Ardrey, Brenda

Subject: FW: Bridgeton Landfill Flowable Fill
Attachments: flowable fill information.pdf

From: Beaudoin, Michael [mailto:mbeaudoin@cecinc.com]
Sent: Wednesday, July 09, 2014 1:59 PM
To: Fitch, Charlene; Nagel, Chris
Cc: Brian Power (bpower@republicservices.com); Jessica E. Merrigan (jmerrigan@lathropgage.com); Getting, James (JGetting@republicservices.com); Jim Teter (jteter@republicservices.com); Grahlherr, Don; Kamp, Kevin
Subject: Bridgeton Landfill Flowable Fill

On behalf of Bridgeton Landfill, I am forwarding the information that we discussed yesterday. CEC has investigated many potential flowable fill mixtures and had conversations with a number of grout and fill contractors. The performance criteria that was demanded during the research was that the fill be:

- inert/non-combustible,
- applied without entrained air,
- sufficiently strong to allow foot and light vehicle traffic,
- curable to a malleable condition so it can deform with future settlement and not crack,
- relatively low permeability so it will resist gas and leachate conduction, and
- previously approved by MDNR and St. Louis County for fill application.

After careful consideration, the only material that appears to be commercially and successfully utilized, tested, approved, and which meets our performance objectives is a mixture of fly ash and water. The proposed mix is 1350 pounds Class C fly ash / 1200 pounds water for each cubic yard of fill. There are no other materials such as cement or sand proposed for addition during our initial applications. See the attachment for additional information.

Bridgeton Landfill's first application of flowable fill will be limited to circular void areas that are on fairly level ground and are not located adjacent to subcap drains and/or linear cracks or features that are not adjacent to any subcap drains. In this way, lateral flow can be easily contained with sandbag pressure on the FML cap and/or visual observation, and the potential to "run" from the application are is limited.

In certain situations—such as filling of a void around an active gas extraction well—precautions will be needed to assure that gas well perforations or not backfilled. In such situations, the contractor will add aggregate to cover the perforations and then a low-slump, quick-dry concrete mix to prevent the flowable fill from entering the aggregate or well perforations.

Note that the expected quantities of flowable fill to be used are relatively small as it will only be used where very local settlement needs to be brought to surrounding grade. A typical void or crack would only require 2-10 cubic yards of material, and a typical project may include a dozen or so voids to be addressed. Also, all fill will remain under an FML cap so it will not be exposed to the environment.

We will provide notice to you that the first application will be performed so that you can observe the process if you desire. We fully expect an iterative process to obtain the best mixture ratio and application techniques. Bridgeton Landfill shares your concerns regarding occlusion of subcap drains or other negative impacts and will not use flowable fill if these were to occur.

Bridgeton Landfill looks forward to using flowable fill to minimize cutting and opening the FML cap, thereby minimizing odors during future cap maintenance activities. Please let us know if you have any concerns or additional questions so we may proceed with this application. Thank you.

Michael R. Beaudoin, P.E. / Principal

Civil & Environmental Consultants, Inc.
44725 Grand River Avenue · Suite 104 · Novi, Michigan 48375
Toll-Free: 866-380-2324 · Direct: 248.374.8610 · Fax: 248-374-8599
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Fully Insured

RRR
PIPE ABANDONMENT

Member of Teamsters
Local # 660

1655 Hwy 67
Festus, Mo 63028
P: 314-574-3788 or 636-947-4217 F: 636-947-6982

FLOWABLE FILL MIX PROPERTIES

Report No. 2890
Date: April 1, 2013

Required Strength: Pipe Fill
Place for: Kansas City

Client:
Project: Mix Design

Test represents 1.00 CuYd/0.76m3

FLOWABLE FILL MATERIAL WEIGHTS

Type I Cement	0.00
Class C Spec Fly Ash	1350 lbs
Coarse Agg. Limestone	0.00
Coarse Agg.	0.00
Fine Aff. River Sand	0.00
Water	1200 lbs
	2550 pounds/cubic yard

Average Wet Unit Weight: 94.4lbs per cu. Ft.

MATERIAL SUBMITTAL REVIEW
No Exceptions ☒
Exceptions noted ☐
Resubmit with corrections ☐
Contractor is not relieved of responsibility for compliance with plans & specifications.
CRAWFORD, MURPHY & TILLY, INC.
By JWM Date 7/30/13

Test Sample	Strength (psi) (ASTM D4832-02)	
14 day	A	B
	84.9	89.3
Average	87.1	

Test Sample	Volumetric Shrinkage (%) (ASTM D4943-02)	
	A	B
Shrinkage Test Samples (oven dried)	10	8
Unconfined Test Samples (air-dried)	14	8

Lapsed Time	Flow (ASTM D939-02)		Water at 23.6° C
(min)	(sec)	(%)	(sec)
<1	8.8	26.6	7.8
25	9.3	27.2	
10	33.5	28.3	
40	No flow	33.9	

FLOWABLE BACKFILL
FIELD SECTION 621 TABLE 1
QUALIFIED COMMERCIAL BRAND MIXTURES
(0621FB)

