

Evaluation of Mesabi Select Taconite Aggregate as a Mn/DOT Class "A" Aggregate

Final Report to the Mineral Coordinating Committee
Dennis Martin, Minnesota Department of Natural Resources
December 13, 2005

Proposal

The proposal was to:

- make construction aggregate from a specific layer of the Biwabik Iron Formation that is currently mined and stockpiled as waste rock by a taconite producer;
- work with Mn/DOT to test and evaluate the material and develop pavement performance data;
- request that Mn/DOT decide if this material shall be designated the highest quality construction aggregate (Mn/DOT's label is Class "A") for use as coarse and fine aggregate in concrete and asphalt, including high traffic volume Superpave mixes.

The rock is here called Mesabi Select to indicate that it is selectively mined from the Mesabi Iron Range and crushed to make construction aggregate. It has a low magnetite content and has not gone through the process to make taconite such as the taconite tailings have.

Background

Taconite producers have an interest to sell byproducts. Businesses in the Twin Cities aggregate market are looking for future sources of quality aggregates in volumes at the scale of a million tons per year. Anecdotal evidence from the Brainerd International Raceway and other regional sites suggests that taconite aggregate creates a durable pavement that provides slight safety improvements in steering and braking. A large aggregate production company in the Twin Cities brought this proposal to the Mineral Coordinating Committee (MCC). Twin Cities aggregate companies are considering business ventures using taconite aggregate. This may require capital investment in production facilities on the Mesabi Range and rail transfer facilities in the Twin Cities that may include ready-mix concrete plants and/or asphalt plants. This also requires railroad agreements to bring the taconite rock to the Twin Cities. Aggregate prices in the Twin Cities are approaching levels where this activity could be profitable in the near future, if rail transport agreements are reached. CN announced the purchase of the DMIR railroad in October 2003, which opens another rail option. Taconite companies could benefit from larger sales volumes of this byproduct. This project focuses upon one set of "buyers" needs, and that is loosely defined as those who want to buy taconite aggregate to make customized products to distribute to those who make quality pavements for the Greater Twin Cities market. This buyer group and the chain of end users currently work in the Twin Cities market and offered their experience to help. We started this effort with no dedicated government funds and found that this buyer group was willing to participate to make the project happen. The project design followed this public-private partnership

concept. The "coarse aggregate size fractions" [see Mn/DOT specifications] have higher unit value, so the project focused upon those components.

This proposal is one step in a larger process. The geological mapping and quality testing needed for construction material from other taconite mines and the marketing of specific products to other states is part of a federal funding proposal that the Natural Resources Research Institute (NRRI) has submitted. The NRRI has done testing and analysis on taconite tailings that are different in terms of size distribution and composition from the material tested in this proposal. The taconite coarse tailings have been used for a portion of certain Mn/DOT bituminous projects, and are reported to have performed successfully. The Tinklinberg Group and NRRI have presented a funding proposal to the Iron Range Resources (IRR) to do further research and market these materials inside and outside of Minnesota. Railroad transportation is a key issue to the successful sales of larger volumes of material. No rail agreements specific to this business concept have yet been announced.

It is in the state's interest to encourage business investment projects in multiple sites using byproducts from the Mesabi Iron Range. This promotes conservation of resources and land through the development of a byproduct from existing mining. This project is an attempt to shorten the timeframe for the business investment decision process. It is likely that the test pavements built here will help in the long-term goal to market higher volumes of Minnesota taconite byproducts to large cities and other states. Another benefit would be an increase in the long-term aggregate supply to the Twin Cities market, which is facing a declining local supply. The Twin Cities market currently consumes approximately 30 million short tons of aggregate per year, and this consumption is projected to increase as the Metro area grows. The state continues to make a significant capital investment in its highway system. A major new source of construction aggregate materials would be a positive step for taxpayers, who cumulatively purchase half the statewide aggregate consumption for public infrastructure projects. Any new supply would help to moderate any potential future price increases for the delivered price of these materials. There will be less future highway congestion in the Twin Cities if a railroad transport system is used instead of a truck haul system.

The concern for a future long-term local aggregate supply is very real. From a conservation perspective, there would be positive benefits to supplement local gravel supplies with high-quality crushed quarry rock. Currently, the very coarse gravel fraction from natural gravel pits is being crushed to make the necessary multiple angular particle surfaces required in the coarse aggregate component of Superpave HMA mixes that the Federal Highway Program is promoting. Since natural gravel deposits rarely contain more than 10% by weight of the coarse (greater than 2 inch) gravel fraction, the finite supply of this material is limited. The cream is today being skimmed off our natural gravel deposits. This will speed up the rate of depletion of our finite supply. Thus the need for quality quarry rock.

Purpose

The purpose of this project was to begin the process of testing and evaluation of the Mesabi Select aggregate and its performance in pavements and to encourage Mn/DOT to make a determination as to the aggregate classification. Mn/DOT highway construction projects are a significant target market for this material. This proposal is a means for private investors to reduce their risk. Prior to such a large capital investment, their request is to achieve a Mn/DOT decision as to whether the material meets the quality specifications for a high value aggregate product, Class A aggregate. Mn/DOT typically requires Class A aggregate for many asphalt Superpave applications and Portland cement concrete pavements. The national trend is toward the use of higher quality aggregate materials with low deleterious content and multiple angular surfaces per particle. Mesabi Select appears to meet this need, appears to exist in significant volumes, and already is being mined and stockpiled. After positive lab test results, the main effort here was a demonstration to determine if the Mesabi Select coarse aggregate is a workable product and whether it has good performance in road pavement. Road pavement performance tests require timeframes of years, so this was an opportunity to begin that process. The coarse aggregate size fractions have higher economic value, so the project focused upon those components during design and testing.

Project Components

The first step was to conduct lab tests on Mesabi Select. Mn/DOT performed the lab tests and found generally favorable results. However, the specific gravity is approximately 3.05, and is an economic disadvantage. The freeze-thaw lab test [ASTM C 1260] results for Portland cement concrete were positive.

A public-private partnership was developed to get to the next step [see sections below Business Partners and Government Agency Partners]. The Mesabi Select construction aggregate was made from a specific 20- foot thick rock layer called the Top of the Lower Cherty at United Taconite's North Pit at Eveleth. 990 short tons of aggregate were made and trucked to the Metro Area for this work. Two product sizes, minus 2 inch and minus ¾ inch, were made with a portable crushing plant at Eveleth by Ulland Brothers and trucked to three destinations. These products were not washed at this Ulland crusher.

- 350 short tons of minus ¾ inch size rock were shipped directly to Commercial Asphalt at Maple Grove to go into the hot mix asphalt;
- 140 short tons of minus 2-inch size rock were shipped directly to MnROAD for the concrete mix. MnROAD is located along I-94 near Monticello.
- 500 short tons of minus 2-inch size rock was shipped to Edward Kraemer and Sons Burnsville quarry. That was crushed and washed to make the final asphalt mix particle size distribution of minus ¾ inch [see Table 13 and Appendix for final mix size distribution

http://mnroad.dot.state.mn.us/research/MnROAD_Project/MnRoadOnlineReports/2004mn1.pdf];

Lakehead Trucking of Duluth won the bid for the truck haul. The total truck haul costs were \$18,162.30 for the 990 short tons split up amongst three destinations.

Mesabi Select was used for the coarse and fine aggregate rock fractions of a Superpave mix design of Hot Mix Asphalt (HMA) to pave a 500- foot section of roadway at the Minnesota Road Research facility (MnROAD) cell 31. This demonstration is at a low volume road that has complete instrumentation. Mn/DOT will monitor the performance for at least a year. This may help Mn/DOT to decide if Mesabi Select makes durable aggregate that provides good pavement performance.

The Mesabi Select minus 2-inch size fraction was used in ready mix concrete to pave cell 54 at MnROAD on October 26, 2004. The concrete pavement is approximately 7 inches thick by 200 feet long by 24 feet [2 lanes] wide from 110 cubic yards of concrete.

Accomplishments

1. Mesabi Select aggregate was tested in Mn/DOT's Maplewood Lab. There were no significant problems identified. Tests to evaluate the potential chemical reactivity of the aggregate with Portland cement concrete will continue to run for at least a year.
2. A successful public- private partnership was developed to build the asphalt pavement and concrete pavement cells at MnROAD. The partners and their contributions are listed in Tables 1, 2, and 3. This work would not have been possible without the generous contributions of time, materials, and assistance that the partners provided. We learned while building the HMA cell 31 that the final crushing stage for Mesabi Select needs to be done in a manner such that flat and elongate particles are not created.
3. Metro area participants visited the Iron Range to see a taconite facility and meet and confer with Iron Range participants.
4. DNR and Mn/DOT gave at least two presentations at 2 different conferences. One was to the Ninth Annual Minnesota Pavement Conference in St. Paul in February 2005. Another was to the Society of Mining Engineers in Duluth in April 2005.
5. Three Mn/DOT reports document the main activities [see references in Appendix]. The reports describe the two pavement cells built at MnROAD and the lab-scale mix design research. The two pavement cells at MnROAD certainly provide a showcase for the material to other states department of transportation.
6. Mn/DOT's Roger Olson developed a Stone Matrix Asphalt mix design in the lab using Mesabi Select and MinnTac fine tailings. It requires only 6.1% oil, which is a reduction from past HMA mixes. [See report reference in Appendix.]

