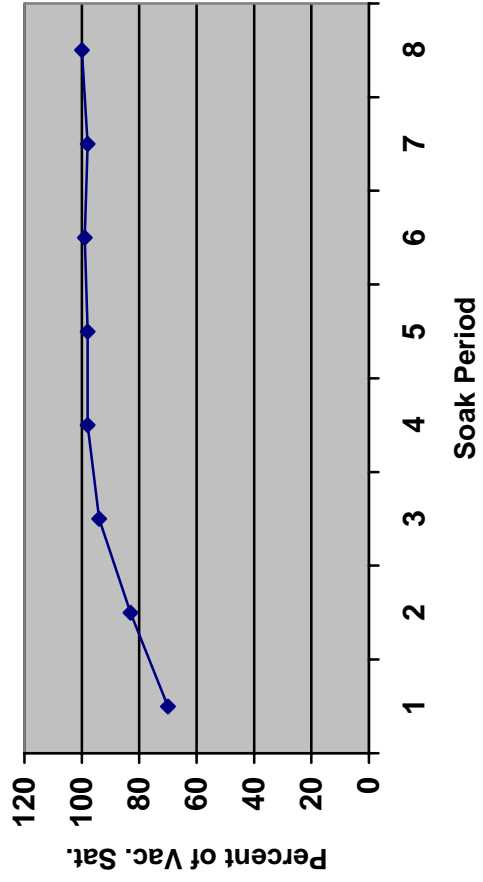
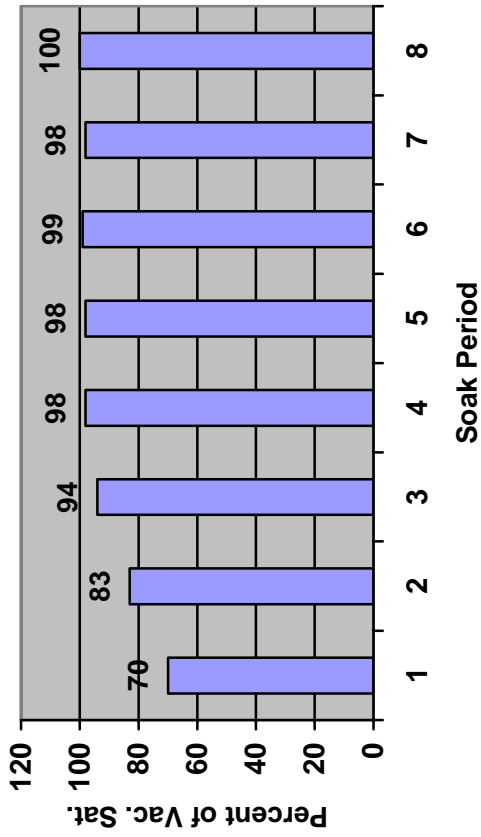
	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	0.91	78
2	7 Day	0.97	84
3	30 Day	1.03	89
4	90 Day	1.07	93
5	180 Day	1.12	97
6	1 Year	1.14	98
7	3 Year	1.17	101
8	Vac. Sat.	1.16	100



### Task 1: Absorption Results, Bundy Hill – ASN: 30-35

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 1 (gms)	Dry 1 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	2-7-05	2-8-05	2031.1	2012.7	0.91	1992.8	1974.2	0.94	0.93
2	24 hr.	2-7-05	2-8-05	1956.0	1939.2	0.87	2072.1	2053.1	0.93	0.90
3	24 hr.	2-7-05	2-8-05	1947.4	1929.7	0.92	2084.0	2066.5	0.85	0.88
4	24 hr.	2-7-05	2-8-05	2039.4	2021.7	0.88	1986.4	1967.8	0.95	0.91
5	24 hr.	2-7-05	2-8-05	2007.0	1989.6	0.87	2011.0	1991.4	0.98	0.93
<b>Avg.</b>										<b>0.91</b>
6	7 Day	2-7-05	2-14-05	2087.4	2067.4	0.97	1945.4	1926.0	1.01	0.99
7	7 Day	2-7-05	2-14-05	2001.3	1983.4	0.90	2031.1	2011.5	0.97	0.94
8	7 Day	2-7-05	2-14-05	1999.4	1979.4	1.01	2039.9	2020.1	0.98	1.00
9	7 Day	2-7-05	2-14-05	2043.0	2022.3	1.02	1993.9	1976.5	0.88	0.95
10	7 Day	2-7-05	2-14-05	2017.0	1996.7	1.02	2014.5	1995.4	0.96	0.99
<b>Avg.</b>										<b>0.97</b>
11	30 Day	2-7-05	3-9-05	2010.0	1990.0	1.01	2023.0	2003.4	0.98	0.99
12	30 Day	2-7-05	3-9-05	1989.9	1967.9	1.12	2048.6	2025.9	1.12	1.12
13	30 Day	2-7-05	3-9-05	2093.7	2074.6	0.92	1937.1	1917.2	1.04	0.98
14	30 Day	2-7-05	3-9-05	1976.5	1956.0	1.05	2062.5	2041.5	1.03	1.04
15	30 Day	2-7-05	3-9-05	2054.1	2034.9	0.94	1976.0	1953.6	1.15	1.05
<b>Avg.</b>										<b>1.03</b>
16	90 Day	2-7-05	5-8-05	2065.1	2042.5	1.11	1972.7	1950.2	1.15	1.13
17	90 Day	2-7-05	5-8-05	2043.2	2022.4	1.03	1993.3	1971.3	1.12	1.07
18	90 Day	2-7-05	5-8-05	2050.0	2030.6	0.96	1981.8	1961.4	1.04	1.00
19	90 Day	2-7-05	5-8-05	2011.4	1990.7	1.04	2019.1	1998.8	1.02	1.03
20	90 Day	2-7-05	5-8-05	2002.9	1979.9	1.16	2035.7	2013.2	1.12	1.14
<b>Avg.</b>										<b>1.07</b>
21	180 Day	2-7-05	8-6-05	1980.4	1958.2	1.13	2048.7	2026.8	1.08	1.11
22	180 Day	2-7-05	8-6-05	2088.3	2063.3	1.21	1958.5	1937.5	1.08	1.15
23	180 Day	2-7-05	8-6-05	2058.2	2037.2	1.03	1983.5	1962.7	1.06	1.05
24	180 Day	2-7-05	8-6-05	2033.7	2007.8	1.29	2004.0	1981.6	1.13	1.21
25	180 Day	2-7-05	8-6-05	1989.6	1968.4	1.08	2047.1	2024.3	1.13	1.10
<b>Avg.</b>										<b>1.12</b>
26	1 Year	2-7-05	2-7-06	1992.5	1970.7	1.11	2025.3	2003.6	1.08	1.09
27	1 Year	2-7-05	2-7-06	2032.7	2010.3	1.11	2003.9	1980.0	1.21	1.16
28	1 Year	2-7-05	2-7-06	2040.2	2017.1	1.15	1993.6	1973.0	1.04	1.09
29	1 Year	2-7-05	2-7-06	2045.8	2021.0	1.23	1996.9	1974.5	1.13	1.18
30	1 Year	2-7-05	2-7-06	1974.3	1952.0	1.14	2060.7	2036.3	1.20	1.17
<b>Avg.</b>										<b>1.14</b>
31	3 Year	2-7-05	2-7-08	2002.7	1977.6	1.27	2033.0	2010.4	1.12	1.20
32	3 Year	2-7-05	2-7-08	2050.3	2027.1	1.14	1988.6	1965.6	1.17	1.16
33	3 Year	2-7-05	2-7-08	2053.5	2031.4	1.09	1977.0	1957.1	1.02	1.05
34	3 Year	2-7-05	2-7-08	1993.3	1969.0	1.23	2044.4	2017.1	1.35	1.29
35	3 Year	2-7-05	2-7-08	1985.8	1961.8	1.22	2051.6	2028.9	1.12	1.17
<b>Avg.</b>										<b>1.17</b>
36	Vac Sat.	2-16-05	2-17-05	2082.7	2055.1	1.34	1955.5	1933.7	1.13	1.24
37	Vac Sat.	2-16-05	2-17-05	2015.0	1991.7	1.17	2030.8	2005.4	1.27	1.22
38	Vac Sat.	2-16-05	2-17-05	1997.5	1975.9	1.09	2039.5	2017.3	1.10	1.10
39	Vac Sat.	2-16-05	2-17-05	1953.2	1931.4	1.13	2082.0	2059.2	1.11	1.12
40	Vac Sat.	2-16-05	2-17-05	2045.4	2022.5	1.13	1991.7	1969.6	1.12	1.13
<b>Avg.</b>										<b>1.16</b>

**Task 1: Absorption Results, Rockwood Stone – ASN: 58-08**

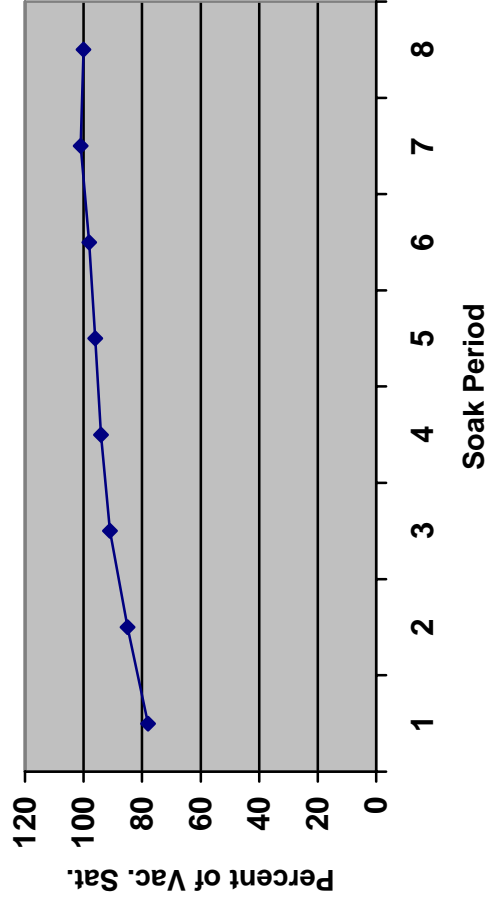
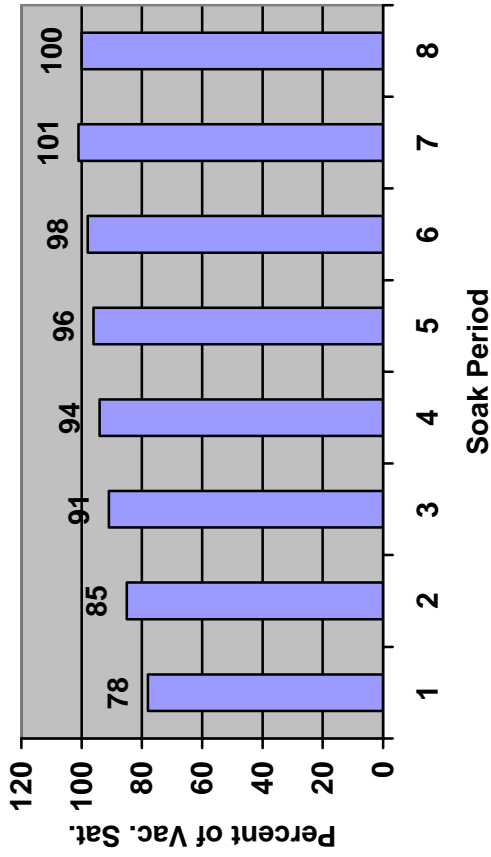


	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	2.38	70
2	7 Day	2.80	83
3	30 Day	3.19	94
4	90 Day	3.32	98
5	180 Day	3.33	98
6	1 Year	3.35	99
7	3 Year	3.33	98
8	Vac. Sat.	3.39	100

## Task 1: Absorption Results, Rockwood Stone – ASN: 58-08

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	2-2-05	2-3-05	2122.0	2075.1	2.26	1961.4	1916.0	2.37	2.31
2	24 hr.	2-2-05	2-3-05	2044.5	1995.2	2.47	2035.8	1991.0	2.25	2.36
3	24 hr.	2-2-05	2-3-05	1978.9	1932.8	2.39	2103.6	2054.9	2.37	2.38
4	24 hr.	2-2-05	2-3-05	1980.3	1931.3	2.54	2083.2	2034.7	2.38	2.46
5	24 hr.	2-2-05	2-3-05	2078.7	2029.2	2.44	2004.9	1958.7	2.36	2.40
<b>Avg.</b>										<b>2.38</b>
6	7 Day	2-2-05	2-9-05	2043.7	1986.5	2.88	2055.6	1999.2	2.82	2.85
7	7 Day	2-2-05	2-9-05	2153.7	2096.8	2.71	1935.6	1882.0	2.85	2.78
8	7 Day	2-2-05	2-9-05	1975.8	1922.2	2.79	2118.7	2062.8	2.71	2.75
9	7 Day	2-2-05	2-9-05	2149.8	2091.2	2.80	1950.1	1896.4	2.83	2.82
10	7 Day	2-2-05	2-9-05	2062.3	2005.5	2.83	2037.0	1982.7	2.74	2.79
<b>Avg.</b>										<b>2.80</b>
11	30 Day	2-2-05	3-4-05	1993.1	1932.7	3.13	2119.0	2058.5	2.94	3.03
12	30 Day	2-2-05	3-4-05	1961.9	1902.9	3.10	2147.7	2078.7	3.32	3.21
13	30 Day	2-2-05	3-4-05	2017.2	1953.3	3.27	2088.5	2024.7	3.15	3.21
14	30 Day	2-2-05	3-4-05	1955.8	1893.2	3.31	2157.4	2090.9	3.18	3.24
15	30 Day	2-2-05	3-4-05	1987.9	1925.3	3.25	2123.5	2057.3	3.22	3.23
<b>Avg.</b>										<b>3.19</b>
16	90 Day	2-2-05	5-3-05	2128.4	2059.4	3.35	1993.5	1929.2	3.33	3.34
17	90 Day	2-2-05	5-3-05	2028.0	1960.0	3.47	2091.2	2024.5	3.29	3.38
18	90 Day	2-2-05	5-3-05	2118.0	2052.7	3.18	2000.3	1934.6	3.40	3.29
19	90 Day	2-2-05	5-3-05	2107.7	2040.9	3.27	2012.0	1946.1	3.39	3.33
20	90 Day	2-2-05	5-3-05	1985.5	1921.1	3.35	2123.4	2057.5	3.20	3.28
<b>Avg.</b>										<b>3.32</b>
21	180 Day	2-2-05	8-1-05	2099.5	2033.8	3.23	2011.6	1946.2	3.36	3.30
22	180 Day	2-2-05	8-1-05	1895.9	1834.4	3.35	2217.3	2148.6	3.20	3.28
23	180 Day	2-2-05	8-1-05	2055.4	1989.1	3.33	2059.6	1993.5	3.32	3.32
24	180 Day	2-2-05	8-1-05	2053.1	1986.4	3.36	2052.5	1984.4	3.43	3.39
25	180 Day	2-2-05	8-1-05	2060.4	1992.9	3.39	2035.2	1969.5	3.34	3.36
<b>Avg.</b>										<b>3.33</b>
26	1 Year	2-2-05	2-2-06	2082.1	2014.9	3.34	2030.8	1962.2	3.50	3.42
27	1 Year	2-2-05	2-2-06	2092.1	2025.9	3.27	2026.5	1963.9	3.19	3.23
28	1 Year	2-2-05	2-2-06	2109.4	2043.0	3.25	1999.3	1935.8	3.28	3.27
29	1 Year	2-2-05	2-2-06	2083.7	2012.5	3.54	2030.3	1965.0	3.32	3.43
30	1 Year	2-2-05	2-2-06	2107.6	2039.3	3.35	2014.3	1947.0	3.46	3.40
<b>Avg.</b>										<b>3.35</b>
31	3 Year	2-2-05	2-2-08	2069.2	2005.2	3.18	2035.2	1969.8	3.32	3.25
32	3 Year	2-2-05	2-2-08	2054.9	1988.2	3.35	2060.2	1995.4	3.25	3.30
33	3 Year	2-2-05	2-2-08	2055.9	1989.7	3.33	2064.0	1996.0	3.41	3.37
34	3 Year	2-2-05	2-2-08	2032.6	1964.2	2.48	2081.0	2014.2	3.32	3.40
35	3 Year	2-2-05	2-2-08	2076.8	2006.8	3.49	2044.4	1981.8	3.16	3.32
<b>Avg.</b>										<b>3.33</b>
36	Vac Sat.	2-24-05	2-25-05	2129.9	2060.0	3.39	1994.6	1928.9	3.41	3.40
37	Vac Sat.	2-24-05	2-25-05	1907.9	1842.6	3.54	2215.1	2139.7	3.52	3.53
38	Vac Sat.	2-24-05	2-25-05	1956.6	1894.0	3.31	2166.8	2097.7	3.29	3.30
39	Vac Sat.	2-24-05	2-25-05	2061.6	1995.7	3.30	2054.4	1985.9	3.45	3.38
40	Vac Sat.	2-24-05	2-25-05	2100.0	2031.2	3.39	2017.4	1953.7	3.26	3.32
<b>Avg.</b>										<b>3.39</b>

**Task 1: Absorption Results, American Aggregate (Milford) – ASN: 63-97**

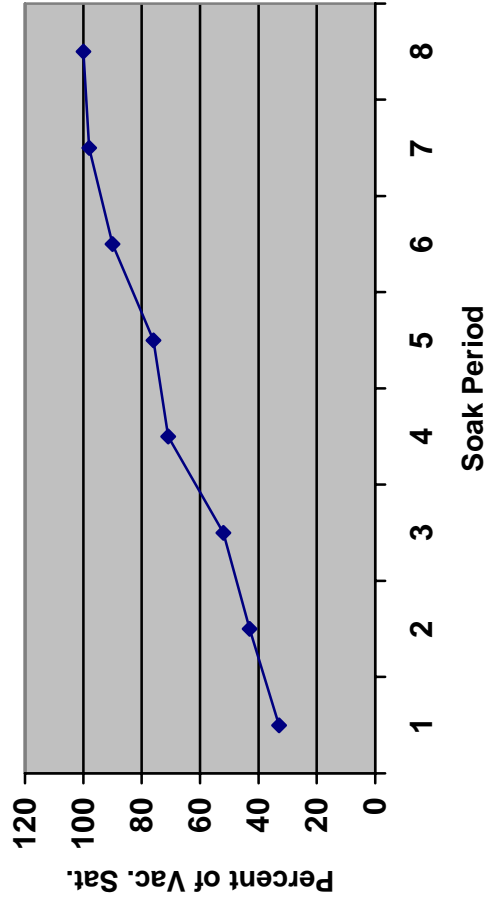
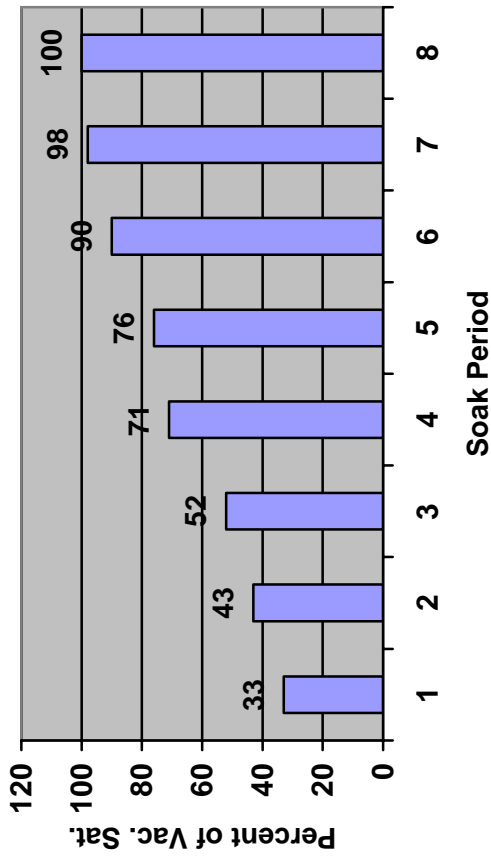


Soak Period		Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	1.18	78
2	7 Day	1.29	85
3	30 Day	1.37	91
4	90 Day	1.41	94
5	180 Day	1.45	96
6	1 Year	1.48	98
7	3 Year	1.52	101
8	Vac. Sat.	1.51	100

**Task 1: Absorption Results, American Agg. (Milford) – ASN: 63-97**

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	1-26-05	1-27-05	2085.0	2058.8	1.27	1952.9	1929.5	1.21	1.24
2	24 hr.	1-26-05	1-27-05	2007.9	1988.1	1.00	2024.5	2002.3	1.11	1.05
3	24 hr.	1-26-05	1-27-05	2051.7	2027.7	1.18	1989.1	1964.8	1.24	1.21
4	24 hr.	1-26-05	1-27-05	2169.5	2142.8	1.25	1863.3	1840.7	1.23	1.24
5	24 hr.	1-26-05	1-27-05	2020.2	1998.1	1.11	2016.1	1992.7	1.17	1.14
<b>Avg.</b>										<b>1.18</b>
6	7 Day	1-26-05	2-2-05	1953.9	1927.8	1.35	2088.6	2060.9	1.34	1.35
7	7 Day	1-26-05	2-2-05	1961.6	1937.0	1.27	2074.9	2050.3	1.20	1.23
8	7 Day	1-26-05	2-2-05	2042.0	2014.8	1.35	2000.8	1974.2	1.35	1.35
9	7 Day	1-26-05	2-2-05	2028.3	2003.6	1.23	2005.6	1982.1	1.19	1.21
10	7 Day	1-26-05	2-2-05	1998.7	1972.6	1.32	2043.3	2017.8	1.26	1.29
<b>Avg.</b>										<b>1.29</b>
11	30 Day	1-26-05	2-25-05	1927.8	1900.3	1.45	2117.8	2090.6	1.30	1.37
12	30 Day	1-26-05	2-25-05	1967.6	1941.1	1.37	2079.2	2051.6	1.35	1.36
13	30 Day	1-26-05	2-25-05	1939.8	1912.7	1.42	2104.3	2073.5	1.49	1.45
14	30 Day	1-26-05	2-25-05	1937.4	1912.2	1.32	2097.7	2071.8	1.25	1.28
15	30 Day	1-26-05	2-25-05	2033.1	2004.9	1.41	2013.1	1986.2	1.35	1.38
<b>Avg.</b>										<b>1.37</b>
16	90 Day	1-26-05	4-26-05	1961.3	1933.6	1.43	2073.4	2048.4	1.22	1.33
17	90 Day	1-26-05	4-26-05	1989.1	1964.3	1.26	2052.2	2022.4	1.47	1.37
18	90 Day	1-26-05	4-26-05	2065.7	2036.4	1.44	1989.6	1963.0	1.36	1.40
19	90 Day	1-26-05	4-26-05	1955.5	1927.4	1.46	2084.2	2057.6	1.29	1.38
20	90 Day	1-26-05	4-26-05	1987.4	1955.8	1.62	2062.4	2030.6	1.57	1.59
<b>Avg.</b>										<b>1.41</b>
21	180 Day	1-26-05	7-25-05	2069.2	2042.4	1.31	1970.7	1942.7	1.44	1.38
22	180 Day	1-26-05	7-25-05	1977.1	1948.0	1.49	2070.0	2040.2	1.46	1.48
23	180 Day	1-26-05	7-25-05	2078.9	2046.6	1.58	1975.4	1945.2	1.55	1.57
24	180 Day	1-26-05	7-25-05	1979.0	1951.6	1.40	2067.9	2040.0	1.37	1.39
25	180 Day	1-26-05	7-25-05	1947.3	1919.1	1.47	2099.0	2070.3	1.39	1.43
<b>Avg.</b>										<b>1.45</b>
26	1 Year	1-26-05	1-26-06	2023.0	1992.6	1.53	2023.3	1995.3	1.40	1.46
27	1 Year	1-26-05	1-26-06	1977.5	1947.5	1.54	2067.2	2038.0	1.43	1.49
28	1 Year	1-26-05	1-26-06	2053.2	2024.3	1.43	2004.2	1972.9	1.59	1.51
29	1 Year	1-26-05	1-26-06	2028.9	2002.0	1.34	2015.8	1985.5	1.53	1.43
30	1 Year	1-26-05	1-26-06	2019.7	1987.5	1.62	2018.8	1990.5	1.42	1.52
<b>Avg.</b>										<b>1.48</b>
31	3 Year	1-26-05	1-26-08	2025.4	1995.6	1.49	2021.3	1992.9	1.43	1.46
32	3 Year	1-26-05	1-26-08	2000.6	1969.7	1.57	2045.5	2015.3	1.50	1.53
33	3 Year	1-26-05	1-26-08	2087.7	2057.1	1.49	1963.3	1933.3	1.55	1.52
34	3 Year	1-26-05	1-26-08	1986.7	1957.8	1.48	2061.9	2028.1	1.67	1.57
35	3 Year	1-26-05	1-26-08	2005.8	1976.9	1.46	2044.7	2014.0	1.52	1.49
<b>Avg.</b>										<b>1.52</b>
36	Vac Sat.	2-22-05	2-23-05	1997.3	1969.9	1.39	2048.3	2018.4	1.48	1.44
37	Vac Sat.	2-22-05	2-23-05	2069.2	2038.1	1.53	1981.7	1951.7	1.54	1.53
38	Vac Sat.	2-22-05	2-23-05	1959.3	1931.6	1.43	2088.0	2057.9	1.46	1.45
39	Vac Sat.	2-22-05	2-23-05	1922.2	1962.6	1.51	2062.3	2028.6	1.66	1.58
40	Vac Sat.	2-22-05	2-23-05	1932.5	1903.0	1.55	2118.9	2087.2	1.52	1.53
<b>Avg.</b>										<b>1.51</b>

**Task 1: Absorption Results, E.C. Levy Slag (Trenton) – ASN: 82-22**

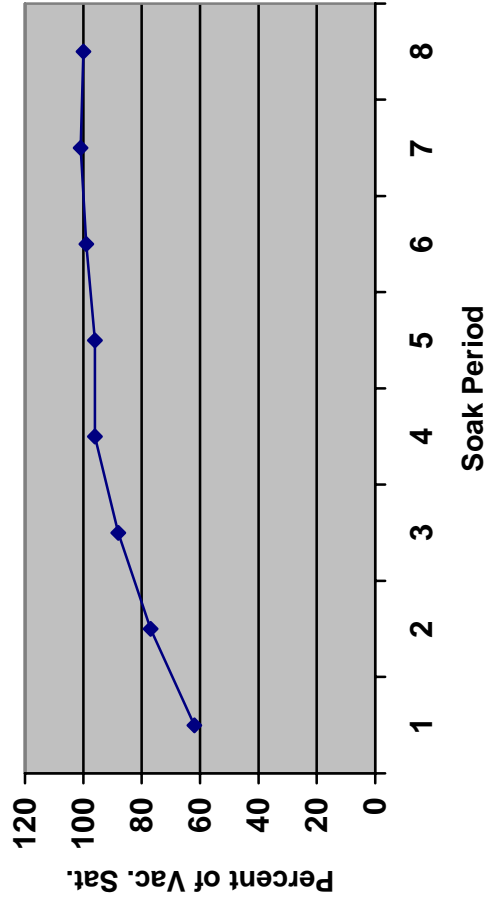
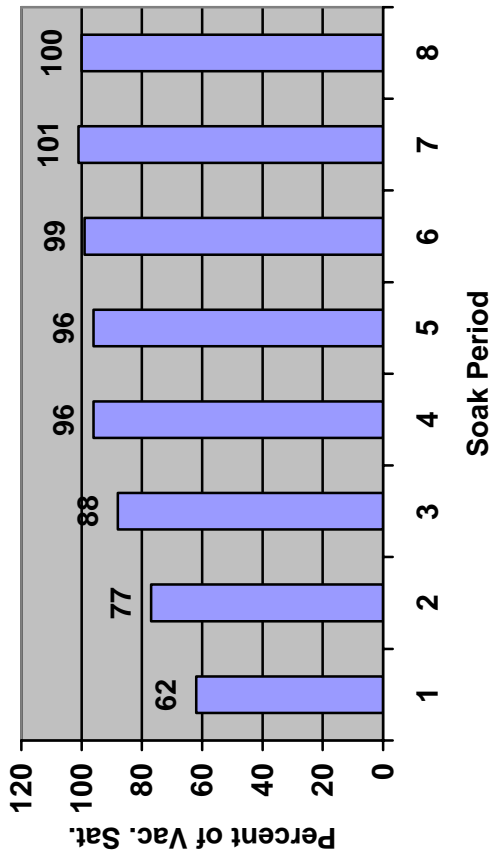


