APPENDIX 2

Bituminous Geomembrane (BGM) Specifications

COLETANCHE®

www.coletanche.com

Axter Coletanche® Inc.
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Montreal, QC, H2S 1T4
CANADA

Prepared: 29/04/2013
Cancels and replaces: 07/01/2013
Code : 1876001
Manufacture source Courchelettes (59-France)
Technical ref: FT AXTER ES2 ASTM

PRODUCT DATA SHEET

COLETANCHE ES 2

DESCRIPTION

COLETANCHE ES 2 is an SBS elastomeric modified bituminous geomembrane.

USE

Moderate level of mechanical resistance, for use an environmental protection and groundworks waterproofing, in particular :
- To cover landfill,
- Hydraulic ponds,
- Containment of Industrial liquid wastes,
- Canals ,
- Contamined land.

Product use must be validated by Axter

APPLICATION METHOD

Torched

STORAGE

Rolls must not be stored directly on the ground. They must be laid supported on concrete blocks, trestles or timber beams) min 35 cm height, placed under the mandrel ends.

COMPOSITION

(indicative)

Reinforcement (g/m²) :	Glass mat	50
Reinforcement (g/m²) :	Non-woven geotextile	250
Binder (g/m²) :	Elastomeric SBS	4300
Surface finish (g/m²) :	Sand	200
Under surface finish (g/m²) :	Polyester antiroot film	15

CHARACTERISTICS

		STANDARD	UNITS	VALUES	Tolerance Min	Tolerance Max
Dimensions	Length	-	*m*	79	≥	
	Width		*m*	5.01	≥	
Thickness (on finished product)		*ASTM D 5199*	mm	4.00	*3.80*	*4.40*
Surface mass		*ASTM D 3776*	kg/m²	4.85	*4.50*	*5.20*
Resistance to tearing	Longitudinal	*ASTM D 4073*	N	825	*619*	
	Cross direction			700	*525*	
Tensile properties : maximum tensile strength	Longitudinal	*ASTM D 7275*	kN/m	27	*20.3*	
	Cross direction			24	*18*	
Tensile properties : elongation	Longitudinal		%	60	*48*	
	Cross direction			60	*48*	
Tensile properties : maximum tensile strength	Longitudinal	*ASTM D 4595*	kN/m	25	*19*	
	Cross direction			21	*16*	
Tensile properties : elongation	Longitudinal		%	80	*60*	
	Cross direction			80	*60*	
Static Puncture		*ASTM D 4833*	N	530	*477*	
Flexibility at low temperature	Surface	*ASTM D 5147*	°C	-20		
	Under surface			-20		
Water permeability (liquid tightness)		*ASTM E 96*	*m/s*	6.10^{-14}		
Gas permeability (gas tightness)		*ASTM D 1434-82*	*m3/(m².j.atm)*	$< 2{,}3.10^{-14}$		

NOTE: AXTER COLETANCHE INC. may modify the composition and/or utilisation of its products without prior notice. Consequently orders will be filled according to the latest specification.
The manufacturer reserves the right to modify, at any time, the characteristics of its products.