Positive Outcomes

This project provided an opportunity to work with Mn/DOT staff and business partners to learn much more about the characteristics, workability, application and performance of Mesabi Select. Mn/DOT staff helped characterize Mesabi Select in terms of the mineralogy, lab tests, mix design, and paving. Highway noise reduction, for example, is a research goal that Mn/DOT staff point out should be investigated with Mesabi Select. Business partners with a wide range of knowledge - from how to crush rock correctly and how to make pavements to the business of end-use consumer needs and the aggregate distribution process in the Metro market - steered our efforts towards practical needs. We heard from the taconite companies that want to sell aggregate and the companies that are considering buying it.

This was also an opportunity to highlight to a broader audience the Mn/DOT need for high-quality aggregates and that impact upon the future local supply of high-quality aggregates around Minnesota. Finally, Mn/DOT continues to evaluate the on-going lab test work and pavement performance for the determination of the aggregate class designation for Mesabi Select.

Business Partners

Many businesses contributed to this project (see Table 1). Dave Edmunds of Edward Kraemer and Sons, Inc. created the project proposal and presented it to the MCC. He continues to help lead the project. United Taconite and Cliffs Erie donated the Mesabi Select rock from the North Pit, transported the rock to the crushing facility, provided cash funding and generally provided direction on how to get that phase done. Ulland Brothers, Inc. donated the crushing of the 1000 short tons of rock and the loading of the rock into the long-haul trucks. Commercial Asphalt worked with Mn/DOT staff to plan the HMA mix design, tested the actual size fractions provided to them to optimize the mix design, and made the HMA while donating a significant discount for the product. Similarly, Bauerly Companies did the same for the ready mix concrete. All the businesses put aside their regular work [and profits] during the busy construction season to do these things. We thank them for all their contributions.

Table 1. Businesses that provided contributions of material or labor or cash for the Superpave HMA pavement cell and the aggregate for the concrete cell include the following list. Each contribution is assigned an estimated value or identified as cash.

<u>Business</u>	<u>Contribution</u>	<u>Estimated Value</u>
United Taconite	Blast Rock to make aggregate; 1000 tons; haul to Ulland crusher in Auburn Mine	\$5,000 in-kind value and \$2,500 cash
Ulland Brothers, Inc.	Crush blast rock to 2 different size specifications; 990 tons total. Load the long-haul trucks going to the Metro.	\$5,000 in-kind value
Edward Kraemer & Sons	Crush, wash, & size to mix design from 500 short tons of material; Pay to haul necessary product from Burnsville to Maple Grove asphalt plant;	\$5,000 in-kind value and \$2,200 direct payment for trucking
Commercial Asphalt	Make the Superpave Hot Mix Asphalt. Total payment to Commercial Asphalt for some of the cost of production of SuperPave Mix will be \$15,400 [or \$28/ton x 550 tons] and that includes the cost of mix design and any sand needed. This compares to a Mn/DOT bid of \$35/ton from Buffalo Bituminous earlier this year for the same tasks, excluding sand and mix design. The savings to our project is at least \$6350 for the 550 tons we	\$6,350 in-kind value

	need, and we will list that as a company contribution to this project.	
Cliffs-Erie	Cash contribution.	\$2,500 cash
Bauerly Companies	Discount for making the ready-mix concrete using Mesabi Select. Delivering the ready-mix concrete to the site.	\$6,066 in-kind value based upon comparative bids and \$1700 in-kind value
Total=		\$36,316

Public Agency Partners & Funding

The Mineral Coordinating Committee sponsored this project and contributed direction and funding (see Table 2). Additionally, the Iron Range Resources (IRR), Natural Resources Research Institute (NRRI), and the Department of Natural Resources (DNR) contributed funding and support for the project. The DNR contributed staff to coordinate the overall activity and to handle the financial transactions.

Table 2. Public agency partners contributed the following towards completing the tasks for the project. The state agencies on the Mineral Coordinating Committee that contributed are the Iron Range Resources (IRR), the Natural Resources Research Institute (NRRI), and the Department of Natural Resources (DNR).

<u>Agency</u>	<u>Contribution</u>	<u>Estimated Value</u>
IRR	Funding for trucking of aggregate from the Range to Burnsville.	\$11,000
NRRI	Funding for trucking of aggregate	\$6,000
DNR	Funding for trucking of aggregate	\$6,000
	Funding for concrete pavement cell	\$6,000
	Funding for Mn/DOT mix design research	\$5,000
Local Road Research Board	Funding to Mn/DOT toward construction of pavement cell	\$30,000
MCC Contribution	Funding to pay partial cost of making the asphalt mix, and some of the trucking cost.	\$16,000
Total =		\$80,000

V. Mn/DOT's Contributions

This project would not have been possible without the Mn/DOT's staff initiative and willingness to help solve the hurdles to completion. The partners within Mn/DOT included the Maplewood Materials Lab, District-3, Metro Maintenance, and the Local Road Research Board. Mn/DOT's role was to help plan the overall testing, design and demonstration work. It included the reconstruction of two test cells at the MnROAD facility, such as the planning, cell preparation, transport of materials from the HMA plant, construction related to the MnROAD cells, sensor installations, testing, setup database, & final construction reports. In fact, Mn/DOT's role was much broader than the straightforward engineering, design, and research functions. Ben Worel and Roger Olson

helped lead and do the overall planning, communication, and outreach that a public-private partnership such as this demands. Ben Worel also led the phases of the project to build cell 31 and cell 54 at MnROAD. Roger Olson led the lab-scale research dealing with Stone Matrix Asphalt mix designs.

Table 3. A summary of Mn/DOT's contributions to the project.

Contribution	Estimated Value
Reconstruction for Cell 31 : removal of old cell; preparation; place new base; haul HMA from asphalt plant to MnROAD; place the pavement surface	\$ 42,500
Purchase and place Sensors	\$ 16,500
Laboratory Testing / Construction Report	\$ 5,000
Initial Data collection setup and monitoring 1 year	\$ 20,000
Reconstruction for Cell 54: removal of old cell; preparation; place new base	To be determined
Purchase and place sensors	To be determined
Laboratory Testing; Construction report.	To be determined
Initial Data collection setup and monitoring 1 year	To be determined
Total=	>\$ 84,000

Recommendations For Continued Work

A status report was given to all participants on February 3, 2005 at Eveleth. At the February 4 MCC meeting, a subcommittee was created for the purpose of developing recommendations to the MCC in regard to funding of this project in FY 2006-07. The subcommittee finalized its recommendations at a meeting on March 29, 2005. The subcommittee supports the following work and recommendations.

1. Mn/DOT has not made a decision as to whether Mesabi Select is a Class A aggregate. Mn/DOT has established a plan for continued test work for the next year, including the lab test ASTM C 1293 for chemical reactivity of the aggregate with cement. The NRRI is working with Mn/DOT to perform geological evaluation on source rock homogeneity in the mines and lab tests of pavement products.
2. Larry Zanko outlined the NRRI's general plan for \$1.87 million in Federal Funds. The funding may be available as soon as July, 2005. The project intent includes:
 - \$150,000 for pavement research with Mn/DOT at MnROAD.
 - \$150,000 for pavement design research with UM Civil Engineering professors.
 - Demonstration projects. [The subcommittee supported a demonstration project on Interstate 35 near Carlton. A Stone Matrix Asphalt overlay of a mix design created by Roger Olson would be built. However, we could not raise the funds within the necessary timeframe to proceed.]
 - Geological work to characterize the aggregate materials at the taconite mines.
 - Aggregate testing work to be done in cooperation with Mn/DOT.
 - Transportation study [see recommendation below]. Larry has had discussions with CN and they are interested in the business concept.

3. The subcommittee recommends that the MCC fund the following in FY 2006-07:
- \$5,000 to Mn/DOT to compile relevant historical pavement performance data from the use of taconite aggregate in northeastern Minnesota state and local highways.
 - \$50,000 to NRRI to support the proposal on “ The Economics and Logistics of Transporting Taconite Mining and Processing Byproducts (Aggregate): Minnesota and Beyond”. This support came with the agreement that the study will include information relevant to existing outstate aggregate mines such as the New Ulm quartzite quarry, Yellow Medicine County granite, St. Cloud granite and Becker County gravel that are shipping by rail. This gives it more statewide value. [Subsequent to March 29, there is a request by the Tinklinberg group for funding by the IRR in regard to a Transportation Study. That request should be coordinated with this NRRI proposal.]
 - Fund the DNR county aggregate map program. This provides counties with the information they need now to plan for a future local supply of aggregate. Many different aggregate quality classes besides the high quality Class A are needed for the future. The most economical approach is to have a local supply. Not all counties are near rail lines to fit the concept to receive aggregate by rail. Every year, the areas of aggregate scarcity within Minnesota continue to expand, which means that longer – and more costly- hauls are needed. Mine permitting continues to be controversial and expensive.