	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	2.34	33
2	7 Day	3.07	43
3	30 Day	3.70	52
4	90 Day	5.08	71
5	180 Day	5.44	76
6	1 Year	6.43	90
7	3 Year	6.98	98
8	Vac. Sat.	7.13	100

## Task 1: Absorption Results, E.C. Levy Slag (Trenton) – ASN: 82-22

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	1-31-05	2-1-05	2078.4	2031.3	2.32	1987.8	1943.0	2.31	2.31
2	24 hr.	1-31-05	2-1-05	2000.3	1954.3	2.35	2059.4	2012.8	2.32	2.33
3	24 hr.	1-31-05	2-1-05	1990.9	1945.9	2.31	2077.1	2029.6	2.34	2.33
4	24 hr.	1-31-05	2-1-05	2016.5	1970.3	2.34	2046.6	1999.5	2.36	2.35
5	24 hr.	1-31-05	2-1-05	1954.6	1907.7	2.46	2115.4	2067.1	2.34	2.40
<b>Avg.</b>										<b>2.34</b>
6	7 Day	1-31-05	2-7-05	1985.1	1926.9	3.02	2103.5	2043.0	2.96	2.99
7	7 Day	1-31-05	2-7-05	2055.4	1994.2	3.07	2040.3	1978.9	3.10	3.09
8	7 Day	1-31-05	2-7-05	1984.7	1925.0	3.10	2098.5	2034.9	3.13	3.11
9	7 Day	1-31-05	2-7-05	2071.3	2009.4	3.08	2026.4	1966.8	3.03	3.06
10	7 Day	1-31-05	2-7-05	2053.9	1992.3	3.09	2043.5	1981.8	3.11	3.10
<b>Avg.</b>										<b>3.07</b>
11	30 Day	1-31-05	3-2-05	2066.7	1991.0	3.80	2045.0	1974.0	3.60	3.70
12	30 Day	1-31-05	3-2-05	2002.5	1932.8	3.61	2085.9	2011.1	3.72	3.66
13	30 Day	1-31-05	3-2-05	2038.6	1965.3	3.73	2084.0	2011.6	3.60	3.66
14	30 Day	1-31-05	3-2-05	2067.2	1989.3	3.92	2035.0	1964.5	3.59	3.75
15	30 Day	1-31-05	3-2-05	2020.3	1948.4	3.69	2099.4	2023.0	3.78	3.73
<b>Avg.</b>										<b>3.70</b>
16	90 Day	1-31-05	5-1-05	2115.6	2010.6	5.22	2061.5	1962.0	5.07	5.15
17	90 Day	1-31-05	5-1-05	2078.5	1979.0	5.03	2088.4	1986.4	5.13	5.08
18	90 Day	1-31-05	5-1-05	2122.1	2019.4	5.09	2047.7	1948.0	5.12	5.10
19	90 Day	1-31-05	5-1-05	2017.5	1922.1	4.96	2146.8	2041.9	5.14	5.05
20	90 Day	1-31-05	5-1-05	1979.0	1885.6	4.95	2185.5	2079.2	5.11	5.03
<b>Avg.</b>										<b>5.08</b>
21	180 Day	1-31-05	7-30-05	2122.8	2016.3	5.28	2061.3	1954.5	5.46	5.37
22	180 Day	1-31-05	7-30-05	2038.8	1929.2	5.68	2135.8	2029.8	5.22	5.45
23	180 Day	1-31-05	7-30-05	2130.8	2016.1	5.69	2058.0	1954.7	5.28	5.49
24	180 Day	1-31-05	7-30-05	2111.7	2007.9	5.17	2082.1	1974.5	5.45	5.31
25	180 Day	1-31-05	7-30-05	2082.0	1973.6	5.49	2111.7	1998.8	5.65	5.57
<b>Avg.</b>										<b>5.44</b>
26	1 Year	1-31-05	1-31-06	2096.2	1973.2	6.23	2128.5	2001.1	6.37	6.30
27	1 Year	1-31-05	1-31-06	2118.7	1997.9	6.05	2114.5	1980.0	6.79	6.42
28	1 Year	1-31-05	1-31-06	2102.2	1969.9	6.72	2135.1	2008.5	6.30	6.51
29	1 Year	1-31-05	1-31-06	2134.4	2004.2	6.50	2113.7	1980.5	6.73	6.61
30	1 Year	1-31-05	1-31-06	2156.3	2027.9	6.33	2065.4	1942.6	6.32	6.33
<b>Avg.</b>										<b>6.43</b>
31	3 Year	1-31-05	1-31-08	2080.1	1941.9	7.12	2190.4	2047.8	6.96	7.04
32	3 Year	1-31-05	1-31-08	2164.7	2026.0	6.85	2094.3	1960.5	6.82	6.84
33	3 Year	1-31-05	1-31-08	2105.0	1969.5	6.88	2161.5	2020.5	6.98	6.93
34	3 Year	1-31-05	1-31-08	2189.0	2042.7	7.16	2060.4	1923.9	7.10	7.13
35	3 Year	1-31-05	1-31-08	2110.1	1969.3	7.15	2152.7	2015.5	6.81	6.98
<b>Avg.</b>										<b>6.98</b>
36	Vac Sat.	2-14--05	2-15-05	2164.0	2023.2	6.96	2090.3	1955.4	6.90	6.93
37	Vac Sat.	2-14-05	2-15-05	2161.8	2016.0	7.23	2096.5	1958.8	7.03	7.13
38	Vac Sat.	2-14-05	2-15-05	2176.1	2023.5	7.54	2091.5	1952.3	7.13	7.34
39	Vac Sat.	2-14-05	2-15-05	2189.2	2042.5	7.18	2075.4	1934.4	7.29	7.24
40	Vac Sat.	2-14-05	2-15-05	2071.1	1934.9	7.04	2183.7	2041.6	6.96	7.00
<b>Avg.</b>										<b>7.13</b>

**Task 1: Absorption Results, France Stone (Silica) – ASN: 93-3**



Soak Period		Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	2.42	62
2	7 Day	2.99	77
3	30 Day	3.39	88
4	90 Day	3.71	96
5	180 Day	3.74	96
6	1 Year	3.82	99
7	3 Year	3.92	101
8	Vac. Sat.	3.87	100

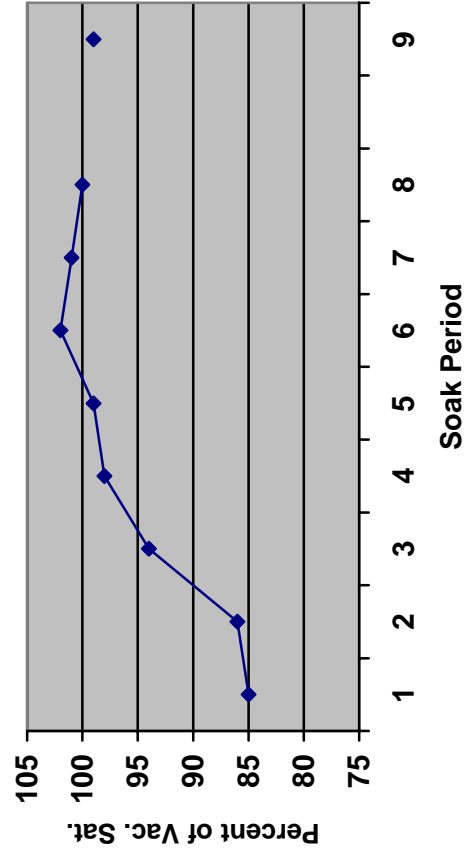
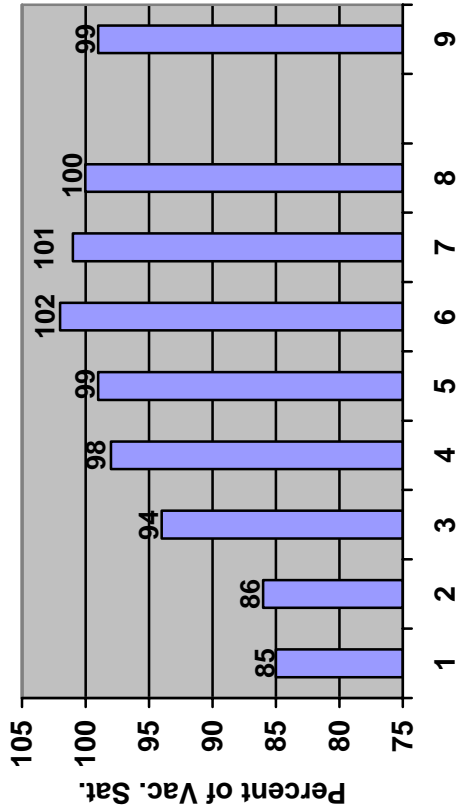


### Task 1: Absorption Results, France Stone (Silica) – ASN: 93-3

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	1-24-05	1-25-05	2050.9	2004.8	2.30	2020.6	1974.5	2.33	2.32
2	24 hr.	1-24-05	1-25-05	2030.2	1982.9	2.39	1988.7	1940.5	2.48	2.43
3	24 hr.	1-24-05	1-25-05	1949.9	1903.1	2.46	2127.5	2077.8	2.39	2.43
4	24 hr.	1-24-05	1-25-05	2049.7	2001.3	2.42	2025.3	1978.3	2.38	2.40
5	24 hr.	1-24-05	1-25-05	2077.2	2026.8	2.49	1992.8	1943.7	2.53	2.51
<b>Avg.</b>										<b>2.42</b>
6	7 Day	1-24-05	1-31-05	2041.5	1984.0	2.90	2034.9	1973.7	3.10	3.00
7	7 Day	1-24-05	1-31-05	2030.6	1972.1	2.97	2058.8	2000.9	2.89	2.93
8	7 Day	1-24-05	1-31-05	2072.6	2013.1	2.96	2009.8	1951.3	3.00	2.98
9	7 Day	1-24-05	1-31-05	2103.5	2042.6	2.98	1977.4	1918.2	3.09	3.03
10	7 Day	1-24-05	1-31-05	2024.8	1967.7	2.90	2059.2	1997.3	3.10	3.00
<b>Avg.</b>										<b>2.99</b>
11	30 Day	1-24-05	2-23-05	2116.5	2047.7	3.36	2004.2	1935.3	3.56	3.46
12	30 Day	1-24-05	2-23-05	2043.2	1976.3	3.39	2058.5	1996.0	3.13	3.26
13	30 Day	1-24-05	2-23-05	2057.7	1989.0	3.45	2033.6	1967.6	3.35	3.40
14	30 Day	1-24-05	2-23-05	2084.0	2015.1	3.42	2018.7	1950.4	3.50	3.46
15	30 Day	1-24-05	2-23-05	2129.6	2062.7	3.24	1962.1	1895.3	3.52	3.38
<b>Avg.</b>										<b>3.39</b>
16	90 Day	1-24-05	4-24-05	2026.7	1953.8	3.73	2081.3	2008.7	3.61	3.67
17	90 Day	1-24-05	4-24-05	2072.9	1999.0	3.70	2043.4	1973.1	3.56	3.63
18	90 Day	1-24-05	4-24-05	2134.6	2056.4	3.80	1990.9	1919.2	3.74	3.77
19	90 Day	1-24-05	4-24-05	2045.1	1970.5	3.79	2069.3	1994.5	3.75	3.77
20	90 Day	1-24-05	4-24-05	2111.4	2037.3	3.64	1991.7	1920.0	3.73	3.69
<b>Avg.</b>										<b>3.71</b>
21	180 Day	1-24-05	7-23-05	2098.8	2024.0	3.70	2034.4	1961.9	3.70	3.70
22	180 Day	1-24-05	7-23-05	2061.4	1985.6	3.82	2067.7	1994.2	3.69	3.75
23	180 Day	1-24-05	7-23-05	2093.3	2017.8	3.74	2043.0	1969.9	3.71	3.73
24	180 Day	1-24-05	7-23-05	2076.0	1999.5	3.83	2059.8	1982.2	3.91	3.87
25	180 Day	1-24-05	7-23-05	2015.0	1943.0	3.71	2084.0	2011.0	3.63	3.67
<b>Avg.</b>										<b>3.74</b>
26	1 Year	1-24-05	1-24-06	2098.7	2020.7	3.86	2031.5	1956.0	3.86	3.86
27	1 Year	1-24-05	1-24-06	2044.4	1970.8	3.73	2084.6	2006.8	3.88	3.81
28	1 Year	1-24-05	1-24-06	2068.2	1992.7	3.79	2048.8	1973.2	3.83	3.81
29	1 Year	1-24-05	1-24-06	2084.4	2009.9	3.71	2046.7	1974.2	3.67	3.69
30	1 Year	1-24-05	1-24-06	2155.9	2075.0	3.90	1974.9	1900.2	3.93	3.92
<b>Avg.</b>										<b>3.82</b>
31	3 Year	1-24-05	1-24-08	2163.2	2081.7	3.92	1963.3	1892.4	3.75	3.83
32	3 Year	1-24-05	1-24-08	1993.9	1920.8	3.81	2139.4	2056.8	4.02	3.91
33	3 Year	1-24-05	1-24-08	2139.5	2055.1	4.11	2004.1	1928.0	3.95	4.03
34	3 Year	1-24-05	1-24-08	1924.9	1852.4	3.91	2213.8	2129.2	3.97	3.94
35	3 Year	1-24-05	1-24-08	2056.4	1978.6	3.93	2073.7	1996.5	3.87	3.90
<b>Avg.</b>										<b>3.92</b>
36	Vac Sat.	2-8-05	2-9-05	2175.7	2096.0	3.80	1961.8	1887.8	3.92	3.86
37	Vac Sat.	2-8-05	2-9-05	2051.3	1976.8	3.77	2088.0	2010.6	3.85	3.81
38	Vac Sat.	2-8-05	2-9-05	2061.9	1983.4	3.96	2081.6	2005.8	3.78	3.87
39	Vac Sat.	2-8-05	2-9-05	2056.5	1977.6	3.99	2066.2	1991.3	3.76	3.88
40	Vac Sat.	2-8-05	2-9-05	2107.3	2025.6	4.03	2026.2	1950.7	3.87	3.95
<b>Avg.</b>										<b>3.87</b>

