## CONTENTS

	HISTORY AND PROPERTIES		
	Polyethylene		
	Polyvinyls		
	Polyvinylidene Chloride	4	
	ABS		
	Other Resins	(	
	Specialized Plastics	(	
	Bituminized Fiber Pipe	C	
	Comparative Properties	10	
2	PIPE AND TUBING MANUFACTURE	25	
	Metallic Piping	25	
	Butt-Welded Pipe	25	
	Lap-Welded Pipe	27	
	Finishing Processes	28	
	Seamless Tubing	28	
	Electrically Welded Pipe and Tubing	30	
	Electric-Welded Large-Diameter Pipe	31	
	Iron Pipe Sizes	33	
	Piping Components	34	
	Sizes of Ferrous Pipe	35	
	Sizes of Tubing	39	
	Nonmetallic Piping	39	
	Extrusion of Elastomers	41	
	Shapes	41	
	Operating Conditions	42	
	ABS Resins	46	
	Dimensional Stability	50	
	Saran–Lined Steel Pipe	54	
	Pipe Fittings	58	
3	CODES AND ENGINEERING APPLICATIONS	61	
	·Piping System Design	62	
4.	POLYVINYL CHLORIDE		
	Definitions		
	Historical Background	65	
	Product Manufacture	66	
	Basic Resin	66	
	Extrusion and Molding Compounds	67	
	Basic Piping Components	67	

	Availability Environmental Behavior of PVC Corrosion Resistance Flammability Weathering Hygienic Effects Abrasion Resistance Mechanical and Physical Properties Tensile Strength Modulus of Elasticity Compressive and Flexural Strength Heat Distortion Temperature Izod Impact Strength	68 70 70 71 71 72 72 73 73 74 75 75
	Working Pressures Specific Gravity Thermal Conductivity Coefficient of Linear Thermal Expansion Electrical Properties Surface Condition Installation Engineering Machining Operation Assembly of Threaded Joints Solvent Cemented Joints Heat Welded Joints Bending Hanging and Supporting Thermal Compensation PVC to Metal Joints Underground Installation PVC Versus Other Piping Materials Metallics Other Thermoplastics Where Rigid PVC Has Been Used	77 77 77 78 79 81 81 82 82 82 83 83 84 85 85 85 85
5.	POLYETHYLENE Objective Review of Pertinent Literature Advantages of Polyethylene Pipe	93 95 95 95 96
	Need For Standards Equipment and Procedure Equipment Preparation of Test Specimen Test Procedure	96 97 97 99 99
	Physical and Mechanical Properties of Resins Tested Experimental Results Discussion	99 100 102

HISTORY AND PROPERTIES  1.1 Thermoplastic Pipe Production 1.1A Plastic Pipe End Use 1.2 Physical Properties of Resins 1.3 Properties of ABS Pipe Resins (Black) 1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties 2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride 2.14 Throughput for Various Sized Extruders		ABBREVIATIONS Abbrevi Definiti		121 121 126	
1.1 Thermoplastic Pipe Production 1.1A Plastic Pipe End Use 1.2 Physical Properties of Resins 1.3 Properties of ABS Pipe Resins (Black) 1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride			TABLES		
1.1 Thermoplastic Pipe Production 1.1A Plastic Pipe End Use 1.2 Physical Properties of Resins 1.3 Properties of ABS Pipe Resins (Black) 1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride		HISTORY AND	PROPERTIES .		
1.1A Plastic Pipe End Use 1.2 Physical Properties of Resins 1.3 Properties of ABS Pipe Resins (Black) 1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride				11	
1.3 Properties of ABS Pipe Resins (Black) 1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride		1.1A	· · · · · · · · · · · · · · · · · · ·	12	
1.4 Effect of Various Factors on the Properties of Resins 1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 I25 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride		1.2	Physical Properties of Resins	14	
1.5 Comparison of Plastics Material with Metal 1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride				16	
1.6 Thermoplastics Materials, Properties, and Prices 1.7 IPM Pipe Dimensions and Properties  2 PIPE AND TUBING MANUFACTURE 2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride			·	18	
PIPE AND TUBING MANUFACTURE  2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride			•	2 <sub>0</sub> 2 <sub>1</sub>	
2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride			·	24	
2.1 Gas Service Pipe 2.2 75 lb. Iron Pipe Size O.D. 2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride	2	PIPE AND TURING MANUFACTURE			
<ul> <li>2.2 75 lb. Iron Pipe Size O.D.</li> <li>2.3 Schedule 40 - Iron Pipe Size</li> <li>2.4 Iron Pipe Size O.D.</li> <li>2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings</li> <li>2.6 Schedule 80 - Iron Pipe Size</li> <li>2.7 Oil Field Pipe - Solvent Welded Pipe Size</li> <li>2.8 Extra Strong S.W.P. O.D.</li> <li>2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings</li> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>	-			34	
2.3 Schedule 40 - Iron Pipe Size 2.4 Iron Pipe Size O.D. 2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings 2.6 Schedule 80 - Iron Pipe Size 2.7 Oil Field Pipe - Solvent Welded Pipe Size 2.8 Extra Strong S.W.P. O.D. 2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions - Polyethylene 2.13 Extrusion of Polyvinyl Chloride			•	34	
<ul> <li>2.5 125 lb. Pipe for Use with Gruvajoint or Victaulic Fittings</li> <li>2.6 Schedule 80 - Iron Pipe Size</li> <li>2.7 Oil Field Pipe - Solvent Welded Pipe Size</li> <li>2.8 Extra Strong S.W.P. O.D.</li> <li>2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings</li> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.3	·	35	
Fittings  2.6 Schedule 80 - Iron Pipe Size  2.7 Oil Field Pipe - Solvent Welded Pipe Size  2.8 Extra Strong S.W.P. O.D.  2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings  2.10 For Lawn Sprinklers  2.11 Steel Pipe Dimensions, Capacities, and Weights  2.12 Operating Conditions - Polyethylene  2.13 Extrusion of Polyvinyl Chloride		2.4	Iron Pipe Size O.D.	35	
<ul> <li>2.6 Schedule 80 - Iron Pipe Size</li> <li>2.7 Oil Field Pipe - Solvent Welded Pipe Size</li> <li>2.8 Extra Strong S.W.P. O.D.</li> <li>2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings</li> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.5	•	36	
<ul> <li>2.7 Oil Field Pipe - Solvent Welded Pipe Size</li> <li>2.8 Extra Strong S.W.P. O.D.</li> <li>2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings</li> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.6	_	36	
<ul> <li>2.9 Oil Field Pipe for Use with Gruvajoint or Victaulic Couplings</li> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.7	·	37	
Couplings 2.10 For Lawn Sprinklers 2.11 Steel Pipe Dimensions, Capacities, and Weights 2.12 Operating Conditions – Polyethylene 2.13 Extrusion of Polyvinyl Chloride			Extra Strong S.W.P. O.D.	37	
<ul> <li>2.10 For Lawn Sprinklers</li> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.9	•	37	
<ul> <li>2.11 Steel Pipe Dimensions, Capacities, and Weights</li> <li>2.12 Operating Conditions - Polyethylene</li> <li>2.13 Extrusion of Polyvinyl Chloride</li> </ul>		2.10	· · ·	38	
2.13 Extrusion of Polyvinyl Chloride			<u>.</u>	40	
, ,		2.12		44	
2.14 Throughput for Various Sized Extruders				46	
2.15 Solvent Welded Pipe Sizes				48 51	

10

10

13

Conclusions

Bibliography

SPECIALIZED PIPE

6