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Quantification of the effects of thin spray-on liner application on shotcrete tensile strength

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DECLARATION

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

……
(Signature of candidate)

…….. day of ……..... (year) …….....

at ……

ABSTRACT

In underground and surface excavations, rock mass instability often occurs, and one method of remedying this is to spray support liners onto the unstable rock surfaces. Thin Spray-on Liners (TSLs) have been used in both the mining and civil engineering industries as sealants, and as surface support to maintain rock mass stability. As a replacement of shotcrete, the use of TSLs for rock support is gaining increasing acceptance in the mining industry due to experience with its exposure. The literature describing success stories of the application of the products have been emerging lately. A significant amount of testing has been carried out to determine the properties of TSLs and to investigate how the products provide support to the excavations.

The research described in this research report describes a laboratory investigation into the extent to which various spray-on liners, coated on unreinforced and reinforced shotcrete specimens, will enhance the tensile strength of the shotcrete. Physical properties and the mechanisms of behaviour of these sprayed liners on shotcrete under laboratory conditions are compared as well. Brazilian indirect tensile strength tests were performed on shotcrete specimens, both uncoated and hand-coated with TSL material for this research. Tests were carried out for a specified range of curing times, and thus the performance of the TSLs was established as a function of curing time. This is seen as a significant parameter to be checked for sensitivity.

The laboratory test results of a total of 96 unreinforced and reinforced shotcrete specimens, using three different TSL products as coatings, showed that the spray-on liners significantly enhanced the tensile strength of the shotcrete. Strength gains 2 hours after application were in the order of 20%, and this increased to approximately 40% after 28 days. Slightly higher strength gains were recorded for the fibre-reinforced shotcrete specimens. In summary, the tests showed that the performance of the TSLs coated on the shotcrete depends on the type and quality of the liner, the curing time and the added material in the shotcrete, eg fibre product. The Brazilian test provided a satisfactory method of evaluating and comparing the enhancement of shotcrete tensile strength provided by different TSL products.

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TABLE OF CONTENTS

CONTENTS **PAGE**

DECLARATION I
ABSTRACT II
ACKNOWLEDGEMENTS III
CONTENTS V
LIST OF FIGURES IX
LIST OF TABLES X
LIST OF SYMBOLS AND ACRONYMS X

CHAPTER 1 INTRODUCTION.....**1**

1.1 BACKGROUND 1
1.2 PROBLEM STATEMENT..... 3
1.3 OBJECTIVES 3
1.4 RESEARCH METHODOLOGY.....4
1.5 FACILITIES REQUIRED.....5

CHAPTER 2 REVIEW OF RELEVANT LITERATURE ON SHOTCRETE AND THIN SPRAY-ON LINERS.....**6**

2.1 INTRODUCTION.....6

2.2 OVERVIEW OF THE SHOTCRETE.....6
2.2.1 Comparison of both the dry mix and the wet mix processes.....7
2.2.2 Fibre reinforced and Unreinforced shotcrete.....8
2.2.3 Shotcrete failure modes 8
2.3 OVERVIEW OF THIN SPRAY-ON LINER 12
2.3.1 Uses of the TSL.....12
2.3.2 Review of previous TSL testing.....13
2.3.3 Advantages of the application of the TSL's as a support element.....14
2.3.4 Disadvantages of the application of the TSL's.....15
2.4 PROPERTIES OF TSL.....16
2.4.1 Physical Properties of the TSL.....16
2.4.2 Chemical Properties of the TSL.....17

2.5 FUNCTIONS OF SPRAYED LINERS AS ROCK SUPPORT.....17

2.6 SUMMARY.....17

CHAPTER 3 SPECIMEN PREPARATIONS AND TESTING.....**18**

3.1 PREPARATION AND MIXING OF THE SHOTCRETE 18
3.1.1 Shotcrete Mixing Methodology 18
3.1.2 Addition of fibre into the shotcrete mixture.....19
3.1.3 Duration of mixing.....20
3.1.4 Application of the mix to the panel tray 20

3.2 PREPARATION OF THE SHOTCRETE SPECIMEN.....21

3.3 THIN SPRAY-ON LINER PRODUCTS USED.....22
3.3.1 TSL Mixing Methodology.....23
3.3.2 Curing time.....24
3.3.3 TSL Thickness.....24

3.4 DESCRIPTION OF APPARATUS, SPECIMEN PREPARATION, TSL COATED SPECIMEN AND TEST PROCEDURES 24
3.4.1 Descriptions of apparatus used.....24
3.4.2 Selection of evenly mixed specimens.....26
3.4.3 TSL coated specimen preparation.....27

3.5 TESTING METHOD 29
3.5.1 Brazilian Indirect Tensile Strength.....29
3.5.2 Indirect Tensile Strength Calculations.....31

3.6 SUMMARY OF PREPARATION AND TESTING.....32

CHAPTER 4 LABORATORY TESTS RESULTS AND ANALYSIS.....**33**

4.1 RESULTS AND ANALYSIS.....33
4.1.1 Load displacement curves of tested shotcrete specimens.....33
4.1.2 Percentage strength increase.....35
4.1.3 3D stress analyses of a TSL coated shotcrete specimen.....39
4.1.4 Calculation and results of the Brazilian strength test on both the reinforced and the unreinforced samples.....40