## Appendix D: Long-Term Soaking of Coarse Aggregates Sampled from Above and Below Static Water Table

**Task 2: Absorption Results, Grand Rapids Gravel #8 ASN: 41-16 (Above Water Table)**

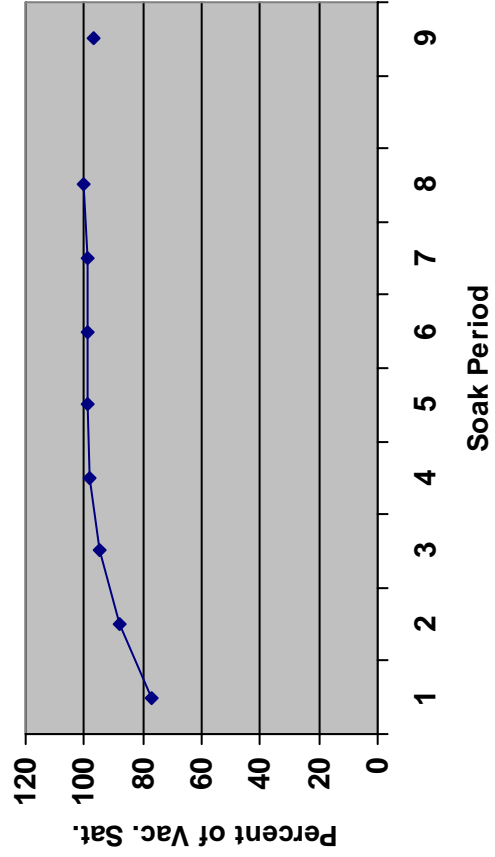
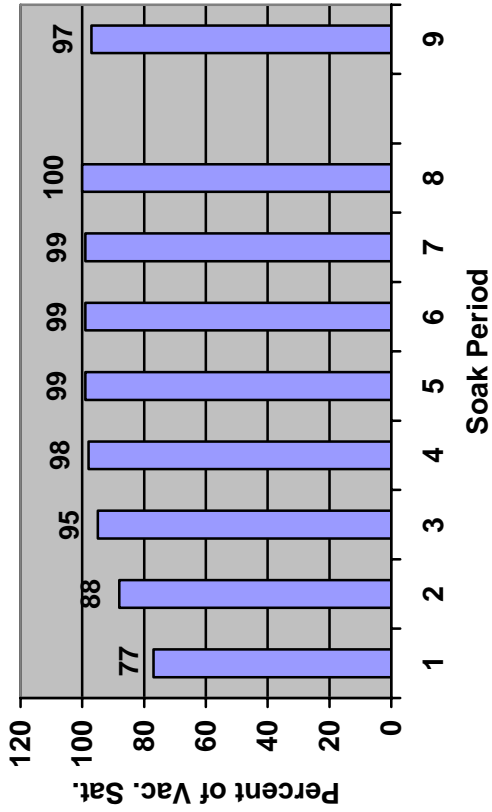


Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	1.18	85
2	1.20	86
3	1.30	94
4	1.36	98
5	1.38	99
6	1.41	102
7	1.40	101
8	1.39	100
9	1.38	99

**Task 2: Absorption Results, Grand Rapids Gravel #8  
ASN: 41-16 (Above Water Table)**

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	6-27-05	6-28-05	1947.0	1925.2	1.13	2095.1	2074.0	1.02	1.07
2	24 hr.	6-27-05	6-28-05	1956.3	1935.7	1.06	2097.0	2071.2	1.25	1.15
3	24 hr.	6-27-05	6-28-05	2083.4	2058.3	1.22	1966.0	1940.0	1.34	1.28
4	24 hr.	6-27-05	6-28-05	2029.0	2004.4	1.23	2011.2	1989.9	1.07	1.15
5	24 hr.	6-27-05	6-28-05	1967.6	1941.8	1.33	2067.1	2042.8	1.19	1.26
<b>Avg.</b>										<b>1.18</b>
6	7 Day	6-29-05	7-6-05	1927.4	1905.3	1.16	2114.8	2090.5	1.16	1.16
7	7 Day	6-29-05	7-6-05	1917.8	1896.0	1.15	2128.4	2102.6	1.23	1.19
8	7 Day	6-29-05	7-6-05	1957.7	1933.5	1.25	2095.0	2068.7	1.27	1.26
9	7 Day	6-29-05	7-6-05	1980.1	1956.5	1.21	2055.9	2032.1	1.17	1.19
10	7 Day	6-29-05	7-6-05	2012.3	1989.5	1.15	2040.6	2016.2	1.21	1.18
<b>Avg.</b>										<b>1.20</b>
11	30 Day	6-27-05	7-27-05	1961.9	1935.7	1.35	2087.2	2063.6	1.14	1.25
12	30 Day	6-27-05	7-27-05	2066.5	2040.0	1.30	1982.5	1955.4	1.39	1.34
13	30 Day	6-27-05	7-27-05	2029.3	2004.3	1.25	2026.6	2000.3	1.31	1.28
14	30 Day	6-27-05	7-27-05	2040.2	2011.9	1.41	2008.7	1983.0	1.30	1.35
15	30 Day	6-27-05	7-27-05	2022.0	1996.7	1.27	2027.0	2000.3	1.33	1.30
<b>Avg.</b>										<b>1.30</b>
16	90 Day	6-27-05	9-25-05	1915.1	1890.9	1.28	2132.2	2105.7	1.26	1.27
17	90 Day	6-27-05	9-25-05	2022.1	1994.5	1.38	2035.6	2004.2	1.57	1.48
18	90 Day	6-27-05	9-25-05	1986.8	1958.3	1.46	2054.7	2027.3	1.35	1.40
19	90 Day	6-27-05	9-25-05	1985.9	1961.2	1.26	2057.8	2031.8	1.28	1.27
20	90 Day	6-27-05	9-25-05	1967.1	1939.6	1.42	2087.8	2059.9	1.35	1.39
<b>Avg.</b>										<b>1.36</b>
21	180 Day	6-27-05	12-24-05	1990.7	1965.0	1.31	2067.8	2038.7	1.43	1.37
22	180 Day	6-27-05	12-24-05	2005.0	1977.3	1.40	2046.0	2019.2	1.33	1.36
23	180 Day	6-27-05	12-24-05	1980.9	1955.0	1.32	2068.1	2039.1	1.42	1.37
24	180 Day	6-27-05	12-24-05	2021.3	1992.5	1.45	2026.7	1999.1	1.38	1.41
25	180 Day	6-27-05	12-24-05	2068.1	2040.1	1.37	1981.8	1954.8	1.38	1.38
<b>Avg.</b>										<b>1.38</b>
26	1 Year	6-27-05	6-27-06	2017.5	1988.5	1.46	2038.1	2011.0	1.35	1.40
27	1 Year	6-27-05	6-27-06	1997.9	1969.0	1.47	2052.3	2024.6	1.37	1.42
28	1 Year	6-27-05	6-27-06	1953.6	1925.6	1.45	2091.3	2062.4	1.40	1.43
29	1 Year	6-27-05	6-27-06	1960.4	1935.3	1.30	2063.1	2033.1	1.48	1.39
30	1 Year	6-27-05	6-27-06	1960.0	1933.1	1.39	2111.5	2080.9	1.47	1.43
<b>Avg.</b>										<b>1.41</b>
31	3 Year	6-27-05	6-27-08	2034.7	2006.7	1.40	2009.7	1981.6	1.42	1.41
32	3 Year	6-27-05	6-27-08	1992.1	1963.4	1.46	2055.8	2027.7	1.39	1.42
33	3 Year	6-27-05	6-27-08	1966.1	1940.2	1.33	2081.4	2053.2	1.37	1.35
34	3 Year	6-27-05	6-27-08	2029.8	2000.5	1.46	2008.4	1981.9	1.34	1.40
35	3 Year	6-27-05	6-27-06	1877.8	1852.0	1.39	2166.6	2136.3	1.42	1.41
<b>Avg.</b>										<b>1.40</b>
36	Vac Sat.	7-11-05	7-12-05	1978.5	1944.7	1.74	2066.0	2039.8	1.28	1.51
37	Vac Sat.	7-11-05	7-12-05	1994.3	1969.0	1.28	2061.0	2034.7	1.29	1.29
38	Vac Sat.	7-11-05	7-12-05	1994.0	1965.3	1.46	2068.1	2037.4	1.51	1.48
39	Vac Sat.	7-11-05	7-12-05	1913.7	1890.6	1.22	2132.0	2103.5	1.35	1.29
40	Vac Sat.	7-11-05	7-12-05	2012.6	1986.0	1.34	2027.8	1999.5	1.42	1.38
<b>Avg.</b>										<b>1.39</b>

**Task 2: Absorption Results, Milford #2 – ASN: 63-48 (Above Water Table)**

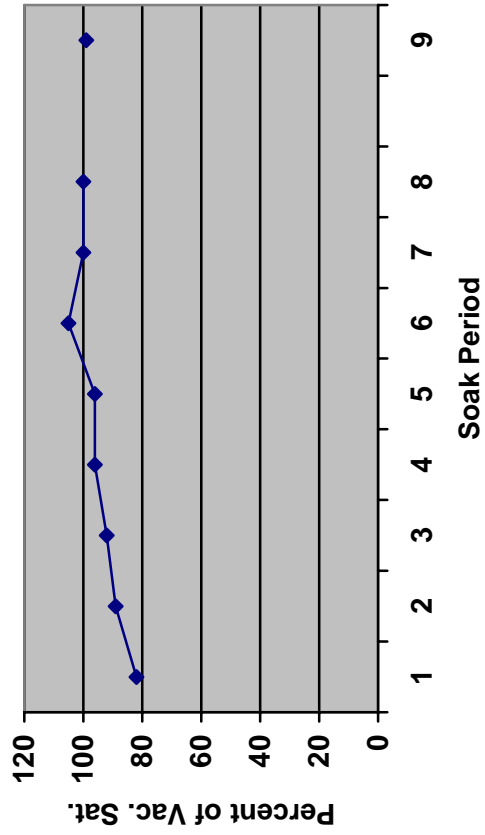
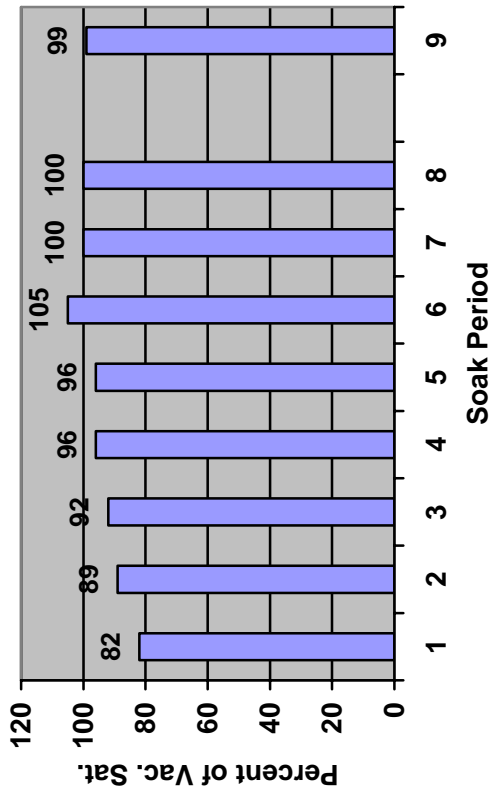


	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	1.29	77
2	7 Day	1.46	88
3	30 Day	1.57	95
4	90 Day	1.62	98
5	180 Day	1.65	99
6	1 Year	1.64	99
7	3 Year	1.64	99
8	Vac Sat.	1.66	100
9	As Sampled Absorption	1.61	97

