

LB/DON/16/04

0A

# PROCESS IMPROVEMENT IN DENIM WASHING

T WICKRAMASINGHE

A dissertation submitted to the Department of  
Textile & Clothing Technology of the University of Moratuwa  
In partial fulfillment of the requirements for the degree of



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
www.lib.mrt.ac.lk

677 "04"

677.037 25

MASTER OF SCIENCE IN TEXTILES STUDIES

University of Moratuwa



79599

Department of Textile & Clothing Technology

University of Moratuwa

Sri Lanka

January 2004

79599

UM Thesis coll.

79599

The work presented in the thesis in part or whole, has not been submitted for any other academic qualification at any institution.

***UOM Verified Signature***

T. Wickremasinghe  
(Candidate)



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

***UOM Verified Signature***

Mr. V.A. Nandasena  
(Supervisor)

## ABSTRACT

This research study is primarily concerned with exploring the avenues for improving the denim washing process while minimizing environmental pollution and satisfying customer expectations. Since denim washing itself is involved with processing of dyes and chemicals that affect the environment, a total prevention of pollution cannot be expected. On the other hand denims are customer driven products and more fashionable out looks are always demanded and of which end result could also be producing a lot of impacts to the environment. So that it is necessary to control the washing processes and take every steps to minimize industry wastes and environmental pollution by employing alternative applications with learned limitations on the products and washing processes.

This research attempts to examine process improvements in denim washing in three directions; product quality, process quality and environment pollution. In order to enhance customer satisfaction, garment quality is to be ensured against customer's stated and unstated needs while monitoring the washing process. The contributory factors in determining the quality of process are cost reduction, productivity improvement, waste minimization, optimum use of resources etc. In case of pollution prevention, water conservation, reuse of chemicals, waste minimization, waste recovery, effluent control, control of environmental hazards etc. are examined.

This study shows the means of increasing the quality of garments and productivity of processes. It proposes the use of bio-degradable enzymes in place of harmful chemicals. In case of preventing environmental pollution, fully compliance to legal requirements and regulations draws high priority. Above all, creation of an awareness on customer trends and behaviour, denim washing, use of chemicals and enzymes, washing conditions etc. is essential.

## LIST OF CONTENTS

	Page
<b>1. Introduction</b>	<b>1</b>
<b>2. Denim Washing Process</b>	
2.1 Denims	3
2.2 Washing Process	5
2.3 Washing Process Stages	6
2.4 General Procedures for Different Washes	16
2.5 Process Improvement	20
<b>3. Methodology</b>	<b>26</b>
<b>4. Findings and Analysis</b>	
4.1 Wash Types and Recipes	28
4.2 Water for Denim Washing	30
4.3 Effects of Washing on Denims	32
4.4 Process Modifications and Improvements	38
4.5 Environmental Discharges	46
4.6 Waste water Treatment Process	48
4.7 Work Environment Hazards	50
<b>5. Conclusions and Recommendations</b>	<b>53</b>
<b>References</b>	<b>57</b>

## LIST OF FIGURES AND TABLES

	<b>Page</b>
<b>Figures</b>	
2.1 Denim washing process stages	6
2.2 Cellulase enzyme reaction on cellulosic fibre	9
2.3 Oxidation of indigo through bleaching	13
2.4 Oxidation pathway of Indigo through enzyme bleaching	14
2.5 Quality Plan for washing of denims	21
2.6 Pollution Prevention Model	24
2.7 Waste flow diagram	27
4.1 & 4.2 Wash comparisons	40
4.3 Wastewater Treatment Process	49



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

### Tables

2.1 Desired colour effects	17
2.2 Stone washing	18
2.3 Enzyme washing	18
2.4 Ice (Acid) washing	19
4.1 Chemical Analysis of raw water	31
4.2 Defects analysis of garments	33
4.3 Washing defects, their causes and solutions	34
4.4 Strength loss	37
4.5 Resource Utilization	43
4.6 Environmental discharges from denim washing	47
4.7 Effluent discharges with limits	48
4.8 Measurement of Noise, Heat and ventilation levels	52

## ACKNOWLEDGEMENT

At the outset I am very grateful to Mr V A Nandasena, Chairman/Managing Director, Vantex (Pvt) Limited, Dehiwela and Visiting Lecturer of the Department of Textile and Clothing Technology, University of Moratuwa, who is also the Project Supervisor for the invaluable guidance and the encouragement given to me with extreme patience and understanding.

I acknowledge with a deep sense of gratitude the assistance extended by all the lecturers and the staff of the University, during my studies and preparation of this research paper.

Finally I wish to extend my appreciation to my colleagues and close associates who guided and assisted me in numerous ways to end up this research study with success.



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)