

**OPTIMIZING MECHANICAL PROPERTIES OF  
CONCRETE USING SUGARCANE BAGASSE ASH**

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Master of Science (Major Component Research)

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Sri Lanka

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Thesis submitted in partial fulfillment of the requirements for the degree  
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## DECLARATION

I declare that this is my own work and this Thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The supervisors should certify the Thesis with the following declaration.

The above candidate has carried out research for the Master of Science (Major Component Research) Thesis under our supervision. We confirm that the declaration made above by the student is true and correct.

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## **ABSTRACT**

In this study, sugarcane bagasse ash is recognized as a pozzolan, and the examination delves into its impact on the structural properties and durability of concrete. A significant volume of bagasse ash is generated annually in Sri Lanka through the recycling of raw bagasse for power generation in the sugar industry. The bagasse ash utilized in this study was procured from a local sugar factory in Sri Lanka. Diverse methods, such as X-ray diffraction, X-ray fluorescence, and laser particle size analysis, were utilized to evaluate the chemical, physical, and mineralogical characteristics of the bagasse ash. Additionally, a scanning electron microscope was utilized to examine the microstructure. The assessment extended to the examination of hardened properties such as compressive strength, bond strength, tensile strength, ultrasonic pulse velocity, and durability properties including water absorption and penetration of chloride.

The concrete mixtures were formulated by substituting bagasse ash at ratios ranging from 5% to 20% by weight instead of Portland cement. The local ash demonstrated pozzolanic characteristics as per the results of chemical, physical, and mineral tests. Notably, mixtures containing 5% to 15% bagasse ash substitution were identified as optimum replacements for achieving elevated compressive and tensile strength. Simultaneously, the water absorption and rapid chloride permeability test indicated a lower value of up to a 10% ash content percentage than control concrete.

**Keywords:** Concrete, Sugarcane bagasse ash, Composites, Mechanical properties, Durability

## TABLE OF CONTENTS

Declaration of the Candidate & Supervisor	i
Acknowledgement	ii
Abstract	iii
Table of Contents	iv
List of Figures	vii
List of Tables	ix
List of Abbreviations	ix
1 Introduction	1
1.1 Background	2
1.1.1 Sugarcane Bagasse Ash	2
1.1.2 Microstructure Properties of Sugarcane Bagasse Ash	3
1.1.3 Drawbacks of Sugarcane Bagasse Ash	4
1.1.4 Sugarcane Bagasse Ash as a Substitution for Cement	4
1.2 Motivation	5
1.3 Problem Statement	6
1.4 Aim and Objectives	6
1.5 Significance of the Research	7
1.6 Thesis Structure	7
2 Literature Review	8
2.1 The Effect of Bagasse Ash Processing	8
2.1.1 Processing Effects on the Pozzolanic Characteristics of Bagasse Ash	8
2.1.2 The Effect of Treating on Bagasse Ash-Incorporated Concrete	9
2.2 Physical and Chemical Properties of Bagasse Ash	10
2.2.1 Physical Characteristics of Bagasse Ash	10
2.2.2 Chemical Composition of Sugarcane Bagasse Ash	11
2.3 Impact on Properties in Fresh State of Concrete	12

2.3.1	Workability	12
2.3.2	Soundness, Consistency and Setting time	12
2.4	Effect of Sugarcane Bagasse Ash on Mechanical Properties	14
2.5	Durability Properties	17
2.6	Summary of the Previous Studies	18
3	Methodology and Experimental Study	20
3.1	Methodology	20
3.2	Materials	20
3.2.1	Cement	21
3.2.2	Sugarcane Bagasse Ash	21
3.2.3	Coarse Aggregate	21
3.2.4	Fine Aggregate	21
3.2.5	Water	21
3.2.6	Admixture	22
3.3	Concrete Mix Design	22
3.4	Chemical and Physical Examination of Sugarcane Bagasse Ash	23
3.4.1	Scanning Electron Microscopy	24
3.4.2	Distribution of Particle Size	24
3.4.3	X-Ray Diffraction	25
3.4.4	X-Ray Fluorescence Spectroscopy	25
3.4.5	Differential Scanning Calorimetry-Thermogravimetric Analysis	25
3.5	Mechanical Characteristics of Bagasse Ash Blended Cement	25
3.5.1	Consistency	25
3.5.2	Setting Time	26
3.6	Mechanical Properties of Bagasse Ash Blended Concrete	26
3.6.1	Slump Test	26
3.6.2	Compressive Strength Test	27
3.6.3	Split Tensile Strength Test	27
3.6.4	Flexural Strength Test	28
3.6.5	Ultrasonic Pulse Velocity Test	28
3.6.6	Bond Strength	30