**Task 2: Absorption Results, Milford #2 ASN: 63-48 (Above Water Table)**

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	6-20-05	6-21-05	1906.0	1881.6	1.30	2121.2	2096.0	1.20	1.25
2	24 hr.	6-20-05	6-21-05	2078.0	2053.5	1.19	1943.3	1917.8	1.33	1.26
3	24 hr.	6-20-05	6-21-05	1978.9	1952.3	1.36	2047.7	2020.1	1.37	1.36
4	24 hr.	6-20-05	6-21-05	2073.7	2049.2	1.20	1961.0	1935.2	1.33	1.26
5	24 hr.	6-20-05	6-21-05	2051.6	2026.4	1.24	1978.8	1952.5	1.35	1.30
<b>Avg.</b>										<b>1.29</b>
6	7 Day	6-20-05	6-27-05	2022.1	1995.2	1.35	2009.6	1981.3	1.43	1.39
7	7 Day	6-20-05	6-27-05	2034.5	2007.0	1.37	2016.6	1984.1	1.64	1.50
8	7 Day	6-20-05	6-27-05	2024.4	1992.6	1.60	2026.5	1995.3	1.56	1.58
9	7 Day	6-20-05	6-27-05	2058.1	2029.5	1.41	1968.4	1938.9	1.52	1.47
10	7 Day	6-20-05	6-27-05	2060.3	2033.1	1.34	1982.5	1954.9	1.41	1.37
<b>Avg.</b>										<b>1.46</b>
11	30 Day	6-20-05	7-20-05	1987.0	1955.6	1.61	2065.2	2031.8	1.64	1.62
12	30 Day	6-20-05	7-20-05	2051.2	2019.5	1.57	2004.8	1973.7	1.58	1.57
13	30 Day	6-20-05	7-20-05	1945.4	1913.7	1.66	2104.0	2075.3	1.38	1.52
14	30 Day	6-20-05	7-20-05	2048.3	2016.4	1.58	2001.8	1972.8	1.47	1.53
15	30 Day	6-20-05	7-20-05	2045.8	2009.4	1.81	2012.2	1983.7	1.44	1.62
<b>Avg.</b>										<b>1.57</b>
16	90 Day	6-20-05	9-18-05	2085.4	2049.0	1.78	1971.2	1938.0	1.71	1.74
17	90 Day	6-20-05	9-18-05	1955.7	1922.8	1.71	2104.0	2073.5	1.47	1.59
18	90 Day	6-20-05	9-18-05	2029.3	1996.2	1.66	2014.3	1987.6	1.34	1.50
19	90 Day	6-20-05	9-18-05	2076.4	2041.5	1.71	1985.1	1955.0	1.54	1.62
20	90 Day	6-20-05	9-18-05	1992.8	1957.8	1.79	2038.1	2008.4	1.48	1.63
<b>Avg.</b>										<b>1.62</b>
21	180 Day	6-20-05	12-17-05	2017.0	1981.5	1.79	2034.5	2000.7	1.69	1.74
22	180 Day	6-20-05	12-17-05	1993.6	1958.9	1.77	2069.4	2038.6	1.51	1.64
23	180 Day	6-20-05	12-17-05	1997.2	1963.9	1.70	2045.3	2012.9	1.61	1.65
24	180 Day	6-20-05	12-17-05	1977.5	1946.7	1.58	2082.8	2046.6	1.77	1.68
25	180 Day	6-20-05	12-17-05	2049.0	2019.7	1.45	2003.5	1970.5	1.67	1.56
<b>Avg.</b>										<b>1.65</b>
26	1 Year	6-20-05	6-20-06	2016.5	1986.4	1.52	2039.3	2006.6	1.63	1.57
27	1 Year	6-20-05	6-20-06	2097.9	2061.1	1.79	1962.1	1931.7	1.57	1.68
28	1 Year	6-20-05	6-20-06	2027.8	1994.4	1.67	2021.9	1990.9	1.56	1.62
29	1 Year	6-20-05	6-20-06	2020.3	1990.2	1.51	2036.9	2005.0	1.59	1.55
30	1 Year	6-20-05	6-20-06	2102.3	2068.7	1.62	1955.7	1919.5	1.89	1.76
<b>Avg.</b>										<b>1.64</b>
31	3 Year	6-20-05	6-20-08	2007.9	1975.9	1.62	2045.9	2015.3	1.52	1.57
32	3 Year	6-20-05	6-20-08	1953.1	1918.5	1.80	2082.9	2050.0	1.60	1.70
33	3 Year	6-20-05	6-20-08	1936.7	1907.4	1.54	2100.9	2066.1	1.68	1.61
34	3 Year	6-20-05	6-20-08	1996.6	1964.8	1.62	2051.4	2019.8	1.56	1.59
35	3 Year	6-20-05	6-20-08	2029.9	1994.6	1.77	2013.0	1980.7	1.63	1.70
<b>Avg.</b>										<b>1.64</b>
36	Vac Sat.	6-28-05	6-29-05	2032.0	1999.6	1.62	2020.1	1989.9	1.52	1.57
37	Vac Sat.	6-28-05	6-29-05	2037.0	2003.2	1.69	2017.6	1982.1	1.79	1.74
38	Vac Sat.	6-28-05	6-29-05	2047.3	2013.3	1.69	2022.7	1983.5	1.98	1.83
39	Vac Sat.	6-28-05	6-29-05	2071.1	2039.7	1.54	1990.6	1956.1	1.76	1.65
40	Vac Sat.	6-28-05	6-29-05	2070.3	2038.6	1.55	1985.2	1956.2	1.48	1.52
<b>Avg.</b>										<b>1.66</b>

**Task 2: Absorption Results, Grand Rapids Gravel #8 ASN: 41-16 (Below Water Table)**

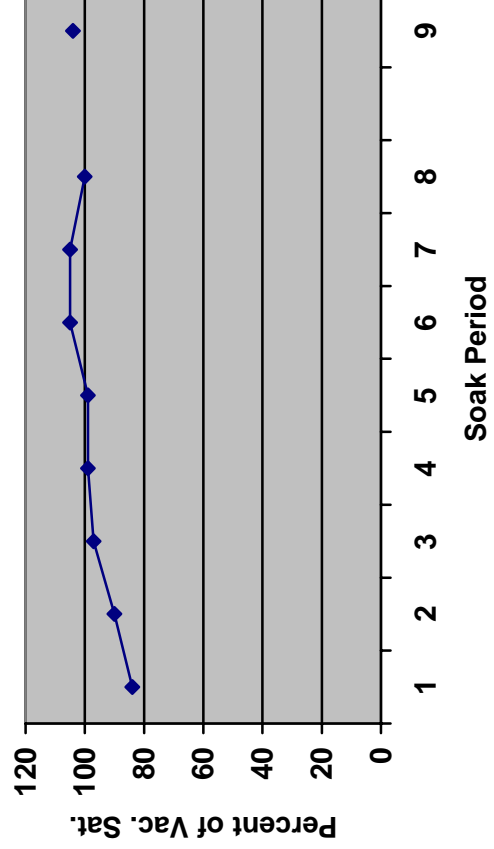
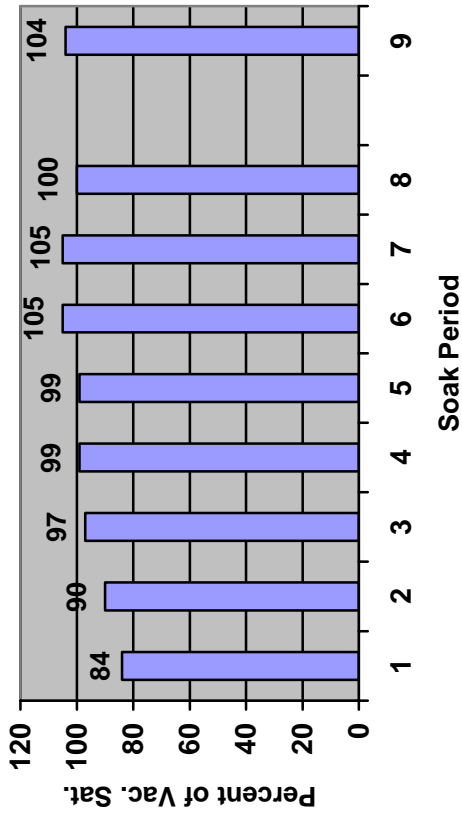


	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	1.16	82
2	7 Day	1.26	89
3	30 Day	1.30	92
4	90 Day	1.36	96
5	180 Day	1.36	96
6	1 Year	1.49	105
7	3 Year	1.41	100
8	Vac. Sat.	1.41	100
9	Stream Wet	1.39	99

**Task 2: Absorption Results, Grand Rapids Gravel #8  
ASN: 41-16 (Below Water Table)**

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	2-15-05	2-16-05	1980.7	1957.9	1.16	2035.4	2014.6	1.03	1.10
2	24 hr.	2-15-05	2-16-05	1877.5	1856.4	1.14	2114.3	2091.4	1.09	1.12
3	24 hr.	2-15-05	2-16-05	1989.9	1967.2	1.15	1983.5	1963.0	1.04	1.10
4	24 hr.	2-15-05	2-16-05	1997.7	1975.5	1.12	2018.2	1997.8	1.02	1.07
5	24 hr.	2-15-05	2-16-05	2081.8	2060.4	1.04	1965.7	1944.0	1.12	1.08
<b>Avg.</b>										<b>1.09</b>
6	7 Day	2-15-05	2-22-05	2087.8	2062.4	1.23	1966.6	1945.6	1.08	1.16
7	7 Day	2-15-05	2-22-05	2005.2	1983.1	1.11	2034.6	2013.6	1.04	1.08
8	7 Day	2-15-05	2-22-05	1998.4	1971.9	1.34	2037.0	2013.8	1.15	1.25
9	7 Day	2-15-05	2-22-05	2019.3	1995.5	1.19	2030.7	2006.4	1.21	1.20
10	7 Day	2-15-05	2-22-05	2011.9	1989.2	1.14	2030.2	2005.9	1.21	1.18
<b>Avg.</b>										<b>1.17</b>
11	30 Day	2-15-05	3-17-05	2029.1	2004.5	1.23	2008.3	1982.2	1.32	1.27
12	30 Day	2-15-05	3-17-05	2009.3	1984.9	1.23	2036.7	2009.6	1.35	1.29
13	30 Day	2-15-05	3-17-05	2009.0	1984.5	1.23	2041.8	2017.1	1.22	1.23
14	30 Day	2-15-05	3-17-05	2076.2	2051.0	1.23	1971.7	1949.3	1.15	1.19
15	30 Day	2-15-05	3-17-05	2009.8	1984.4	1.28	2046.6	2018.7	1.38	1.33
<b>Avg.</b>										<b>1.26</b>
16	90 Day	2-15-05	5-16-05	1977.7	1951.2	1.36	2081.0	2053.7	1.33	1.34
17	90 Day	2-15-05	5-16-05	1982.9	1958.9	1.23	2061.5	2036.3	1.24	1.23
18	90 Day	2-15-05	5-16-05	1994.5	1970.0	1.24	2049.2	2025.4	1.18	1.21
19	90 Day	2-15-05	5-16-05	2045.9	2020.7	1.25	1991.2	1966.6	1.25	1.25
20	90 Day	2-15-05	5-16-05	2083.1	2055.1	1.36	1965.0	1938.4	1.37	1.37
<b>Avg.</b>										<b>1.28</b>
21	180 Day	2-15-05	8-14-05	2021.6	1996.0	1.28	2017.4	1995.2	1.11	1.20
22	180 Day	2-15-05	8-14-05	1969.7	1944.6	1.29	2082.7	2056.3	1.28	1.29
23	180 Day	2-15-05	8-14-05	2005.6	1980.2	1.28	2044.5	2021.0	1.16	1.22
24	180 Day	2-15-05	8-14-05	2043.5	2016.2	1.35	2002.5	1979.7	1.15	1.25
25	180 Day	2-15-05	8-14-05	2015.0	1986.2	1.45	2041.3	2011.5	1.48	1.47
<b>Avg.</b>										<b>1.29</b>
26	1 Year	2-15-05	2-15-06	1978.8	1951.7	1.39	2075.0	2051.4	1.15	1.27
27	1 Year	2-15-05	2-15-06	2005.8	1977.6	1.43	2044.4	2017.2	1.35	1.39
28	1 Year	2-15-05	2-15-06	1994.4	1967.3	1.38	2041.2	2013.0	1.40	1.39
29	1 Year	2-15-05	2-15-06	2044.4	2017.3	1.34	1997.8	1967.3	1.55	1.45
30	1 Year	2-15-05	2-15-06	1979.7	1953.9	1.32	2058.3	2032.1	1.29	1.30
<b>Avg.</b>										<b>1.36</b>
31	3 Year	2-15-05	2-15-08	1996.3	1967.4	1.47	2049.9	2021.7	1.39	1.43
32	3 Year	2-15-05	2-15-08	1622.5	1898.9	1.24	2121.8	2092.3	1.41	1.33
33	3 Year	2-15-05	2-15-08	1980.2	1951.0	1.50	2060.6	2031.4	1.44	1.47
34	3 Year	2-15-05	2-15-08	2032.0	2004.6	1.37	2016.2	1985.5	1.55	1.46
35	3 Year	2-15-05	2-15-08	2014.7	1988.6	1.31	2030.2	2001.8	1.42	1.37
<b>Avg.</b>										<b>1.41</b>
36	Vac Sat.	2-23-05	2-24-05	2053.1	2028.1	1.23	1998.3	1971.4	1.36	1.30
37	Vac Sat.	2-23-05	2-24-05	2024.3	1999.1	1.26	2031.5	2007.0	1.22	1.24
38	Vac Sat.	2-23-05	2-24-05	2080.3	2053.0	1.33	1973.6	1947.3	1.35	1.34
39	Vac Sat.	2-23-05	2-24-05	2073.0	2046.9	1.28	1988.3	1962.6	1.31	1.29
40	Vac Sat.	2-23-05	2-24-05	2018.0	1991.5	1.33	2039.6	2013.4	1.30	1.32
<b>Avg.</b>										<b>1.30</b>