4.2 SUMMARY OF THE LABORATOTY TESTS RESULTS AND ANALYSIS.....45

CHAPTER 5 CONCLUSIONS **46**
CHAPTER 6 REFERENCES **47**
APPENDICES.....**54**

APPENDIX A – Percentage Strength gain 54

1 - Table A.1.1 Percentage strength gain for on unreinforced shotcrete.....54
2 - Table A.1.2 Percentage strength gain for TSL A on reinforced shotcrete.....54
3 - Table A.2.1 Percentage strength gain for TSL B on unreinforced shotcrete.....54
4 - Table A.2.2 Percentage strength gain for TSL B on reinforced shotcrete.....55
5 - Table A.3.1 Percentage strength gain for TSL C on unreinforced shotcrete.....55
6 - Table A.3.2 Percentage strength gain for TSL C on reinforced shotcrete.....55

APPENDIX B – Results on the strength Tests.....56

1- Table B.1 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL A on unreinforced shotcrete specimen 56
2- Table B.2 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL A on reinforced shotcrete specimen 57
3- Table B.3 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL B on unreinforced shotcrete specimen 58
4- Table B.4 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL B on reinforced shotcrete specimen 59

5- Table B.5 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL C on unreinforced shotcrete specimen ……..60

6- Table B.6 Brazilian Indirect Tensile Strength used on 4mm thickness for TSL C on reinforced shotcrete specimen ……..61

APPENDIX C – Results on RS3 software package……..62

1 - Table C.1 Shotcrete and TSL– Vertical query line on the Loaded Brazilian Disc Specimen ……..62
2 - Table C.2 Shotcrete and TSL– Horizontal query line on the Loaded Brazilian Disc Specimen ……..63

APPENDIX D – Brazilian Test Graphs for each TSL……..64

1 - Figure D.1 Brazilian Test on TSL A coated on unreinforced shotcrete specimen.....64
2 - Figure D.2 Brazilian Test on TSL A coated on unreinforced shotcrete specimen.....64
3 - Figure D.3 Brazilian Test on TSL B coated on unreinforced shotcrete specimen.....65
4 - Figure D.4 Brazilian Test on TSL B coated on unreinforced shotcrete specimen.....65
5 - Figure D.5 Brazilian Test on TSL C coated on unreinforced shotcrete specimen.....66
6 - Figure D.6 Brazilian Test on TSL C coated on unreinforced shotcrete specimen.....66

LIST OF FIGURES

Figure 1. Updated Shotcrete failure mechanisms (modified from Barrett and McCreath 1995)……10
Figure 2. Typical plant layout for wet-mix pneumatic-feed equipment……19
Figure 3. Polypropylene fibre used in the mix ……20
Figure 4. Shotcrete tray and a sprayed panel……21
Figure 5. a) Uncut shotcrete panel. b) Cut panel slabs. c) Uneven slabs……22
Figure 6. Method of mixing: a) Kitchen food mixer. b) Hand mixing. c) Power drill and mixer……23
Figure 7. Dimensions of apparatus used: Steel ring that supported steel frame ……25
Figure 8. Clamping fixture (knobs) and the 42mm diameter hole of the rectangular frame……25
Figure 9. Spatula and a scraper ……26
Figure 10. Specimen drilled from two types of mixtures: a) uneven mixture type b) even mixture Type……27
Figure 11. Steps followed during coating of the TSL onto the specimen……28
Figure 12: a) Specimen loaded into the test machine. b) Schematic of Brazilian disc……30
Figure 13: a) Untested specimen and b) Tested failed specimen……31
Figure 14. A typical example of the compressive diametrical load versus diametrical displacement behaviour for plain and fibre reinforced shotcrete……33
Figure 15. A typical example of the compressive diametrical load versus diametrical displacement behaviour for uncoated and TSL coated unreinforced shotcrete……35

Figure 16. Graphical representation of the unreinforced shotcrete strength gain……37
Figure 17. Graphical representation of the reinforced shotcrete strength gain……38
Figure 18. 3D view of the Brazilian disc specimen: (a) TSL coating (b) Without Coating……39
Figure 19: Modelling Results (a) Vertical and Horizontal Query lines (b) Contour planes……40
Figure 20. Brazilian Strength Test Results for TSL A, B and C coated on the reinforced shotcrete specimen……43
Figure 21. Brazilian Strength Test Results for TSL A, B and C coated on the reinforced shotcrete specimen……44

LIST OF TABLES

Table 1. Comparison of features of dry-mix and wet mix shotcrete processes……7
Table 2. Review of some test method reviewed by Potvin et al (2004)……13
Table 3. Ideal properties of the TSL (Espley-Boudreau, 1999)……16
Table 4. Polypropylene fibre specifications……19
Table 5. Unreinforced shotcrete percentage strength gain……36
Table 6. Percentage strength gain equation of different TSL's ……37
Table 7. Reinforced shotcrete percentage strength gain ……38
Table 8. Percentage strength gain equation of different TSL's ……39
Table 9. Brazilian Indirect Tensile Strength (No TSL): Unreinforced ……41
Table 10. Brazilian Indirect Tensile Strength (No TSL): Reinforced ……42
Table 11.Unreinforced shotcrete tensile strength equations and the correlation coefficients….43
Table 12. Reinforced shotcrete tensile strength equations and the correlation coefficients…….44

LIST OF SYMBOLS AND ACRONYMS

σt	Tensile strength (MPa)
MPa	Mega Pascal
Kg	Kilogram
P	Applied Load (kN)
D	Diameter of specimen core (mm)
A	Failure Area (m^2)
t	Thickness of the core (mm)
TSL	Thin Spray-on Liner
*	Typical values assumed