Appendix

I. Mn/DOT Technical Reports and website link:

- 2004 MNROAD Mesabi Select Hot Mix Asphalt (LRRB Inv.819) Cell 31 Low Volume Road Construction Report, March 2005

This report by Bill Zerfas, Benjamin Worel, and Ronald Mulvaney of Mn/DOT describes the 500- foot asphalt pavement cell that was built in August, 2004 using Mesabi Select coarse and fine aggregate. This report primarily describes the construction of the pavement cell.

- 2004 MnROAD Mesabi Select Ready Mix Concrete Cell 54

Low Volume Road Construction Report, in progress.

This report primarily describes the construction of the pavement cell. The plan is to do testing on this pavement cell during 2005 and report those results late in the year 2005. That next report title and authors will be: MnROAD Cell-54 Mesabi Hard Rock Concrete Construction and First Year Performance Report, by Bernard Izevbekhai, Rebecca Embacher, Tom Burnham, and Benjamin Worel.

- Use of Taconite Rock in Asphalt Paving Mixtures, in progress.

This report by Roger Olson, Ed Johnson, David Linell and Tomas Hunt describes the Mn/DOT Stone Matrix Asphalt lab-scale tests using Mesabi Select aggregates and tailings.

http://mnroad.dot.state.mn.us/research/MnROAD_Project/MnRoadOnlineReports/2004mn1.pdf

- II. Comments by Jerry Lang, Bauerly Companies Concrete Products Division on the use of Mesabi Select Taconite aggregate in a batch of Ready Mix Concrete for MnROAD cell 54 construction. [see page 10]
- III. Mn/DOT Lab Data Results on Mesabi Select Taconite Aggregate for Sieve Size Distribution, Freeze/Thaw, Alkali-Silica Reactivity, Water Absorption, Specific Gravity, Los Angeles Rattler, % Flat and Elongated, Magnesium Sulfate Soundness [see pages 11 –16].



2 November 2004

RE: MnROAD Paving Project – Mesabi Select Aggregate

Comments on The MnROAD Paving conducted 26 Oct 2004

Our feeling is that the overall paving went well. We made a few adjustments while we were batching, primarily due to the different aspects of the coarse aggregate or Mesabi Select Taconite.

1. The rock seemed to work well but we did notice a much higher water demand. This could be from the rock gradation running fine.
2. Although we did not run a #200 test on the rock, we noticed a lot of 100-200 fines on the bottom of the pans for the ¾ inch plus rock and the ¾ inch minus rock. This could also drive up the water demand.
3. The overall gradations ran a bit finer than was specified in the gradation specifications, particularly on certain sizes. For example;
 - o 1 Inch specification was 55% - Actual was 71%
 - o 3 / 4 Inch specification was 22% - Actual was 44%
 - o 3 / 8 Inch specification was 45% - Actual was 60%

It was these factors that probably drove up the water demand higher than we expected. This did not pose any particular problems for us and once we recognized the issue we were able to resolve it however we did exceed the design water by about 2 gallons/yard.

4. The admixtures performed as expected and there were no surprises there. An increase in the Water Reducer would decrease the water demand due to the rock gradation. Once we got the water demand under control, the air content and mixing problem was resolved also.
5. The Mesabi Select aggregate is noticeably much heavier than our normal coarse aggregate and it took the batch computer a few loads to adjust for the "in-air" free-fall resulting in the first two or three loads exceeding the target weight for the coarse aggregate by about 1%. Once the batch computer recognized the weight of the aggregate coming from those selected bins, it adjusted the flow rate to once again hit the target weight.
6. We had no problems discharging the material once it was mixed or cleaning up our trucks at the completion of the pour.
7. We believe with some gradation and portioning changes, this could be a very workable mix.

Any questions, please feel free to give me a call @ (320) 650-0155.

Jerry E. Lang
VP – Concrete Products Division
Bauerly Companies

From: "Nancy Whiting" <Nancy.Whiting@dot.state.mn.us>
To: <mbsnyder@cpamn.com>, <dennis.martin@dnr.state.mn.us>, "Bernard Izevbekhai" <Bernard.Izevbekhai@dot.state.mn.us>, "Doug Schwartz" <Doug.Schwartz@dot.state.mn.us>, "Tom Burnham" <Tom.Burnham@dot.state.mn.us>, <JSmall@edkraemer.com>
Date: 9/1/2004 6:49:17 PM
Subject: Re: TACONITE AGGREGATE FOR CONCRETE

The final report of the freeze/thaw testing of the 'Mesabi Select' taconite coarse aggregate has been received from American Engineering Testing. A copy also was sent to Doug and Jim Small. Dennis - I trust you will share this with others in the task group.