**Task 2: Absorption Results, Milford #2 – ASN: 63-48 (Below Water Table)**



	Soak Period	Ave. Abs. (%)	% of Vac. Sat.
1	24 Hr.	1.09	84
2	7 Day	1.17	90
3	30 Day	1.26	97
4	90 Day	1.28	99
5	180 Day	1.29	99
6	1 Year	1.36	105
7	3 Year	1.37	105
8	Vac. Sat.	1.30	100
9	Stream Wet	1.35	104



**Task 2: Absorption Results, Milford #2 ASN: 63-48 (Below Water Table)**

Sample #	Soak Period	Soak Date	Test Date	SSd 1 (gms)	Dry 1 (gms)	Abs. 1 (%)	SSd 2 (gms)	Dry 2 (gms)	Abs. 2 (%)	Avg. Abs. %
1	24 hr.	2-15-05	2-16-05	1980.7	1957.9	1.16	2035.4	2014.6	1.03	1.10
2	24 hr.	2-15-05	2-16-05	1877.5	1856.4	1.14	2114.3	2091.4	1.09	1.12
3	24 hr.	2-15-05	2-16-05	1989.9	1967.2	1.15	1983.5	1963.0	1.04	1.10
4	24 hr.	2-15-05	2-16-05	1997.7	1975.5	1.12	2018.2	1997.8	1.02	1.07
5	24 hr.	2-15-05	2-16-05	2081.8	2060.4	1.04	1965.7	1944.0	1.12	1.08
<b>Avg.</b>										<b>1.09</b>
6	7 Day	2-15-05	2-22-05	2087.8	2062.4	1.23	1966.6	1945.6	1.08	1.16
7	7 Day	2-15-05	2-22-05	2005.2	1983.1	1.11	2034.6	2013.6	1.04	1.08
8	7 Day	2-15-05	2-22-05	1998.4	1971.9	1.34	2037.0	2013.8	1.15	1.25
9	7 Day	2-15-05	2-22-05	2019.3	1995.5	1.19	2030.7	2006.4	1.21	1.20
10	7 Day	2-15-05	2-22-05	2011.9	1989.2	1.14	2030.2	2005.9	1.21	1.18
<b>Avg.</b>										<b>1.17</b>
11	30 Day	2-15-05	3-17-05	2029.1	2004.5	1.23	2008.3	1982.2	1.32	1.27
12	30 Day	2-15-05	3-17-05	2009.3	1984.9	1.23	2036.7	2009.6	1.35	1.29
13	30 Day	2-15-05	3-17-05	2009.0	1984.5	1.23	2041.8	2017.1	1.22	1.23
14	30 Day	2-15-05	3-17-05	2076.2	2051.0	1.23	1971.7	1949.3	1.15	1.19
15	30 Day	2-15-05	3-17-05	2009.8	1984.4	1.28	2046.6	2018.7	1.38	1.33
<b>Avg.</b>										<b>1.26</b>
16	90 Day	2-15-05	5-16-05	1977.7	1951.2	1.36	2081.0	2053.7	1.33	1.34
17	90 Day	2-15-05	5-16-05	1982.9	1958.9	1.23	2061.5	2036.3	1.24	1.23
18	90 Day	2-15-05	5-16-05	1994.5	1970.0	1.24	2049.2	2025.4	1.18	1.21
19	90 Day	2-15-05	5-16-05	2045.9	2020.7	1.25	1991.2	1966.6	1.25	1.25
20	90 Day	2-15-05	5-16-05	2083.1	2055.1	1.36	1965.0	1938.4	1.37	1.37
<b>Avg.</b>										<b>1.28</b>
21	180 Day	2-15-05	8-14-05	2021.6	1996.0	1.28	2017.4	1995.2	1.11	1.20
22	180 Day	2-15-05	8-14-05	1969.7	1944.6	1.29	2082.7	2056.3	1.28	1.29
23	180 Day	2-15-05	8-14-05	2005.6	1980.2	1.28	2044.5	2021.0	1.16	1.22
24	180 Day	2-15-05	8-14-05	2043.5	2016.2	1.35	2002.5	1979.7	1.15	1.25
25	180 Day	2-15-05	8-14-05	2015.0	1986.2	1.45	2041.3	2011.5	1.48	1.47
<b>Avg.</b>										<b>1.29</b>
26	1 Year	2-15-05	2-15-06	1978.8	1951.7	1.39	2075.0	2051.4	1.15	1.27
27	1 Year	2-15-05	2-15-06	2005.8	1977.6	1.43	2044.4	2017.2	1.35	1.39
28	1 Year	2-15-05	2-15-06	1994.4	1967.3	1.38	2041.2	2013.0	1.40	1.39
29	1 Year	2-15-05	2-15-06	2044.4	2017.3	1.34	1997.8	1967.3	1.55	1.45
30	1 Year	2-15-05	2-15-06	1979.7	1953.9	1.32	2058.3	2032.1	1.29	1.30
<b>Avg.</b>										<b>1.36</b>
31	3 Year	2-15-05	2-15-08	2019.2	1992.6	1.33	2031.8	2003.8	1.40	1.37
32	3 Year	2-15-05	2-15-08	2055.4	2026.1	1.45	1987.1	1962.3	1.26	1.35
33	3 Year	2-15-05	2-15-08	2058.4	2029.7	1.41	1988.7	1958.0	1.57	1.49
34	3 Year	2-15-05	2-15-08	2079.1	2051.4	1.35	1962.4	1936.5	1.34	1.34
35	3 Year	2-15-05	2-15-08	2075.7	2048.6	1.32	1970.3	1645.7	1.26	1.29
<b>Avg.</b>										<b>1.37</b>
36	Vac Sat.	2-23-05	2-24-05	2053.1	2028.1	1.23	1998.3	1971.4	1.36	1.30
37	Vac Sat.	2-23-05	2-24-05	2024.3	1999.1	1.26	2031.5	2007.0	1.22	1.24
38	Vac Sat.	2-23-05	2-24-05	2080.3	2053.0	1.33	1973.6	1947.3	1.35	1.34
39	Vac Sat.	2-23-05	2-24-05	2073.0	2046.9	1.28	1988.3	1962.6	1.31	1.29
40	Vac Sat.	2-23-05	2-24-05	2018.0	1991.5	1.33	2039.6	2013.4	1.30	1.32
<b>Avg.</b>										<b>1.30</b>

# Appendix E: 24 Hour Absorption Testing Before and After Vacuum Saturation

## Task 3: Absorption Results, Bundy Hill (Natural Gravel) - ASN: 30-35

Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
1 bvs	1957.5	1941.1	2090.7	2072.9	0.8449	0.8587	0.85
2 bvs	2090.8	2071.2	1944.1	1928.0	0.9463	0.8351	0.89
3 bvs	2036.9	2019.2	1997.6	1980.9	0.8766	0.8430	0.86
4 bvs	2004.6	1984.7	2013.1	1994.9	1.0027	0.9123	0.96
5 bvs	2062.5	2043.1	1970.4	1952.1	0.9495	0.9374	0.94
<b>Avg. 1-5</b>			Date 8/30/05				<b>0.90</b>
1 avs	2036.5	2019.3	1985.0	1967.9	0.8518	0.8689	0.86
2 avs	2044.0	2024.5	1976.4	1960.0	0.9632	0.8367	0.90
3 avs	2073.0	2054.6	1943.3	1927.2	0.8956	0.8354	0.87
4 avs	1973.4	1953.8	2039.2	2020.4	1.0032	0.9305	0.97
5 avs	1957.0	1938.6	2071.2	2051.9	0.9491	0.9406	0.94
<b>Avg. 1-5</b>			Date 9/7/05				<b>0.91</b>
6 bvs	2033.3	2016.5	2002.6	1984.1	0.8331	0.9324	0.88
7 bvs	2016.4	1999.3	2005.5	1989.6	0.8553	0.7992	0.83
8 bvs	2045.6	2026.1	1985.1	1968.1	0.9624	0.8638	0.91
9 bvs	1965.4	1947.0	2070.2	2053.2	0.9450	0.8280	0.89
10 bvs	2009.7	1992.9	2019.6	2002.9	0.8430	0.8338	0.84
<b>Avg. 6-10</b>			Date 11/1/05				<b>0.87</b>
6 avs	1995.6	1977.4	2022.7	2005.9	0.9204	0.8375	0.88
7 avs	2050.3	2033.3	1965.1	1949.0	0.8361	0.8261	0.83
8 avs	1997.6	1980.1	2027.2	2008.5	0.8838	0.9310	0.91
9 avs	2035.0	2018.1	1991.7	1973.3	0.8374	0.9324	0.88
10 avs	2065.0	2047.8	1955.8	1939.6	0.8399	0.8352	0.84
<b>Avg. 6-10</b>			Date 11/4/05				<b>0.87</b>
11 bvs	2017.9	2001.1	2012.7	1994.6	0.8395	0.9074	0.87
12 bvs	2021.0	2005.0	2009.0	1993.4	0.7980	0.7826	0.79
13 bvs	1998.7	1981.5	2019.5	2003.5	0.8680	0.7986	0.83
14 bvs	2039.5	2021.3	1989.5	1973.1	0.9004	0.8312	0.87
15 bvs	2047.7	2030.1	1976.1	1958.6	0.8670	0.8935	0.88
<b>Avg. 11-15</b>			Date 11/1/05				<b>0.85</b>
11 avs	2014.6	1997.1	2009.8	1991.1	0.8763	0.9392	0.91
12 avs	1999.4	1982.6	2025.1	2009.9	0.8474	0.7562	0.80
13 avs	1942.3	1926.2	2069.8	2052.3	0.8358	0.8527	0.84
14 avs	2051.3	2034.7	1972.5	1953.7	0.8158	0.9623	0.89
15 avs	2026.1	2007.8	1980.6	1963.1	0.9114	0.8914	0.90
<b>Avg. 11-15</b>			Date 11/4/05				<b>0.87</b>
16 bvs	2023.2	2006.8	2004.8	1989.4	0.8172	0.7741	0.80
17 bvs	1982.8	1967.1	2048.2	2029.9	0.7981	0.9015	0.85
18 bvs	2041.2	2024.2	1982.7	1965.7	0.8398	0.8648	0.85
19 bvs	1970.1	1952.6	2068.4	2049.5	0.8962	0.9222	0.91
20 bvs	2009.0	1990.3	2014.1	1996.2	0.9396	0.8967	0.92
<b>Avg. 16-20</b>			Date 11/8/05				<b>0.87</b>
16 avs	2051.1	2035.2	1973.6	1958.3	0.7812	0.7813	0.78
17 avs	1995.0	1979.3	2033.1	2015.0	0.7932	0.8983	0.85
18 avs	1981.3	1964.4	2039.0	2022.4	0.8603	0.8208	0.84
19 avs	2013.8	1996.2	2019.2	2000.5	0.8817	0.9348	0.91
20 avs	2037.5	2018.7	1982.2	1965.0	0.9313	0.8753	0.90
<b>Avg. 16-20</b>			Date 11/30/05				<b>0.86</b>
21 bvs	1999.1	1980.2	2026.9	2009.6	0.9544	0.8609	0.91
22 bvs	2010.0	1991.0	2011.4	1993.6	0.9543	0.8928	0.92
23 bvs	2009.5	1993.0	2007.5	1989.2	0.8279	0.9200	0.87
24 bvs	1944.4	1928.9	2079.8	2061.7	0.8036	0.8779	0.84
25 bvs	2029.9	2011.8	2004.4	1985.3	0.8997	0.9621	0.93
<b>Avg. 21-25</b>			Date 11/8/05				<b>0.89</b>
21 avs	1953.2	1937.4	2050.0	2030.5	0.8155	0.9604	0.89
22 avs	2042.8	2024.6	1957.9	1940.0	0.8989	0.9227	0.91
23 avs	2017.7	2001.1	1993.0	1975.5	0.8295	0.8858	0.86
24 avs	1982.8	1967.5	2029.2	2011.6	0.7776	0.8749	0.83
25 avs	2093.3	2073.8	1934.6	1917.2	0.9403	0.9076	0.92
<b>Avg. 21-25</b>			Date 12/6/05				<b>0.88</b>
26 bvs	1968.4	1950.4	2052.9	2038.0	0.9229	0.7311	0.83
27 bvs	2026.7	2007.7	2005.0	1988.5	0.9464	0.8298	0.89
28 bvs	2029.9	2010.7	1996.9	1981.7	0.9549	0.7670	0.86
29 bvs	2030.7	2014.1	1994.9	1976.4	0.8242	0.9360	0.88
30 bvs	2084.9	2068.6	1926.7	1911.5	0.7880	0.7952	0.79
<b>Avg. 26-30</b>			Date 11/9/05				<b>0.85</b>
26 avs	2007.3	1990.7	1993.1	1977.2	0.8339	0.8042	0.82
27 avs	2051.8	2034.8	1967.1	1949.6	0.8355	0.8976	0.87
28 avs	2025.3	2008.7	1982.0	1963.4	0.8264	0.9473	0.89
29 avs	2025.6	2007.9	1980.4	1962.8	0.8815	0.8967	0.89
30 avs	2049.4	2034.0	1956.6	1940.0	0.7571	0.8557	0.81
<b>Avg. 26-30</b>			Date 12/6/05				<b>0.86</b>

bvs = 24 hour Absorption Test done before Vacuum Saturation.  
avs = 24 hour Absorption Test done after Vacuum Saturation.

