

The Chemical Treatment of Boiler Water

TABLE OF CONTENTS

Chapter 1 Principles of Steam Generation	1
1.1 Regulations Governing the Operation of Boilers	3
1.2 Properties of Steam	4
1.3 Water for Generating Steam	6
1.4 Relationships Among Operating Variables	7
Chapter 2 Objectives in Treating Water for Boilers	12
2.1 Prevention of Scaling in Boilers	12
2.2 Prevention of Corrosion in Boilers	18
2.3 Prevention of Stress Corrosion Cracking	22
2.4 Prevention of Steam Contamination	23
Chapter 3 Physical Methods for Improving Water Quality	27
3.1 Clarification	27
3.2 Deaeration	28
3.3 Oil Removal	30
3.4 Blowdown	34
Chapter 4 External Chemical Treatments	38
4.1 Coagulation by Chemicals	38
4.2 Softening	39
4.3 Silica Removal	51
Chapter 5 Internal Chemical Treatment	65
5.1 Precipitation of Calcium and Magnesium	65
5.2 Chelation of Calcium and Magnesium	69
5.3 Inhibition of Corrosion in Boilers	72
5.4 Prevention of Stress Corrosion Cracking	81
5.5 Prevention of Silica Carryover and Scaling	88
5.6 Clarification of Boiler Water	92
5.7 Prevention of Foaming in Boilers	95
5.8 Corrosion Inhibitors for Steam Condensate Systems	98
Chapter 6 Operating Procedures	120
6.1 Types of Boilers	120
6.2 Water Treatment Programs	123
6.3 Operating Guidelines	175
Chapter 7 Complications in the Operations of Boilers	195
7.1 Fireside Corrosion and Deposits	195
7.2 Water-Formed Deposits	201
7.3 Superheater and Turbine Deposits	208

7.4 Preboiler Corrosion 212
7.5 Internal Corrosion and Tube Failures 217
7.6 Contaminants in Boiler Feed Water 221
7.7 Chemical Cleaning Procedures 222

Chapter 8 Analytical Methods 243
8.1 Boiler Plant Control Methods 243
8.2 Analysis of Chemical Cleaning Solutions 265
8.3 Evaluation of Ion Exchange Resins 268

Appendix I 276
Appendix II 281
Index 284