Brand Name	Source
Cellufoam Terra-Fill 250 (8/95)	Cellufoam Concrete Systems P.O.Box 86, Station A Scarbough, Ontario Canada M1K 5B9
* Controlled Density Fill (CDF) (8/07)	RRR Trucking, LLC P.O. Box 652 St. Charles, MO 63302
Darafill (High Air Content Entrainment Additive (1/95)	W. R. Grace 62 Whittemore Avenue Cambridge, MA 02140-1692
Elastizell PS (1/95)	Elastizell of St. Louis, Inc. P.O. Box 267 Valley Park, MO 63088
Rheocell Rheofill (High Air Entrainment Additive) (5/98)	Master Builders, Inc. 680 Craig Road, #104 St. Louis, MO 63141

MATERIAL SUBMITTAL REVIEW
No Exceptions Taken ☒
Exceptions taken as noted ☐
Resubmit with corrections ☐
Contractor is not relieved of responsibility for compliance with Plans & Specifications.
CRAWFORD, MURPHY & TILLY, INC.
By JWM Date 7/30/13

Charlie A. Dooley
County Executive

Saint Louis
COUNTY
HIGHWAYS & TRAFFIC
PUBLIC WORKS

Sheryl L. Hodges, D.E. P.E., L.P.G.
Director

April 30, 2008

Mr. Bill Revalre
RRR Trucking, LLC
P.O. Box 652
St. Charles, Missouri 63302

RE: Controlled Density Fill (CDF)
Request for Flowable Fill and Pipe Fill Approval

Dear Mr. Revelle:

I have reviewed your request for your new product submittal Controlled Density Fill (CDF), for use as Flowable Fill Backfill mixture.

After reviewing the product technical specifications, lab testing, and MoDOT's and MSD's letters of approval, we are approving your product on a project-by-project basis as excavatable flowable fill and pipe fill.

Please be aware that approval of your product is contingent upon continued compliance with:

- permit requirements
- contract special provision specifications
- satisfactory field performance

Approval does not relieve you of the responsibility to provide certifications for all materials prior to incorporation into the permitted or County-funded project.

If you have any questions or need additional information please feel free to contact, Mr Vince Ogar, Deputy Chief Materials Engineer at 314-615-1186.

Sincerely,

Richard E. Hotesinger, P.E.
Chief Materials Engineer

REH:mw

cc. Charles H. Taylor, P.E., Division Manager, Construction

Highways & Traffic: 12° South Meramec Avenue • Saint Louis, MO 63105 • 314/615-8504 • FAX 314/615-8184
Public Works: 41 South Central Avenue • Saint Louis, MO 63105 • 314/615-5164 • FAX 314/615-7085

MATERIAL SUBMITTAL REVIEW

No Exceptions Taken ☒
Exceptions taken as noted ☐
Resubmit with corrections ☐

Contractor is not relieved of responsibility for compliance with plans & specifications.

CRAWFORD, MURPHY & TILLY, INC.

By JWM Date 7/30/13

SCI ENGINEERING, INC.
130 POINT WEST BOULEVARD
ST. CHARLES, MISSOURI 63301
636•949•8200 FAX 636•949•8269
www.sciengineering.com

August 2, 2007

Mr. Dave Wieties
Alternate Fuels, Inc. (AFI)
7127 Reichert Road
Columbia, Illinois 62236

RE: Laboratory Test Results of Field Samples
Fly Ash as Flowable Fill
SCI No. 2006-0675.11

Dear Mr. Wieties:

This letter transmits the results of the testing of field collected samples of the Meramec fly ash flowable fill to evaluate the mixing procedure used on site. Our services have been provided as an extension to our proposal dated August 8, 2006, as approved by you on August 11, 2006. A report summarizing laboratory test results of laboratory mixed samples was issued on October 3, 2006.

PROJECT DESCRIPTION AND TESTING PROTOCOL

Alternative Fuels, Inc. (AFI) desires to test the engineering properties of the Meramec Class C Fly Ash slurry produced by their on-site mixing method. The equipment that is used to pump and monitor the flowable fill is contained in a tandem-axle trailer that can be pulled with pickup truck. The fly ash is pumped through a 4-inch line from a tanker truck to inside the trailer to a tee connection with an approximate 1½-inch water line. As the valves are opened, the fly ash and water are blended.

The fly ash is typically pumped at 15 pounds per square inch (psi) from the tanker; the valve controlling the flow of the fly ash is fully open during placement, or shut off when mixing is completed, as there is no attempt to regulate the flow of fly ash from the tanker to the mixing unit. The pump pressure gauge is mounted on the tanker and monitored by the truck driver, who routinely checks the pressure, about five different times as a single tanker is unloaded. Lower pressure from the tanker could plug the 4-inch line, while a higher pressure could cause the tanker to burst. The flowable fill can be produced at approximately 1 cubic yard per minute or approximately 1 tanker per hour.