**Task 3: Absorption Results, Rockwood Stone - ASN: 58-8**

Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
1 bvs	2127.6	2076.9	1964.0	1917.7	2.4411	2.4144	2.43
2 bvs	2002.6	1957.4	2058.4	2014.0	2.3092	2.2046	2.26
3 bvs	2019.7	1973.0	2051.2	2006.0	2.3670	2.2532	2.31
4 bvs	2181.2	2132.2	1902.0	1860.6	2.2981	2.2251	2.26
5 bvs	1944.7	1900.2	2139.6	2091.9	2.3418	2.2802	2.31
<b>Avg. 1-5</b>			9/8/05				<b>2.31</b>
1 avs	2048.4	1999.4	2033.9	1986.3	2.4507	2.3964	2.42
2 avs	2044.2	1999.0	1998.5	1954.7	2.2611	2.2408	2.25
3 avs	2014.0	1969.6	2047.0	1999.8	2.2543	2.3602	2.31
4 avs	2040.5	1994.0	2032.3	1987.8	2.3320	2.2386	2.29
5 avs	2033.3	1986.2	2044.4	1999.1	2.3714	2.2660	2.32
<b>Avg. 1-5</b>			9/14/05				<b>2.32</b>
6 bvs	2033.2	1987.0	2052.0	2004.3	2.3251	2.3799	2.35
7 bvs	1994.6	1946.7	2084.0	2037.5	2.4606	2.2822	2.37
8 bvs	2050.2	2003.4	2038.6	1993.2	2.3360	2.2777	2.31
9 bvs	2074.4	2026.5	1996.5	1952.7	2.3637	2.2430	2.30
10 bvs	2051.5	2003.8	2032.4	1984.3	2.3805	2.4240	2.40
<b>Avg. 6-10</b>			12/8/05				<b>2.35</b>
6 avs	2016.8	1969.7	2059.8	2013.3	2.3912	2.3096	2.35
7 avs	2031.4	1984.1	2038.6	1992.0	2.3840	2.3394	2.36
8 avs	2091.8	2046.4	1988.4	1942.3	2.2185	2.3735	2.30
9 avs	2050.0	2002.9	2006.2	1962.1	2.3516	2.2476	2.30
10 avs	2064.2	2015.4	2006.3	1959.9	2.4214	2.3675	2.39
<b>Avg. 6-10</b>			1/4/06				<b>2.34</b>
11 bvs	2014.6	1969.7	2065.5	2018.9	2.2795	2.3082	2.29
12 bvs	2023.3	1978.2	2062.1	2015.3	2.2799	2.3222	2.30
13 bvs	2044.4	2000.3	2027.2	1982.4	2.2047	2.2599	2.23
14 bvs	2017.1	1971.7	2067.7	2018.5	2.3026	2.4375	2.37
15 bvs	1986.4	1941.3	2095.6	2048.3	2.3232	2.3092	2.32
<b>Avg. 11-15</b>			12/13/05				<b>2.30</b>
11 avs	2035.5	1990.5	2037.0	1990.3	2.2607	2.3464	2.30
12 avs	1957.1	1913.2	2120.7	2072.5	2.2946	2.3257	2.31
13 avs	2009.0	1965.3	2055.2	2009.0	2.2236	2.2996	2.26
14 avs	1983.4	1937.8	2092.9	2043.7	2.3532	2.4074	2.38
15 avs	1982.2	1936.9	2093.1	2045.6	2.3388	2.3220	2.33
<b>Avg. 11-15</b>			1/4/06				<b>2.32</b>
Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
16 bvs	2029.1	1980.8	2051.8	2002.3	2.4384	2.4721	2.46
17 bvs	2065.7	2016.6	2019.6	1972.6	2.4348	2.3826	2.41
18 bvs	2117.1	2070.2	1959.2	1914.4	2.2655	2.3402	2.30
19 bvs	2036.6	1988.9	2046.8	2000.8	2.3983	2.2991	2.35
20 bvs	2085.4	2036.9	2000.4	1953.9	2.3811	2.3799	2.38
<b>Avg. 16-20</b>			12/13/05				<b>2.38</b>
16 avs	2035.9	1986.9	2036.9	1987.9	2.4662	2.4649	2.47
17 avs	1983.0	1935.5	2093.4	2044.9	2.4541	2.3718	2.41
18 avs	2067.6	2021.1	1998.7	1953.4	2.3007	2.3190	2.31
19 avs	2071.2	2021.0	2005.0	1960.7	2.4839	2.2594	2.37
20 avs	2031.0	1982.6	2044.3	1996.7	2.4412	2.3839	2.41
<b>Avg. 16-20</b>			1/10/06				<b>2.39</b>
21 bvs	2030.2	1981.7	2052.5	2005.0	2.4474	2.3691	2.41
22 bvs	2016.7	1970.4	2067.0	2020.6	2.3498	2.2963	2.32
23 bvs	2054.0	2005.7	2034.0	1985.6	2.4081	2.4376	2.42
24 bvs	2091.1	2042.0	1994.4	1948.1	2.4045	2.3767	2.39
25 bvs	2064.6	2016.4	2023.3	1976.9	2.3904	2.3471	2.37
<b>Avg. 21-25</b>			12/14/05				<b>2.38</b>
21 avs	1971.1	1924.5	2103.2	2053.0	2.4214	2.4452	2.43
22 avs	2040.7	1994.7	2035.4	1988.0	2.3061	2.3843	2.35
23 avs	2024.2	1976.4	2057.4	2007.6	2.4185	2.4806	2.45
24 avs	2094.8	2045.4	1984.5	1937.9	2.4152	2.4047	2.41
25 avs	2105.4	2056.7	1975.7	1929.6	2.3679	2.3891	2.38
<b>Avg. 21-25</b>			1/11/06				<b>2.40</b>
26 bvs	2053.8	2007.5	2036.0	1990.9	2.3064	2.2653	2.29
27 bvs	2002.4	1955.9	2087.9	2041.6	2.3774	2.2678	2.32
28 bvs	2008.1	1961.1	2072.9	2023.0	2.3966	2.4666	2.43
29 bvs	2029.4	1982.3	2062.2	2016.0	2.3760	2.2917	2.33
30 bvs	2054.2	2005.7	2038.1	1991.3	2.4181	2.3502	2.38
<b>Avg. 26-30</b>			12/20/05				<b>2.35</b>
26 avs	1975.9	1929.7	2109.1	2061.5	2.3942	2.3090	2.35
27 avs	2076.5	2027.7	2005.4	1959.5	2.4067	2.3424	2.37
28 avs	2043.7	1996.3	2031.2	1983.6	2.3744	2.3997	2.39
29 avs	2042.7	1995.8	2043.2	1994.8	2.3499	2.4263	2.39
30 avs	2058.9	2010.3	2027.3	1979.7	2.4175	2.4044	2.41
<b>Avg. 26-30</b>			1/12/06				<b>2.38</b>

bvs = 24 hour Absorption Test done before Vacuum Saturation.  
avs = 24 hour Absorption Test done after Vacuum Saturation.

**Task 3: Absorption Results, American Aggregate (Milford) - ASN: 63-97**

Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
1 bvs	1994.4	1975.2	2028.8	2007.2	0.9720	1.0761	1.02
2 bvs	2083.1	2059.9	1950.4	1927.6	1.1263	1.1828	1.15
3 bvs	2053.9	2030.3	1978.5	1954.3	1.1624	1.2383	1.20
4 bvs	2005.7	1981.5	2039.6	2016.4	1.2213	1.1506	1.19
5 bvs	2021.4	1998.9	2002.2	1981.6	1.1256	1.0396	1.08
<b>Avg. 1-5</b>			Date 8/30/05				<b>1.13</b>
1 avs	2034.7	2014.5	1982.5	1962.8	1.0027	1.0037	1.00
2 avs	2057.5	2034.7	1969.1	1946.4	1.1206	1.1662	1.14
3 avs	1953.2	1930.4	2072.9	2047.9	1.1811	1.2208	1.20
4 avs	2008.8	1985.2	2023.2	2000.0	1.1888	1.1600	1.17
5 avs	2057.9	2036.9	1959.0	1936.4	1.0310	1.1671	1.10
<b>Avg. 1-5</b>			Date 9/7/05				<b>1.12</b>
6 bvs	2054.7	2031.7	1988.0	1962.6	1.1320	1.2942	1.21
7 bvs	2025.1	1999.2	2017.7	1993.4	1.2955	1.2190	1.26
8 bvs	2039.3	2018.5	1984.7	1962.8	1.0305	1.1158	1.07
9 bvs	2015.0	1992.7	2026.0	2004.3	1.1191	1.0827	1.10
10 bvs	2060.5	2038.4	1983.8	1962.0	1.0842	1.1111	1.10
<b>Avg. 6-10</b>			Date 1/18/06				<b>1.15</b>
6 avs	2012.7	1989.3	2018.3	1993.2	1.1763	1.2593	1.22
7 avs	1941.8	1915.8	2086.5	2061.9	1.3571	1.1931	1.28
8 avs	2032.9	2010.0	1980.9	1960.9	1.1393	1.0199	1.08
9 avs	2008.1	1985.3	2023.9	2002.1	1.1484	1.0888	1.12
10 avs	1967.9	1947.1	2066.2	2043.0	1.0682	1.1356	1.10
<b>Avg. 6-10</b>			Date 2/23/06				<b>1.16</b>
11 bvs	1985.2	1963.3	2058.0	2032.0	1.1155	1.2795	1.20
12 bvs	2058.3	2037.0	1973.0	1949.2	1.0456	1.2210	1.13
13 bvs	1961.4	1939.4	2074.7	2050.6	1.1344	1.1753	1.15
14 bvs	2089.5	2066.4	1945.4	1923.9	1.1179	1.1175	1.12
15 bvs	1988.8	1962.9	2036.7	2011.8	1.3195	1.2377	1.28
<b>Avg. 11-15</b>			Date 1/26/06				<b>1.18</b>
11 avs	2012.9	1988.1	2023.0	2000.0	1.2474	1.1500	1.20
12 avs	1957.7	1936.6	2060.9	2037.7	1.0895	1.1385	1.11
13 avs	1991.1	1969.6	2035.5	2011.8	1.0916	1.1780	1.13
14 avs	2009.7	1986.5	2010.7	1989.6	1.1679	1.0605	1.11
15 avs	1982.9	1958.9	2035.2	2009.0	1.2252	1.3041	1.26
<b>Avg. 11-15</b>			Date 2/23/06				<b>1.16</b>
16 bvs	2033.5	2010.4	2002.0	1980.4	1.1490	1.0907	1.12
17 bvs	2011.4	1988.8	2025.6	2001.4	1.1364	1.2091	1.17
18 bvs	2014.2	1990.5	2026.8	2003.2	1.1906	1.1781	1.18
19 bvs	2014.7	1991.4	2028.4	2003.9	1.1700	1.2226	1.20
20 bvs	2029.0	2004.4	2012.9	1986.7	1.2273	1.3188	1.27
<b>Avg. 16-20</b>			Date 2/9/06				<b>1.19</b>
16 avs	2028.9	2007.6	1910.2	1889.5	1.0610	1.0955	1.08
17 avs	2014.5	1991.2	2013.6	1991.9	1.1701	1.0894	1.13
18 avs	1993.8	1968.8	2039.4	2015.3	1.2698	1.1958	1.23
19 avs	2006.3	1982.8	2026.9	2004.0	1.1852	1.1427	1.16
20 avs	2013.6	1989.8	2018.5	1992.9	1.1961	1.2846	1.24
<b>Avg. 16-20</b>			Date 2/28/06				<b>1.17</b>
21 bvs	2018.6	1996.6	2005.1	1981.9	1.1019	1.1706	1.14
22 bvs	1992.3	1969.3	2054.1	2031.3	1.1679	1.1224	1.15
23 bvs	2108.1	2082.4	1936.0	1913.3	1.2341	1.1864	1.21
24 bvs	1966.6	1942.2	2076.2	2052.9	1.2563	1.1350	1.20
25 bvs	2091.3	2068.9	1938.3	1917.4	1.0827	1.0900	1.09
<b>Avg. 21-25</b>			Date 2/14/06				<b>1.16</b>
21 avs	2013.2	1991.3	2001.7	1978.8	1.0998	1.1573	1.13
22 avs	2067.6	2042.5	1971.3	1951.0	1.2289	1.0405	1.13
23 avs	1973.7	1952.0	2061.3	2035.8	1.1117	1.2526	1.18
24 avs	2022.7	1999.5	2012.5	1988.7	1.1603	1.1968	1.18
25 avs	2018.7	1997.0	2002.7	1981.5	1.0866	1.0699	1.08
<b>Avg. 21-25</b>			Date 2/28/06				<b>1.14</b>
26 bvs	2054.2	2030.3	1989.3	1967.1	1.1772	1.1286	1.15
27 bvs	1994.3	1971.4	2047.4	2024.4	1.1616	1.1361	1.15
28 bvs	2002.2	1980.7	2038.4	2014.9	1.0855	1.1663	1.13
29 bvs	1971.9	1947.9	2066.2	2043.7	1.2321	1.1009	1.17
30 bvs	2046.4	2021.3	1999.3	1974.7	1.2418	1.2457	1.24
<b>Avg. 26-30</b>			Date 2/14/06				<b>1.17</b>
26 avs	2043.0	2020.3	1993.1	1970.8	1.1236	1.1315	1.13
27 avs	1983.2	1961.4	2051.1	2027.5	1.1114	1.1640	1.14
28 avs	2006.2	1982.9	2027.4	2006.1	1.1750	1.0618	1.12
29 avs	2029.5	2007.0	1996.0	1976.2	1.1211	1.1862	1.15
30 avs	1983.2	1960.0	2054.9	2028.9	1.1837	1.2815	1.23
<b>Avg. 26-30</b>			Date 3/1/06				<b>1.15</b>

bvs = 24 hour Absorption Test done before Vacuum Saturation.  
avs = 24 hour Absorption Test done after Vacuum Saturation.