The results are good. Batch #1 represent a CA-15 mix with a larger topsize aggregate and Batch #2 is a smaller coarse aggregate (topsize -3/4"). Six beams were tested from each batch. The average values, after 305 cycles are (range of values in paranthesis):

BATCH 1
Weight loss: 0.61% (0.47-0.72%)
Length change/expansion: 0.06% (0.03-0.09%)
Relative Dynamic Modulus (RDM): 85 (81-89)

BATCH 2
Weight loss: 0.71% (0.43-0.80%)
Length change/expansion: 0.07% (0.06-0.08%)
Relative Dynamic Modulus (RDM): 82 (79-85)

As many of you know I start my 1-year leave of absence from MnDOT next week. Chuck Howe will have the copy of this report for the Geology Unit and he will be representing the Geology Unit on aggregate use of taconite products in my absence. As a parting comment the next important steps I see necessary towards considering this aggregate as a high quality concrete aggregate is to place a test section at MnRoad (perhaps over culverts as discussed earlier?) and to test for ASR reactivity in the C1293 Concrete Prism test (if you recall the C1260 test suggested no susceptibility to expansive ASR but C1293 results are necessary for all new concrete aggregates). If you continue to include me in the e-mail discussions I will continue to offer comments, as long as my e-mail account remains active (so be forwarded :)

Take care and good luck the further testing and paving with all types of taconite aggregate.
Nancy

Nancy M. Whiting
Geologist

Minnesota Dept. of Transportation
Office of Materials
1400 Gervais Ave
Maplewood, MN 55109

651-779-5603
651-779-5616 (FAX)



**State of Minnesota Department of Transportation
Aggregates Test Report**

JAN 14 2004

Office of Materials
1400 Gervais Avenue
Maplewood, MN 55109

Sample ID: CO-CA03-0812	Project No: For Info Only	Sample ID	Project No:
Field ID: 3/4"	Billing Agency:	Field ID:	Billing Agency:
Date Sampled:	Proj Eng:	Date Sampled	Proj Eng:
Date Received: 12/19/03	Submitter: Nancy Whiting	Date Received	Submitter:
Approved: 01/13/2004 09:09	IAS Name:	Approved:	IAS Name:
T.H. Number:	Pit #:	T.H. Number:	Pit #:
Bridge #:	Pit Name: EVTAC	Bridge #:	Pit Name:
Grad Spec:	Pit Owner:	Grad Spec:	Pit Owner:
Spec. Class:	Sampled From: Blwabk Iron Formation	Spec. Class:	Sampled From:
Quality Spec:	Usage: Concrete & Blt	Quality Spec:	Usage:
Plant Name:		Plant Name	
Comment:	"Mesabi Select"	Comment:	

% Passing Sieve:	Lab Test	Field Test	Spec. Limits		Lab Test	Field Test	Spec. Limits	
			Low	High			Low	High
19.0mm (3/4")	100							
16.0mm (5/8")	97							
12.5mm (1/2")	73							
9.5mm (3/8")	32							
4.75mm (#4)	3							
% Absorpt 3/4-3/8	0.71							
ulk SpG 3/4-3/8	3.086							
LAR B-Pct Loss	12.93							
% Flat/Elong	6							
Mag% Lost 3/4-1/2	0.27							
Mag% Lost 1/2-3/8	1.94							
Mag% Lost 3/8-4	1.60							
% Mag Total Loss	1							

Test Procedures: AASHTO T-10, T-21, T-27 (M), T-30 (M), T-84 (M), T-95 (M), T-98 (M), T-104 (M), T-113 (M), T-176 (M), T-248 (M), T-304 Method A, ASTM C123, ASTM C535, ASTM D3042, ASTM D4791 (M), Liho (MP), Micro Deval (MP), Percent Crushing (MP) M = Mn/DOT Modified MP = Mn/DOT Procedures

- Charge:
- 1 - 1012
 - 1 - 1018
 - 1 - 1018
 - 1 - 1028
 - 1 - 1035

Approved By: 

cc: Concrete Engineer
Bituminous Engineer
Dist. 1 Materials Engr.
Nancy Whiting

Remarks: The Loose Unit Weight of this material is 101.4 PCF

* Value does not meet Spec
** Value out of Field-Lab Tolerance
*** Trace (0.0045 - 0.044) Detected
% Shale In Sand N.C. = Trace