The viscosity of the flowable fill is controlled by adjusting the water pressure with a ball valve. While the water supply hydrant pressure generally ranges from 100 to 150 psi., a pressure gauge mounted on the water line is monitored and adjusted during the placement of the flowable fill. Typically, the water pressure gauge is maintained at approximately 60 psi; however, if the flowable fill is pumped to greater distances (more than about 1,000 feet), then the water pressure is reduced to around 50 psi for a thinner mix

MATERIAL SUBMITTAL REVIEW
No Exceptions Taken ☒
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Resubmit with corrections ☐
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CRAWFORD, MURPHY & TILLY, INC.
By JWM Date 7/30/13

Table 1 – Strength Test and Density Results

Mixture	Cure Period (days)	Day Compressive Strength (psi) minimum	maximum	average	Average Moisture Content (percent)	Average Wet Density (pcf)	Average Dry Density (pcf)
Mixture 1 70 psi water pressure	7	72			78	80.8	45.5
	14	76	98	87	78	89.8	50.4
	28	81	114	94	76	90.5	51.4
Mixture 2 60 psi water pressure	7	31			76	75.9	43.0
	14	42	53	48	76	89.4	50.7
	28	39	53	46	78	90.0	50.6
Mixture 3 50 psi water pressure	7	38			74	76.9	44.3
	14	52	50	54	82	89.8	49.4
	28	60	70	65	73	86.7	50.1

use in Ft. Worth

Overall, there was little correlation between the change in water pressure and the resulting strength of the samples. The average strength for all of the field collected samples was 58 psi. While there was a definitive increase in strength from the 7-day to 14-day strengths, the samples did not increase consistently in strength from the 14- to 28-day breaks. The previous laboratory mixed samples showed a more consistent increase in strength with time, and also an increase in strength with an increased fly ash content.

The results of the testing on the field prepared samples would suggest that the field mixing yields more variability than the laboratory mixed samples. The samples obtained from a water pressure of 70 psi did have higher strengths than the samples mixed at lower water pressures, which was anticipated. However, there was little difference between the first 60 psi sample and the 50 psi sample; in fact the strengths were actually lower for the 50 psi sample which were contrary to what was anticipated. Furthermore, there was a significant difference between the two 60 psi samples. One explanation may be that the second 60 psi sample was collected towards the end of the fly ash tanker being emptied, potentially resulting in a thinner mix; however, the viscosity measurements do not support this.

There was little difference in the strengths of the samples allowed to drain and those that were not drained. Some of the drained samples had higher strengths than the undrained samples, although some were lower. Sample size had little effect on the strength results. The larger 4- by 8-inch samples had slightly higher strengths than the smaller 3- by 6-inch samples.

The flow test data is summarized in Table 2. Decreasing the water pressure produced a thinner slurry, as was anticipated. The lapsed time of the 60 psi mixture through the ½-inch-opening correlates with the lapsed time for the 50/50 fly ash-water mixture produced previously in the laboratory.

MATERIAL SUBMITTAL REVIEW
We Exceptions Taken ☒
Exceptions taken as noted ☐
Resubmit with corrections ☐
Contractor is not relieved of responsibility for compliance with plans & specifications.
CRAWFORD, MURPHY & TILLY, INC.
By Tkm Date 7/30/13

SCI ENGINEERING, INC
[illegible]
[illegible]
[illegible]
[illegible]

Concrete Compression Test Report

ASTM C [illegible]

Project: MODOT ROUTE [illegible]	Report No. 1
Location: ST LOUIS MISSOURI	Report Date 6/[illegible]/2009
	SCI No: 2009[illegible]
Client: RRR FLOWABLES	[illegible] ID: [illegible]

Placement Location: not available

Contractor	not available	[illegible]	[illegible]	[illegible]	not available
Supplier	not available	Field Admixtures		none	
Plant	not available	Water added gal		not available	
Truck No	not available	Slump in	not available	Air Content%	not available
Ticket No	not available	Conc Temp F		not available	
Time Batched	not available	Air Temp F		not available	
Time Cast	not available	Truck Obs		not available	
Date Cast	5/2[illegible]/2009	Weather Obs		not available	
Date Received	6/[illegible]/2009	Max Size		not available	
Cast By	Client	Cement Type		[illegible]	
Specification	[illegible] psi @ 28 Days	Plan. Admixture		not available	

[illegible]

COMPRESSION TEST RESULTS

[illegible]

Lab Cylinder Number	Job Cylinder Number	Type of Curing	Test Date	Age days	Diam in	Area sq in	Maximum Load, lbs	Compressive Strength, psi
1834	1	Field	6/[illegible]/2009	28	[illegible]	[illegible]	[illegible]	[illegible]
1835	[illegible]	Field	[illegible]/2009	28	[illegible]	[illegible]	[illegible]	[illegible]

MATERIAL SUBMITTAL REVIEW
No Exceptions Taken ☒
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Resubmit with corrections ☐
Contractor is not relieved of responsibility for compliance with plans & specifications.
CRAWFORD, MURPHY & TILLY, INC.
By DWM Date 7/30/13

[illegible]

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SCI ENGIN[illegible]

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