**Task 3: Absorption Results, E.C. Levy Slag (Trenton) - ASN: 82-22**

Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
1 bvs	1974.2	1930.2	2084.9	2037.0	2.2796	2.3515	2.32
2 bvs	2024.0	1975.0	2046.4	1997.7	2.4810	2.4378	2.46
3 bvs	2068.5	2016.7	2006.1	1959.5	2.5685	2.3782	2.47
4 bvs	2054.4	2004.4	2014.3	1969.9	2.4945	2.2539	2.37
5 bvs	2070.5	2022.1	1996.7	1951.8	2.3936	2.3004	2.35
<b>Avg. 1-5</b>			Date 3/22/05				<b>2.39</b>
1 avs	2040.9	1992.6	1989.9	1942.5	2.4240	2.4402	2.43
2 avs	1940.8	1894.8	2101.7	2048.8	2.4277	2.5820	2.50
3 avs	1987.2	1937.9	2069.1	2017.9	2.5440	2.5373	2.54
4 avs	2043.3	1993.3	1994.6	1946.3	2.5084	2.4816	2.50
5 avs	2015.5	1965.6	2024.7	1974.9	2.5387	2.5216	2.53
<b>Avg. 1-5</b>			Date 3/25/05				<b>2.50</b>
6 bvs	2029.0	1981.0	2024.3	1978.4	2.4230	2.3200	2.37
7 bvs	2050.3	2001.6	2016.8	1970.1	2.4330	2.3704	2.40
8 bvs	2065.6	2016.0	2006.5	1958.4	2.4603	2.4561	2.46
9 bvs	2036.2	1988.7	2028.5	1979.1	2.3885	2.4961	2.44
10 bvs	2025.3	1976.2	2047.8	1998.5	2.4846	2.4668	2.48
<b>Avg. 6-10</b>			Date 3/29/05				<b>2.43</b>
6 avs	2077.8	2028.2	1950.2	1903.3	2.4455	2.4641	2.45
7 avs	2014.0	1966.9	2018.5	1972.5	2.3946	2.3321	2.36
8 avs	2025.7	1978.2	2003.4	1954.1	2.4012	2.5229	2.46
9 avs	2021.7	1971.0	2014.5	1964.9	2.5723	2.5243	2.55
10 avs	1989.4	1939.2	2056.1	2004.3	2.5887	2.5844	2.59
<b>Avg. 6-10</b>			Date 4/6/05				<b>2.48</b>
11 bvs	2039.8	1994.1	2028.6	1983.4	2.2918	2.2789	2.29
12 bvs	2054.6	2007.1	2007.6	1961.3	2.3666	2.3607	2.36
13 bvs	1999.3	1954.2	2061.9	2016.4	2.3078	2.2565	2.28
14 bvs	2019.0	1971.9	2044.3	1996.6	2.3886	2.3891	2.39
15 bvs	2037.4	1988.0	2025.6	1979.5	2.4849	2.3289	2.41
<b>Avg. 11-15</b>			Date 4/5/05				<b>2.35</b>
11 avs	2006.1	1956.7	2035.2	1984.5	2.5246	2.5548	2.54
12 avs	2014.1	1964.9	2014.6	1965.1	2.5039	2.5190	2.51
13 avs	1975.2	1926.5	2060.1	2011.4	2.5279	2.4212	2.47
14 avs	2024.7	1974.8	2011.4	1960.8	2.5268	2.5806	2.55
15 avs	2003.6	1954.0	2035.0	1984.1	2.5384	2.5654	2.55
<b>Avg. 11-15</b>			Date 4/8/05				<b>2.52</b>
16 bvs	2058.7	2007.4	2028.3	1979.7	2.5555	2.4549	2.51
17 bvs	2083.4	2033.0	2002.2	1953.0	2.4791	2.5192	2.50
18 bvs	1925.1	1878.3	2167.5	2112.0	2.4916	2.6278	2.56
19 bvs	2045.1	1993.7	2041.0	1989.0	2.5781	2.6144	2.60
20 bvs	1987.7	1937.0	2102.2	2049.9	2.6174	2.5513	2.58
<b>Avg. 16-20</b>			Date 4/12/05				<b>2.55</b>
16 avs	2065.1	2015.1	1989.3	1939.3	2.4813	2.5782	2.53
17 avs	2032.2	1982.0	2016.8	1968.5	2.5328	2.4536	2.49
18 avs	1930.8	1883.9	2125.7	2073.2	2.4895	2.5323	2.51
19 avs	2063.7	2011.4	1985.8	1937.6	2.6002	2.4876	2.54
20 avs	2067.0	2015.7	1976.8	1930.2	2.5450	2.4142	2.48
<b>Avg. 16-20</b>			Date 4/19/05				<b>2.51</b>
21 bvs	2034.1	1988.5	2069.5	2021.6	2.2932	2.3694	2.33
22 bvs	2094.0	2043.3	1998.5	1949.5	2.4813	2.5135	2.50
23 bvs	2059.4	2011.5	2033.5	1985.4	2.3813	2.4227	2.40
24 bvs	2104.6	2055.4	1989.3	1941.7	2.3937	2.4515	2.42
25 bvs	2099.2	2049.3	1994.3	1946.4	2.4350	2.4610	2.45
<b>Avg. 21-25</b>			Date 4/20/05				<b>2.42</b>
21 avs	2019.0	1969.9	2063.3	2012.6	2.5446	2.5191	2.53
22 avs	2036.8	1986.0	2026.7	1977.1	2.5579	2.5087	2.53
23 avs	2006.8	1956.8	2058.2	2009.9	2.5552	2.4031	2.48
24 avs	2053.5	2001.8	2016.9	1967.9	2.5827	2.4900	2.54
25 avs	2012.2	1962.9	2059.4	2009.0	2.5116	2.5087	2.51
<b>Avg. 21-25</b>			Date 4/26/05				<b>2.52</b>
26 bvs	2017.4	1971.4	2068.2	2019.8	2.3334	2.3963	2.36
27 bvs	2045.3	1999.8	2038.9	1992.1	2.2752	2.3493	2.31
28 bvs	2009.6	1962.5	2071.7	2025.2	2.4000	2.2961	2.35
29 bvs	2059.7	2010.3	2014.4	1966.2	2.4573	2.4514	2.45
30 bvs	2072.8	2025.7	1994.3	1948.0	2.3251	2.3768	2.35
<b>Avg. 26-30</b>			Date 5/3/05				<b>2.36</b>
26 avs	2040.1	1988.9	2023.0	1972.9	2.5743	2.5394	2.56
27 avs	2036.9	1986.0	2026.0	1976.5	2.5629	2.5044	2.53
28 avs	1994.3	1944.8	2070.6	2018.0	2.5452	2.6065	2.58
29 avs	1974.3	1924.0	2084.5	2032.5	2.6143	2.5584	2.59
30 avs	2004.0	1953.0	2040.3	1990.0	2.6114	2.5276	2.57
<b>Avg. 26-30</b>			Date 5/11/05				<b>2.57</b>

bvs = 24 hour Absorption Test done before Vacuum Saturation.  
avs = 24 hour Absorption Test done after Vacuum Saturation.

**Task 3: Absorption Results, France Stone (Silica) - ASN: 93-3**

Sample #	SSd 1 (Wt.)	Dry 1 (Wt.)	SSd 2 (Wt.)	Dry 2 (Wt.)	Abs % 1	Abs % 2	Avg 1 & 2
1 bvs	2042.4	1997.7	2027.7	1983.5	2.2376	2.2284	2.23
2 bvs	2109.1	2063.2	1956.5	1913.5	2.2247	2.2472	2.24
3 bvs	2109.7	2064.7	1958.5	1913.5	2.1795	2.3517	2.27
4 bvs	2047.3	1998.5	2017.9	1972.7	2.4418	2.2913	2.37
5 bvs	2069.8	2025.1	1972.8	1928.8	2.2073	2.2812	2.24
<b>Avg. 1-5</b>			9/8/05				<b>2.27</b>
1 avs	2110.7	2065.0	1943.9	1900.4	2.2131	2.2890	2.25
2 avs	2026.3	1982.0	2031.7	1986.7	2.2351	2.2651	2.25
3 avs	2039.1	1991.7	2020.7	1977.0	2.3799	2.2104	2.30
4 avs	2010.8	1963.6	2042.2	1995.1	2.4037	2.3608	2.38
5 avs	2023.8	1977.6	2009.0	1966.4	2.3362	2.1664	2.25
<b>Avg. 1-5</b>			9/14/05				<b>2.29</b>
6 bvs	2089.9	2042.4	1997.2	1952.5	2.3257	2.2894	2.31
7 bvs	2052.3	2005.2	2040.8	1993.4	2.3489	2.3778	2.36
8 bvs	2021.4	1974.7	2074.4	2029.0	2.3649	2.2376	2.30
9 bvs	2047.6	2000.0	2037.3	1988.2	2.3800	2.4696	2.42
10 bvs	1974.7	1925.1	2121.6	2072.8	2.5765	2.3543	2.47
<b>Avg. 6-10</b>			3/7/06				<b>2.37</b>
6 avs	2068.5	2022.3	2003.7	1959.5	2.2845	2.2557	2.27
7 avs	2068.6	2020.5	2008.9	1963.7	2.3806	2.3018	2.34
8 avs	2003.7	1960.9	2081.0	2034.1	2.1827	2.3057	2.24
9 avs	2072.7	2026.1	1999.0	1952.1	2.3000	2.4025	2.35
10 avs	2025.6	1978.7	2045.4	1997.8	2.3702	2.3826	2.38
<b>Avg. 6-10</b>			3/21/06				<b>2.32</b>
11 bvs	2038.5	1992.6	2059.3	2011.7	2.3035	2.3662	2.33
12 bvs	1990.1	1943.6	2107.6	2059.0	2.3925	2.3604	2.38
13 bvs	2011.9	1963.3	2088.4	2041.0	2.4754	2.3224	2.40
14 bvs	2012.3	1965.6	2094.7	2045.5	2.3759	2.4053	2.39
15 bvs	2062.3	2015.1	2040.2	1990.4	2.3423	2.5020	2.42
<b>Avg. 11-15</b>			3/7/06				<b>2.38</b>
11 avs	2131.1	2082.6	1953.6	1909.8	2.3288	2.2934	2.31
12 avs	2021.4	1976.7	2064.6	2016.7	2.2613	2.3752	2.32
13 avs	2068.0	2020.2	2020.4	1975.0	2.3661	2.2987	2.33
14 avs	2022.4	1977.9	2073.9	2024.4	2.2499	2.4452	2.35
15 avs	2030.9	1985.0	2058.8	2009.8	2.3123	2.4380	2.38
<b>Avg. 11-15</b>			3/21/06				<b>2.34</b>
16 bvs	2010.2	1964.4	2095.9	2045.0	2.3315	2.4890	2.41
17 bvs	2058.7	2012.6	2062.4	2015.6	2.2906	2.3219	2.31
18 bvs	2063.8	2015.5	2041.2	1995.0	2.3964	2.3158	2.36
19 bvs	2028.3	1980.3	2083.8	2036.5	2.4239	2.3226	2.37
20 bvs	2051.7	2003.5	2052.3	2006.3	2.4058	2.2928	2.35
<b>Avg. 16-20</b>			3/10/06				<b>2.36</b>
16 avs	2056.0	2007.0	2039.0	1992.5	2.4414	2.3338	2.39
17 avs	2015.2	1969.1	2094.4	2048.6	2.3412	2.2357	2.29
18 avs	2012.1	1966.9	2068.5	2020.9	2.2980	2.3554	2.33
19 avs	2119.5	2071.7	1977.9	1932.3	2.3073	2.3599	2.33
20 avs	2036.0	1990.7	2054.1	2006.3	2.2756	2.3825	2.33
<b>Avg. 16-20</b>			3/22/06				<b>2.36</b>
21 bvs	2074.4	2028.3	2054.7	2006.8	2.2728	2.3869	2.33
22 bvs	2085.4	2034.4	2079.8	2031.8	2.5069	2.3624	2.43
23 bvs	2053.8	2005.8	2094.7	2047.3	2.3931	2.3152	2.35
24 bvs	2069.8	2019.8	2069.8	2023.1	2.4704	2.3083	2.39
25 bvs	2078.4	2028.7	1978.8	1933.0	2.4498	2.3694	2.41
<b>Avg. 21-25</b>			3/10/06				<b>2.38</b>
21 avs	2089.0	2041.5	2028.3	1983.3	2.3267	2.2689	2.30
22 avs	2104.9	2054.4	2049.6	2002.1	2.4581	2.3725	2.42
23 avs	2131.2	2083.8	2005.6	1959.4	2.2747	2.3579	2.32
24 avs	2075.1	2027.0	2053.4	2006.0	2.3730	2.3629	2.37
25 avs	1994.7	1948.1	2045.5	1997.6	2.3921	2.3979	2.40
<b>Avg. 21-25</b>			3/22/06				<b>2.36</b>
26 bvs	2055.0	2007.6	2023.2	1975.5	2.3610	2.4146	2.39
27 bvs	1997.0	1951.6	2084.0	2038.0	2.3263	2.2571	2.29
28 bvs	2063.2	2015.7	2024.7	1980.0	2.3565	2.2576	2.31
29 bvs	2057.2	2008.6	2036.7	1987.9	2.4196	2.4548	2.44
30 bvs	2057.1	2010.4	2039.2	1993.0	2.3229	2.3181	2.32
<b>Avg. 26-30</b>			3/14/06				<b>2.35</b>
26 avs	2020.0	1973.9	2041.9	1995.8	2.3355	2.3098	2.32
27 avs	2003.9	1958.9	2057.8	2013.8	2.2972	2.1849	2.24
28 avs	2015.0	1968.4	2058.7	2014.5	2.3674	2.1941	2.28
29 avs	2096.3	2047.0	1986.9	1939.8	2.4084	2.4281	2.42
30 avs	2064.6	2016.8	2017.5	1972.6	2.3701	2.2762	2.32
<b>Avg. 26-30</b>			3/23/06				<b>2.32</b>

bvs = 24 hour Absorption Test done before Vacuum Saturation.  
avs = 24 hour Absorption Test done after Vacuum Saturation.