

# Contents

ABBREVIATIONS .....	xiii
1. THE WATER-SEWAGE CYCLE .....	1
Importance of Water and Sewerage. Water-Supply System. Sewerage System. Storm Drainage. Water Treatment. Sewage Treatment. Bibliography.	
2. QUANTITY OF WATER FROM RAINFALL .....	3
Rainfall and Snowfall. Rainfall Variations. Rain Making. Runoff. Estimation of Watershed Yield. Empirical Formulas for Runoff for Water Supply. Investigation of Source for Yield. Quality of Surface Water. Storm Rainfall. Rational Method of Computing Runoff. Empirical Formula for Runoff for Sewer Design. Flood Flow. Percolation and Absorption. Evaporation. Ground Water. Bibliography. Problems.	
3. WATER USE AND SEWAGE VOLUME .....	40
Classes of Water Use. Domestic Consumption. Commercial and Industrial Use. Public Use. Fire Demand. Special Uses of Water. Leakage. Factors Affecting Use and Waste of Water. Rate of Water Use for Design. Summary on Water Use. Flow of Domestic Sewage. Volume of Industrial Waste. Infiltration into Sewers. Maximum Flow of Sewage. Data for Pumping-Station Design. Estimation of Sewage Flow for Design. Bibliography. Problems.	
4. HYDRAULICS OF WATER AND SEWAGE CONDUITS .....	59
Flow in Water Pipes. Flow in Sewers. Limiting Velocities in Sewers. Design of Full Sewers. Design of Partly Filled Sewers. Design of Other Than Circular Sewers. Bibliography. Problems.	
⑤ PIPING FOR WATER AND SEWER SYSTEMS .....	73
Cast-Iron Water Pipes. Asbestos-Cement Pipe. Concrete Pipe. Steel Pipe. Service Pipes. Electrolysis. Water Hammer. Thickness of Metal Pipe. Appurtenances for Water Systems. Vitrified-Clay Sewer Pipe. Concrete Sewer Pipe. Other Materials for Sewers. Appurtenances for Sewers. Junctions of Large Sewers. Loads on Pipes in Trenches. Testing and Strength of Sewer Pipe. Bibliography. Problems.	
6. COLLECTION AND STORAGE OF WATER .....	99
Required Storage Capacity. Mass Diagram. Reservoir Location. Dams. Water Pressure on Dam. Other Forces on Dams. Safety of	

	Dam Against Overturning. Resistance to Sliding. Crushing at Toe. Cross Section of Gravity Dam. Spillway Design. Arch Dams. Deck-Type Dams. Fill Dams. Silting of Reservoirs. Flashboards and Fish Ladders. Collecting Ground Water. Transportation of Water. Bibliography. Problems.	
7.	WATER DISTRIBUTION .....	131
	Requirements of Distribution System. Types of Distribution Systems. Minimum Pipe Sizes. Computation of Sizes in Dead-End System. Flow in Interconnected Piping. Expansion of Dead-End Distribution System. Use of Special Chart. Flow from Reservoirs or Elevated Tanks. Distribution Storage. Engineering for Laying Pipelines. Construction of Pipelines. Disinfecting Mains. Bibliography. Problems.	
8.	COLLECTION AND TRANSPORTATION OF SEWAGE .....	161
	Layout of Sewerage System. Position of Sewer in Street. Procedure in Establishing Layout. Design of System of Sanitary Sewers. Design of Storm-Drainage System. Combined Sewers. Sewer Construction. Measuring Infiltration. Records. Curved Sewers. Bibliography. Problems.	
9.	PUMPS AND PUMPING .....	191
	Purposes of Pumps. Types of Pumps. Power for Pumping. Choice of Type of Pump. Operation of Pumps. Pumping Sewage. Pumping Installations. Design of Pumping Station for Sewage. Bibliography. Problems.	
10.	EXAMINATION OF WATER AND SEWAGE .....	206
	Purposes of Examination of Water. The Sanitary Survey. Nature of Sewage and Industrial Wastes. Characteristics of Examinations. Standards for Water Quality. Physical Properties of Water. Chemical Standards for Water. Hardness. Alkalinity and Acidity. Chlorides and Sulfates. Iron and Manganese. Dissolved Oxygen. Bacteria. Bacteriological Examinations of Water. Microscopic Organisms in Water. Electron Microscope. Tests Made on Sewage. Physical Examination of Sewage. Chemical Tests on Sewage. Bibliography. Problems.	
11.	WATER TREATMENT BY SCREENING AND SEDIMENTATION .....	227
	Characteristics of Screens. Intakes. Clarification by Settling. Design of Sedimentation Tanks. Construction Features of Sedimentation Tanks. Coagulation. Design of Mixing Basins. Chemicals Used for Coagulation. Use of Aluminum Sulfate. Use of Ferrous Sulfate. Use of Chlorinated Copperas. Use of Ferric Sulfate. Chemical Aids to Coagulation. Determining Coagulant Dosages. Equipment for Feeding Chemicals. Bibliography. Problems.	