- Meets Requirements
- Does Not Meet Requirement
- For Info Only



**State of Minnesota Department of Transportation
Aggregates Test Report**

Office of Materials
1400 Gervais Avenue
Maplewood, MN 55109

JAN 14 2004

Sample ID: CO-CA03-0813 Field ID: 3/8" Date Sampled: Date Received: 12/19/03 Approved: 01/13/2004 09:16 T.H. Number: Bridge #: Grad Spec: Spec. Class: Quality Spec: Plant Name: Comment:	Project No: For Info Only Billing Agency: Proj Eng: Submitter: Nancy Whiting IAS Name: Pit #: Pit Name: EVTAC Pit Owner: Sampled From: Blwablk Iron Formation Usage: Concrete & Bit (r.c.w.) Comment: "Mesabi Select"	Sample ID: Field ID: Date Sampled: Date Received: Approved: T.H. Number: Bridge #: Grad Spec: Spec. Class: Quality Spec: Plant Name: Comment:	Project No: Billing Agency: Proj Eng: Submitter: IAS Name: Pit #: Pit Name: Pit Owner: Sampled From: Usage:
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	% Passing Sieve:	Lab Test	Field Test		Spec. Limits	
			Low	High	Low	High
9.5mm (3/8")	100					
4.75mm (#4)	29					
% Absorpt 3/8-#4	0.92					
Bulk SpG 3/8-#4	3.113					
LAR C-Pct Loss	14.18					
% Flat/Elong	0					
Mag% Lost 3/8-4	2.13					

Test Procedures: AASHTO T-19, T-21, T-27 (M), T-30 (M), T-84 (M), T-85 (M), T-98 (M), T-104 (M), T-113 (M), T-176 (M), T-248 (M), T-304 Method A, ASTM C123, ASTM C635, ASTM D3042, ASTM D4791 (M), Litho (MP), Micro Deval (MP), Percent Crushing (MP) M = MnDOT Modified MP = MnDOT Procedures

Charge: 1 - 1012
 1 - 1016
 1 - 1018
 1 - 1028
 1 - 1035

Approved By:

cc: Concrete Engineer
 Bituminous Engineer
 Dist. 1 Materials Engr.
 Nancy Whiting

Remarks: The Loose Unit Weight of this material is 93.7 PCF

* Value does not meet Spec	<input type="checkbox"/> Meets Requirements
** Value out of Field-Lab Tolerance	<input type="checkbox"/> Does Not Meet Requirement
*** Trace (0.0045 - 0.044) Detected	<input checked="" type="checkbox"/> For Info Only
% Shale in Sand N.C. = Trace	



State of Minnesota Department of Transportation
Aggregates Test Report

Office of Materials
1400 Gervais Avenue
Maplewood, MN 55109

DEC 29 2003

Sample ID: CO-CA03-0814 Field ID: Sand Date Sampled: Date Received: 12/19/03 Approved: 12/26/2003 07:58 T.H. Number: Bridge #: Grad Spec: 3126 Spec. Class: Quality Spec: Plant Name: Comment:	Project No: For Info Only Billing Agency: Proj Eng: Submitter: Nancy Whiting IAS Name: Pit #: Pit Name: EVTAC Pit Owner: Sampled From: Biwabik Iron Formation Usage: Concrete & Bit "Mesabi Select"	Sample ID: Field ID: Date Sampled: Date Received: Approved: T.H. Number: Bridge #: Grad Spec: Spec. Class: Quality Spec: Plant Name: Comment:	Project No: Billing Agency: Proj Eng: Submitter: IAS Name: Pit #: Pit Name: Pit Owner: Sampled From: Usage:
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% Passing Sieve:	Lab Test	Field Test	Spec. Limits		Lab Test	Field Test	Spec. Limits	
			Low	High			Low	High
9.5mm (3/8")	100		100					
4.75mm (#4)	100		95	100				
2.36mm (#8)	*58		80	100				
2.00mm (#10)	46							
1.18mm (#16)	*21		55	85				
600um (#30)	*6		30	60				
425um (#40)	3							
300um (#50)	*1		5	30				
50um (#100)	0		0	10				
75um (#200)	0.3		0.0	2.5				
% Absorpt (-4)	1.4							
Bulk SpG (-4)	3.049							
Avg % FAA	48.2							
Color Plate	Much Lighter than Std							

Test Procedures: AASHTO T-19, T-21, T-27 (M), T-30 (M), T-84 (M), T-85 (M), T-98 (M), T-104 (M), T-113 (M), T-176 (M), T-248 (M), T-304 Method A, ASTM C123, ASTM C535, ASTM D3042, ASTM D4791 (M), Litho (MP), Micro Deval (MP), Percent Crushing (MP) M = Mn/DOT Modified MP = Mn/DOT Procedures

Charge: 1 - 1013
 1 - 1017
 1 - 1021
 1 - 1035

Approved By:

cc: Concrete Engineer
 Bituminous Engineer
 Dist. 1 Materials Engr.
 Nancy Whiting
 R. Patrin

Remarks: THE LOOSE UNIT WEIGHT OF THIS MATERIAL WAS 104.7 PCF.
 NOTE: The ASR results on this material will follow at a later date by separate report.