3.7	Durability of Concrete	31
3.7.1	Water Absorption	31
3.7.2	Rapid Chloride Permeability Test	31
4	Results	34
4.1	Chemical and Physical Examination of Sugar Cane Bagasse Ash	34
4.1.1	Scanning Electron Microscopy	34
4.1.2	Particle Size Distribution	35
4.1.3	X-Ray Diffraction	36
4.1.4	X-Ray Fluorescence Spectroscopy	37
4.1.5	Differential Scanning Calorimetry - Thermogravimetric Analysis	37
4.2	Mechanical Properties of Blended Cement	37
4.2.1	Consistency	37
4.2.2	Setting Time	39
4.3	Mechanical Properties of Concrete	39
4.3.1	Slump Test	39
4.3.2	Compressive Strength Test	40
4.3.3	Tensile Strength	42
4.3.4	Flexural Strength	43
4.3.5	Ultrasonic Pulse Velocity	43
4.3.6	Bond Strength	44
4.4	Durability of Concrete	46
4.4.1	Water Absorption	46
4.4.2	Rapid Chloride Permeability Test	46
4.5	Discussion	47
5	Conclusion and Recommendations	50
5.1	Conclusion	50
5.2	Recommendation for Future Research	51
	References	53



## LIST OF FIGURES

<b>Figure</b>	<b>Description</b>	<b>Page</b>
Figure 1.1	SCBA production (Million tons) [1]	2
Figure 1.2	Processing of SCBA [2]	3
Figure 2.1	The formation of ashes following calcination at different temperatures [3]	9
Figure 2.2	Raw bagasse ash exhibiting various shapes [4]	11
Figure 2.3	2.3a Water consistency [5]; 2.3b Initial and final setting time [5]	14
Figure 2.4	Compressive strength of SCBA replaced concrete [6]	15
Figure 2.5	Flexural strength of SCBA blended concretes [7]	17
Figure 2.6	2.6a Chloride penetration depth value [8] 2.6b Colorimetric treatment applied to samples [8]	18
Figure 3.1	Methodology	20
Figure 3.2	SCBA sample collection	22
Figure 3.3	SCBA collected sample and treated sample	22
Figure 3.4	Concrete mixer and the curing tank	24
Figure 3.5	Vicat plunger	27
Figure 3.6	Compressive Strength Test	28
Figure 3.7	Split Tensile Strength Test	29
Figure 3.8	Flexural Strength Test	29
Figure 3.9	UPV testing apparatus	30
Figure 3.10	Bond strength test	31
Figure 3.11	Water absorption test	32
Figure 3.12	Pre setup for RCPT test	33
Figure 3.13	RCPT Test	33
Figure 4.1	Top ash samples (SEM images)	34
Figure 4.2	Bottom ash samples (SEM images)	35
Figure 4.3	Size distribution of SCBA particles	35
Figure 4.4	XRD analysis of SCBA sample	36
Figure 4.5	DSC (below) and TGA (above) for SCBA sample	38
Figure 4.6	Consistency of SCBA blended cement	38
Figure 4.7	Setting time of SCBA replaced cement	39
Figure 4.8	Slump of SCBA replaced concrete	40
Figure 4.9	Compressive strength results of SCBA replaced concrete	41
Figure 4.10	Split tensile strength of SCBA blended concrete	42
Figure 4.11	Flexural strength of SCBA blended concrete	43
Figure 4.12	UPV of SCBA blended concrete	44

Figure 4.13	Tested specimens of pullout test	45
Figure 4.14	Water absorption of SCBA blended concrete	46
Figure 4.15	Charge passed through the SCBA blended concrete	48

## LIST OF TABLES

<b>Table</b>	<b>Description</b>	<b>Page</b>
Table 2.1	Effect of SCBA on the workability	13
Table 2.2	Effect on the compressive strength	15
Table 2.3	Effect on the tensile strength	16
Table 2.4	Impact of SCBA on the durability properties	19
Table 3.1	No. of sample used in each testing for each mix	23
Table 3.2	Mixture proportion for SCBA concrete	24
Table 4.1	Particle size distribution of SCBA	36
Table 4.2	Oxide composition of SCBA and Portland cement	37
Table 4.3	Pullout test results	45
Table 4.4	Qualitative identification RCPT	47

## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
ADB	Asian Development Bank
ASTM	American Society for Testing and Materials
C-S-H	Calcium - Silicate - Hydrate
DSC-TGA	Differential Scanning Calorimetry- Thermogravimetric Analysis
LOI	Loss On Ignition
OPC	Ordinary Portland Cement
PAI	Pozzolanic Activity Index
RCPT	Rapid Chloride Permeability Test
RHA	Rice Husk Ash
SAI	Strength Activity Index
SBAS	Sugarcane Bagasse Ash Sand
SCBA	Sugarcane Bagasse Ash
SCM	Supplementary Cementitious Material
SEM	Scanning Electron Microscopy
SSA	Specific Surface Area
SSD	Saturated Surface Dry
UHPC	Ultra High-Performance Concrete
UPV	Ultrasonic Pulse Velocity
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence