

# TABLE OF CONTENTS

Page no.

CHAPTER 1: INTRODUCTION.....	1
1-1. Background.....	1
1-2. Objectives.....	5
CHAPTER 2: LITERATURE REVIEW.....	6
2-1 Coagulation.....	6
2-1-1 General.....	6
2-1-2 Purpose of Coagulation.....	7
2-1-3 Coagulation Process.....	8
2-1-4 Zeta Potential.....	9
2-1-5 Factors Influencing Coagulation.....	10
2-1-6 Metal Coagulants.....	12
2-2 Flocculation.....	14
2-2-1 Bridging.....	15
2-2-2 Flocculation Process.....	16
2-3 Roughing Filtration.....	16
2-3.1 Classification of granular filtration methods.....	17
2-3.2 Roughing filter configurations.....	17
2-3.3 Roughing filter design parameters.....	18
2-3.3.1 Filter media size.....	18
2-3.3.2 Hydraulic loading rate.....	19
2-3.3.3 Filter length.....	20
2-3.4 Roughing filter operation and maintenance.....	21
2-3.5 Important of suspension characteristics in roughing filter.....	22
2-3.5.1 Size and density distribution of solid matter.....	22
2-3.5.2 Influence of water chemistry on solid surface-chemical properties.....	23
2-3.6 Particle removal mechanisms in roughing filters.....	23
2-3.6.1 Physico-chemical filtration.....	24
2-3.6.2 Surface and straining filtration.....	25
2-3.6.3 iron removal.....	26
2-3.7 Review of previous roughing filtration studies.....	26
CHAPTER 3: MATERIALS AND METHODS.....	27

3.1 Jar test analysis.....	28
3.2 Pilot plant set up and operation.....	30
3.2.1 Raw water intake.....	33
3.2.2 Up flow gravel filter columns.....	33
3.2.3 Coagulation system.....	35
3.2.4 Static mixer.....	35
3.2.5 Peri-staltic pumps.....	36
3.3 Measurements.....	36
3.3.1 Turbidity determination.....	36
3.3.2 Flow control.....	37
3.3.3 Head loss.....	37
3.3.4 pH measurements.....	37
3.4 Total and fecal coliform.....	38
3.5 Sieve analysis.....	38
3.6 Pilot experimental process conditions.....	39

**CHAPTER 4: RESULTS AND DISCUSSION.....41**

4.1 Presentation of results.....	41
4.2 Jar test experiments.....	42
4.3 Pilot filter runs.....	43
4.4 Results of total and fecal coliform tests.....	55
4.5 Fe results.....	56
4.6 Discussion.....	56
4.6.1 General.....	56
4.6.2 Removal efficiency.....	56
4.6.3 Effect of coagulant.....	58
4.6.4 Grain size.....	59
4.6.5 Filter cleaning.....	60
4.6.6 Bacteriological and Fe water quality improvement.....	60

**CHAPTER 5 Conclusions and Recommendations.....61**

5.1 Conclusions.....	61
5.2 Recommendations.....	62

**REFERENCES.....63**

**APPENDICES**