* Value does not meet Spec
 ** Value out of Field-Lab Tolerance
 *** Trace (0.0045 - 0.044) Detected
 % Shale in Sand N.C. = Trace

Meets Requirements
 Does Not Meet Requirement
 For Info Only

FEB 17 2009

STATE OF MINNESOTA

TEST METHOD MNDOT MODIFY ASTM C - 1280

DEPARTMENT OF TRANSPORTATION
MATERIALS ENGINEERING AND RESEARCH

SUMMARY REPORT ON POTENTIAL ALKALI - SILICA REACTION OF AGGREGATES

MNDOT SPEC: SEE SPECIAL PROVISIONS

ASR #	AGG SOURCE	CODE	LAB NO#	PIT NO	CEMENT	FLYASH	%	3 DAY	5 DAY	7 DAY	8 DAY	11 DAY	12 DAY	14 DAY
ASR03350	EVTAC		CA030814		HOLCIM-MASON CITY		20	0.0503	0.0587				0.0613	0.0760
ASR03351	EVTAC		CA030814		HOLCIM-MASON CITY	NSP BAGAN	20	0.0497	0.0557				0.0563	0.0697
ASR03352	EVTAC		CA030814		HOLCIM-MASON CITY	COAL CREEK	20	0.0372	0.0350				0.0360	0.0510
ASR03353	EVTAC		CA030814		HOLCIM-MASON CITY	SLAG	35	0.0320	0.0380				0.0383	0.0527
ASR03354	EVTAC		CA030814		LAFARGE-DAVENPORT		20	0.0357	0.0427				0.0423	0.0597
ASR03355	EVTAC		CA030814		LAFARGE-DAVENPORT	NSP BAGAN	20	0.0350	0.0370				0.0367	0.0490
ASR03356	EVTAC		CA030814		LAFARGE-DAVENPORT	COAL CREEK	20	0.0267	0.0307				0.0313	0.0397
ASR03357	EVTAC		CA030814		LAFARGE-DAVENPORT	SLAG	35	0.0280	0.0350				0.0403	0.0507

Mosab
Sibect
↑

DATE COMPLETED: GRAID USED: PIT RUN: PROJECT NO#: RESEARCH DISTRICT:

COMMENTS:
CC: CONCRETE OFFICE - MARIA MASTEN
CONCRETE RESEARCH OFFICE - CURT TURGEON
PROJECT ENG#: NANCY WHITING
CHARGE OUT#: 0516

REVIEWED BY: Rod P. Sturm

From: "Nancy Whiting" <Nancy.Whiting@dot.state.mn.us>
To: <dennis.martin@dnr.state.mn.us>, "Gregory Johnson"
<Greg.Johnson@dot.state.mn.us>, "Roger Olson" <Roger.Olson@dot.state.mn.us>
Date: 2/17/2004 11:13:53 AM
Subject: Mesabi Select

I talked with Jim Small today and United Taconite (formerly EVTAC) is blasting today and they will set aside 2000 tons from the Top of the Lower Cherty-Waste for Mesabi Select aggregate. Although there will be some waste once crushed to a specified gradation it should be plenty of rock, especially if we do not use it for base and place cell 26 on the same base material as the other cells. The next step is to find the funding to bring this rock into the metro area where Kraemer & Sons can crush it to our specs. Dennis - any luck yet in securing this funding?

On another note - the C1260 ASR Rapid Mortar Bar test results are available. The highest expansion was 0.076%, suggesting it is non-reactive. Even though we rely on the year long C1293 Concrete Prism test for our coarse aggregate in concrete, given such low C1260 results MnDOT may feel comfortable enough to use it in a concrete test section. This will have to be discussed.

Nancy

Nancy M. Whiting
Geologist

Minnesota Dept. of Transportation
Office of Materials
1400 Gervais Ave
Maplewood, MN 55109

651-779-5603
651-779-5616 (FAX)
nancy.whiting@dot.state.mn.us

Where words leave off music begins.
- Heine

CC: "Charles Howe" <Charles.Howe@dot.state.mn.us>, <JSmall@edkraemer.com>