APPENDIX 3

WRSF Dike– QC/QA Program

		QA Inspectors			QC Representatives			
Item	**Material**	**Task**	**Frequency**	**Form to be fill**	**Task**	**Frequency**	**Form to be filled**	**Owner Representative – Coordinator**
Survey	All placed material limits	Visual assessment for grade limits	Periodically	Daily report	Ensure that the surveyors use the latest information, bench marks and other datum and have a good understanding of the Project and meet requirements	Continuously	Daily report	Coordinate and compile information
Respect of the gradation limit	Rockfill	Visual assessment	Periodically	Daily report	Visual inspection	Continuously	Daily report	Evaluation of PAG / NPAG[5] material. Coordination to change the borrow source if required, adjust the exploitation by sorting out boulders with the Agnico Eagle operator, etc.
Respect of the gradation limit	Coarse Filter	Visual assessment	Periodically	Daily report	Visual inspection	Continuously	Daily report	Modify the source or the method of crushing and/or processing
Respect of the gradation limit	Fine filter BGM bedding and cover	Visual inspection Review QC data and procedure	Periodically as requested	Daily report	Visual inspection and testing - Sampling - Grain Size distribution	Daily	Daily report	Collect and assess the QC results. Adapt the screening if required
Respect of the gradation limit	Fine Filter amended with bentonite	Ensure that mixing location and procedures are respected. Review QC data and procedure	Periodically As requested	Daily report	- Sampling for external lab: - Grain Size distribution - Saturated hydraulic conductivity (see note) - Standard Proctor (see note) - Sand Cone (see note)	Daily 1 / 300 m³ 1 / 300 m³ 1 / 300 m³	Daily report	
Storage	Bentonite and BGM[6]	Visual inspection	Once	Daily report	Visual inspection	Once	Daily report	Ensures that the storage in conformity with the manufacturer's specifications
Foundation approuval (footprint)	Snow / Ice / Boulder removal	Visual inspection	Periodically prior to filling of footprint	Daily report / QA / QC approuval form	Visual inspection to detect any unsuitable material and coordination with Contractor to ensure specifications are met Manage the clearing limits with the surveyor	Continuously	Daily report / QA / QC approval form	Collect, review and compile completed QC/QA forms
Foundation approuval (Key trench)	Bedrock / Ice poor Till	Visual inspection for foundation approval and verify the excavation limit with the surveyor	Periodically prior to fill placement	Daily report / QA / QC approuval form	Visual inspection to detect soil and rock fragments in bedrock cracks and/or joints. Coordination with the Contractor to remove the above undesirable materials. Verify the excavation limits with the surveyor	Continuously	Daily report / QA / QC approval form	Collect, review and compile completed QC/QA original forms
Foundation treatment (key trench)	Slush grout	Visual assessment	Periodically	Daily report / QA / QC approbation form	Visual inspection of each lift – ensure specifications are met.	Periodically	Daily report / QA / QC approval form	Collect, review and compile completed QC/QA original forms
Placement of material	All materials	Visual assessment	Periodically	Daily report / QA / QC approbation form	Visual inspection of each lift – ensure specifications are met.	Periodically	Daily report / QA / QC approval form	Collect, review and compile completed QC/QA original forms
Compaction of material	All materials	Visual inspection – procedures meet the specification	Periodically	Daily report	Visual inspection / manage the procedures with the Contractor, counting the number of passes	Continuously	Daily report	Collect, review and compile completed QC/QA original forms Collect and compile original form
Membrane installation	BGM	Visual assessment and may request additional testing	Periodically	Daily report	Visual inspection Destructive Tests (DT) Vacuum	Continuously 2 / day (1/1000 m min) 2 / day (30 m seam length)	Contractor QC report	Collect, review and compile completed QC/QA original forms;

1 PAG/NGAG = potential acid generating/non potential acid generating

Note: Because of the limited quantity of the FFAB (<1400 m^3), the required QC tests do not exceed about four (4) tests per test type.

6 BGM = Bituminous geomembrane

APPENDIX 4

Bituminous Geomembrane (BGM) QC/QA Plan

Table A: Schecule of QC Testing by Contracor

Type of test	In-Situ or Sample Extraction	Testing Standard	Frequency of testing	Specified Value
Tensile Shear Strengthof BGM Seams	Sample Extraction	D7056	1 per 1000 m of seam length	15 kN^3m (min)
Vacuum Box Testing	In-situ	ASTM D5641	1 per 30 m of seam length	No defects permitted
Ultrasonic T of Seams	In-situ	ASTM D7006	1 per 300 m of seam length	No defects permitted
Visual	In-situ		Along entire seam	No defects permitted

Table B: Schecule of QA Testing by QA Inspector

Type of test	Testing Type and Standard	Frequency of testing	Specified Value
Oversee vacuum box test	In-Situ	1 every 10 QC tests	pass
Oversee vacuum box test	In-Situ	1 every 5 QC tests	pass
Thickness	ASTM D5199	1 per 1000 m of seam length	3.8 mm (min)
Density	ASTM D792	1 per 1000 m of seam length	1268 g/cm^3
Tensile Shear Strength of Seams	ASTMD7056	1 for every 5 QC tests	15 kN/m (min)
Tensile Strengh of BGM Liner material	ASTM D4595-86	1 per 2000 m of seam length	26.8 kN^3m longitudinal and 16.2 kN/m transverse