12. FILTRATION OF WATER .....	254
Types of Filters. Rates of Operation. The Sand Bed. The Gravel Layer. Arrangement of Units. Design of Filter Units. Under-drainage Systems. Clear-Well Capacity. Loss of Head. Washing the Filter. Equipment for Controlling Filtration. Application and Operation of Rapid Sand Filters. Pressure Filters. Slow Sand Filters. Bibliography. Problems.	
13. DISINFECTION OF WATER .....	274
Use of Chlorine. Efficiency of Chlorination. Action of Chlorine. Quantity of Chlorine Required. Application of Liquid Chlorine. Hypochlorites. Chlorine and Ammonia. Special Methods of Disinfection. Bibliography. Problems.	
14. REMOVAL OF DISSOLVED MINERALS FROM WATER .....	286
Hardness. Lime-Soda Process. Required Quantities of Lime and Soda Ash. Handling and Feeding Chemicals. Recarbonation. Cation-Exchange Process. Operation of Cation Exchangers. Results of Exchange Softening. Fluorine. Iron and Manganese. Methods of Aeration. Conversion of Saline Water. Removal of Radioactivity from Water. Bibliography. Problems.	
15. CONTROL OF CORROSIVENESS, TASTE, AND ODOR .....	304
Corrosion of Water Pipes. Tests for Corrosiveness of Water. Control of Corrosiveness. Control of Taste and Odors. Use of Copper Sulfate. Treatment with Chlorine and Ammonia. Treatment with Activated Carbon. Other Treatments for Tastes and Odors. Micro-strainers. Bibliography. Problems.	
16. PRIMARY TREATMENT OF SEWAGE .....	318
Characteristics of Sewage. Disposal by Dilution. Disposal by Irrigation. Recharge of Ground Waters. Grit Chambers. Bar Screens. Fine Screens. Cutting Screens or Comminutors. Oil and Grease Removal. Factors Influencing Sedimentation. Types of Settling Tanks. Principles of Design of Settling Tanks. Construction Features of Settling Tanks. Dimensions of Rectangular Settling Tanks. Dimensions of Circular Tanks. Results of Sedimentation. Imhoff Tanks. Mechanical Two-Story Tanks. Septic Tanks. Chemical Aids to Sedimentation. Bibliography. Problems.	
17. THE ACTIVATED SLUDGE PROCESS .....	351
Steps in Process. Primary and Final Settling Tanks. Characteristics of Process. The Sludge Volume Index. Return Sludge. Empirical Practices in Design. Rational Design. Methods of Aeration. Application of Diffused Air. Mechanical Aeration. Return-Sludge Factors. Sludge Age. Bibliography. Problems.	

18. SECONDARY TREATMENT OF SEWAGE .....	372
Features of Trickling Filters. Dosing Trickling Filters. Filter Media. Underdrainage and Ventilation. Fly Control. Number and Shape of Filter Units. Recirculation. Pretreatment and Post Treatment. Effect of Temperature. Design of Standard-Rate Filters. Types of High-Rate Filters. Single- and Two-Stage Plants. Design of High-Rate Filters. Secondary Sand Filtration. Contact Beds. Hays Process. Flotation. Lagoons and Oxidation Ponds. Chlorination of Sewage. Bibliography. Problems.	
19. SLUDGE TREATMENT AND DISPOSAL .....	397
Characteristics of Sludge. Sludge Digestion. Digestion Tanks. Gas Production. Gas Utilization. Control of Heating. Design of Heating System. Sludge Thickening. Flow of Sludge in Pipes. Methods of Dewatering Sludge. Vacuum Filtration. Other Methods of Dewatering Sludge. Air Drying of Sludge. Lagoons. Other Methods of Sludge Disposal. Bibliography. Problems.	
20. INDUSTRIAL WATER SUPPLY AND WASTE TREATMENT .....	416
Water Supply for Industries. Plant Survey for Water and Wastes. Disposal of Industrial Wastes. Treatment of Industrial Wastes. Cannery Wastes. Dairy Wastes. Distillery Wastes. Brewery Wastes. Meat-Packing Wastes. Textile Wastes. Pharmaceutical Wastes. Paper-Manufacturing Wastes. Other Industrial Wastes. Example of Treatment. Bibliography. Problems.	
21. ARRANGEMENTS FOR CONSTRUCTION .....	432
Preliminary Considerations. Plans and Specifications. Financing. Estimates of Cost. Advertising for Bids and Awarding Contract. Control of Work. Location Surveys. Construction Notes. Accessories for Plant Operation. Bibliography. Problems.	
22. DESIGN OF A MODERN SEWAGE-TREATMENT PLANT .....	447
Assumed Conditions. Design Bases. Sedimentation Process. Primary Settling Tanks. The Filters. Sludge Digestion. Sludge Dewatering. Office and Operating Building. Miscellaneous Items. Problems.	
23. DESIGN OF WATER TREATMENT PLANT .....	464
Governing Considerations. Assumed Type of Plant. Procedure in Design.	
APPENDIX .....	
A .....	473
B .....	474
C .....	481
D .....	490
INDEX .....	495