

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY</b>	<b>III</b>
BACKGROUND	III
HYPOTHESIS AND OBJECTIVES	III
<i>Hypothesis</i>	<i>iii</i>
<i>Objectives</i>	<i>iv</i>
OUTLINE OF APPROACH	IV
RESULTS	V
RECOMMENDATION	VII
<b>ACKNOWLEDGEMENTS</b>	<b>IX</b>
<b>ABBREVIATIONS</b>	<b>X</b>
<b>TABLE OF CONTENTS</b>	<b>XI</b>
<b>LIST OF FIGURES</b>	<b>XIII</b>
<b>LIST OF TABLES</b>	<b>XV</b>
<b>1 INTRODUCTION</b>	<b>1</b>
<b>2 POTENTIAL USE OF ENZYMES WITH INDUSTRIAL EFFLUENTS</b>	<b>3</b>
2.1 PAPER AND PULP	3
2.2 OLIVE MILL	4
2.3 MINING	4
2.4 TEXTILE	4
<b>3 MATERIALS AND METHODS</b>	<b>6</b>
3.1 SOURCE OF SLUDGE	6
3.2 REACTOR DESIGN AND OPERATION	6
3.3 PREPARATION OF SEWAGE SLUDGE AND EXTRACTION OF ENZYME MIXTURE	6
3.4 ANALYTICAL PROCEDURES	7
3.5 ENZYME ASSAYS	7
3.5.1 <i>Lipases</i>	7
3.5.2 <i>Proteases</i>	8
3.5.3 <i>Glucosidases</i>	8
3.5.4 <i>Sulphatases and phosphatases</i>	8
3.5.5 <i>Endoglucanases</i>	8
3.5.6 <i>Azo-reductases</i>	9
3.5.7 <i>Hydrogenases</i>	9
3.6 ENZYME PURIFICATION	9
3.6.1 <i>Glucosidase</i>	9
3.6.2 <i>Hydrogenase/azoreductase</i>	9
3.6.3 <i>Endoglucanase</i>	10
3.7 ENZYME PROPERTIES	10
3.7.1 <i>pH</i>	10
3.7.2 <i>Temperature</i>	10
3.7.3 <i>Stability</i>	10
3.7.4 <i>Kinetic parameters: <math>K_m</math> and <math>V_{max}</math></i>	10
3.8 ENZYME SCREENING	10
3.8.1 <i>Textile dyes</i>	10
3.9 INDUCTION STUDIES	11
3.9.1 <i>Textile dyes</i>	11

3.10	INDUSTRIAL EFFLUENT ANALYSIS	11
3.10.1	<i>Textile industry</i>	11
3.11	FIELD TESTING OF THE PRODUCT	11
3.11.1	<i>Textile industry</i>	11
<b>4</b>	<b>RESULTS</b>	<b>13</b>
4.1	REACTOR OPERATION	13
4.2	ENZYME EXTRACTION	14
4.3	ENZYME DISTRIBUTION	14
4.4	ENZYME PURIFICATION	14
4.4.1	<i>Glucosidase</i>	14
4.4.2	<i>Hydrogenase/azoreductase</i>	15
4.4.3	<i>Endoglucanase</i>	16
4.5	ENZYME PROPERTIES	16
4.6	ENZYME SCREENING	17
4.6.1	<i>Textile dyes</i>	17
4.7	INDUCTION STUDIES	18
4.7.1	<i>Textile dyes</i>	18
4.8	INDUSTRIAL EFFLUENT ANALYSIS	20
4.8.1	<i>Textile industry</i>	20
4.9	FIELD TESTING	22
4.9.1	<i>Textile industry</i>	22
<b>5</b>	<b>DISCUSSION</b>	<b>33</b>
<b>6</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>36</b>
6.1	CONCLUSIONS	36
6.2	RECOMMENDATIONS	36
<b>7</b>	<b>FUTURE RESEARCH</b>	<b>37</b>
<b>8</b>	<b>REFERENCES</b>	<b>38</b>
<b>9</b>	<b>CAPACITY BUILDING</b>	<b>41</b>
9.1	STUDENTS	41
9.1.1	<i>MSc Students</i>	41
9.1.2	<i>Post doctoral fellow</i>	41
9.2	PUBLICATIONS	41
9.2.1	<i>Papers</i>	41
9.2.2	<i>Conference presentations</i>	42