APPENDIX 5

Approval form

SNC·LAVALIN

SITE REPORT
(Detailed)

Document number

Visit date	Time (Start/End)	Project No.	Prepared by

Project	Client
	Agnico Eagle

Consultant	Contractor
SNC-Lavalin	

Weather : ☐Sunny ☐Cloudy ☐Rain ☐Storm ☐Snow ☐Glaze

Wind : ☐None ☐Light ☐Moderate ☐Strong, gusts

Temperature : _____ °C

Comments : _____

Appendix : ☐Yes ☐No Pictures ☐Yes ☐No Inspection report or other : _____

ACTIVITIES PERFORMED BY SNC-LAVALIN (indicate if test forms were used)

SITE GUIDELINES (guidelines, memos, modification proposals, etc.)

No	Subject	Given to

SPECIFIC ELEMENTS VERIFIED

Elements	Location	Scope and comments

SAFE AND SAFETY REMARKS

Issued by :

Signature | Date

Verified by :

Signature | Date

SKETCH

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APPROVAL FORM

PROJECT : _____

PROJECT #: _____ **DATE:** _____

DOCUMENT #: _____ **TIME:** _____

(YYYYMMDD-DS/NS-01) DS/NS = Day/Night shift (24 hour clock)

APPROVAL FOR :

- ❒ Foundation approval (footprint)
- ❒ Foundation approval (key trench)
- ❒ Fill placement: _____
- ❒ CB cutoff wall approval
- ❒ Other: _____

LOCATION		**PREVIOUS APPROVALS**	
Station		**Station:**	
Inclination:		**Details:**	
ELEVATION :	❒ varies _____ m		

COMPLIANCE WITH TECHNICAL SPECIFICATIONS:

(Add additional items if needed)

	VERIFICATIONS DONE BY:				
	QA		**QC**		**N/A**
	Y	**N**	**Y**	**N**	
1. Lines and grades					
2. Free of ice/snow/water					
3. Cleaning of trench and/or pile bottom					
4. Gradation (visual)					
5. Placement (lift thickness, segregation, etc.)					
6. Compaction					
7. Foundation on bedrock					
8. Key-in depth into bedrock					
9. Water quality					
10. CB slurry viscosity and density					
11. Elevation of CB Piles					
12. Primary piles strength (Minimum of 50 kPa UCS)					
13. Keying between primary and secondary					
14. Cracks on top of cutoff wall					

	QA		QC		N/A
	Y	N	Y	N	
15. CB mix/slurry tested (UCS, permeability, and pinhole tests)					
16. As built survey completed					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					

DETAILS

(Refer to list above for item #)

		APPROVED BY:			
		QA		QC	
ITEM		Y	N	Y	N

APPROVED BY:	NAME	SIGNATURE	DATE
QA REPRESENTATIVE			
QC REPRESENTATIVE			
OWNER'S REPRESENTATIVE			

SNC·LAVALIN

B | Technical Note on Thermal Analysis of WRSF Dike

Title of document: **THERMAL ANALYSES AT THE WRSF DIKE**

Client: **AGNICO EAGLE MINES LTD.**

Project: **AMARUQ WATER MANAGEMENT INFRASTRUCTURE DETAILED ENGINEERING**

Prepared by: Mathieu Durand-Jézéquel, Jr. Eng., M. Sc.

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Approved by: Yohan Jalbert, Eng.

REVISION INDEX

Revision #	Prep.	App.	Date	Pages Revised	Remarks
PA	M. D.-J.		2018-06-13		Issued for internal review
PB	M. D.-J. / G. H.	Y. J.	2018-07-31	All	Issued for Client's comments
00	M. D.-J.	Y. J.	2018-08-13	All	Final version

NOTICE TO READER

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SNC-Lavalin has, in preparing estimates, as the case may be, followed accepted methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care, and is thus of the opinion that there is a high probability that actual values will be consistent with the estimate(s). Unless expressly stated otherwise, assumptions, data and information supplied by, or gathered from other sources (including the Client, other consultants, testing laboratories and equipment suppliers, etc.) upon which SNC-Lavalin's opinion as set out herein are based have not been verified by SNC-Lavalin; SNC-Lavalin makes no representation as to its accuracy and disclaims all liability with respect thereto.

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