Contents

Pr	eface			ix
1	Hist	ory and	d Terminology of Crude Oil	1
	1.1	1.1 Historical Perspectives		3
			rn Perspectives	14
			mpanies	15
			tions and Terminology	17
			Petroleum	21
		1.4.2	Natural Gas	23
		1.4.3	Heavy Oil	25
			Tar Sand Bitumen	26
	1.5	Refere	nces	28
2	Origin and Occurrence of Oil		31	
	2.1	The Fo	ormation of Oil	35
	2.2	Reserv	oirs	36
		2.2.1	Reservoir Structure	36
		2.2.2	Accumulation in Reservoirs	38
		2.2.3	Distribution of Fluids in the Reservoir	39
		2.2.4	Migration of Reservoir Fluids	41
		2.2.5	Transformation of Petroleum in the Reservoir	42
		2.2.6	Relationship of Petroleum Composition and	
			Properties	44
	2.3	Reserv	voir Classification	45
	2.4	Reserv	voir Evaluation	49
		2.4.1	Depletable and Renewable Resources	49
		2.4.2	Development of Resources	50
		2.4.3	New Evaluation Technology	51
	2.5	Estima	ation of Reserves in Place	52
	2.6	Reserv	ves	55
		261	Conventional Petroleum	56

vi Contents

		2.6.2	Natural Gas	57
		2.6.3	Heavy Oil	58
		2.6.4	Tar Sand Bitumen	59
	2.7	Refere	ences	62
3	Exploration, Recovery, and Transportation			
	3.1	Explo	ration	66
	3.2	70		
		3.2.1	Preparing to Drill	70
		3.2.2	The Drilling Rig	71
		3.2.3	Drilling	72
		3.2.4	Well Completion	73
	3.3	Recov	very	75
		3.3.1	Primary Recovery (Natural Methods)	77
		3.3.2	Secondary Recovery	79
		3.3.3	Enhanced Oil Recovery	82
	3.4	Bitum	nen Recovery	86
		3.4.1	Mining Methods	86
		3.4.2	Non-Mining Methods	88
	3.5	Trans	portation	91
	3.6	Produ	ucts and Product Quality	97
	3.7	Refer	ences	100
4	Cru	de Oil	Classification and Benchmarks	103
	4.1	Crud	e Oil Classification	105
		4.1.1	Classification as a Hydrocarbon Resource	107
		4.1.2	Classification by Chemical Composition	107
		4.1.3	Density and API Gravity	109
		4.1.4	Viscosity	109
		4.1.5	UOP Characterization Factor	110
		4.1.6	Pour Point	110
		4.1.7	Recovery Method	111
	4.2	Class	sification of Reserves	111
		4.2.1	SPE Standards	114
		4.2.2	SEC Standards	119
		4.2.3	Russian Standards	122
		4.2.4	Miscellaneous Standards	125

		Contents	vii	
	4.3	Benchmark Crude Oils	126	
	4.4	References	132	
5	The Petroleum Culture			
	5.1	The Petroleum Culture	138	
	5.2	Oil in Perspective	138	
		5.2.1 History	138	
		5.2.2 The Middle East Emerges	140	
		5.2.3 Recent History	144	
	5.3	The Seven Sisters	145	
	5.4	Reserve Estimates	148	
		5.4.1 Historical Variation of Reserve		
		Estimates	149	
		5.4.2 Patterns of Use	151	
		5.4.3 Energy and the Political Costs of Oil	154	
		5.4.4 Price Swings	155	
	5.5	References	156	
6	Oil	Prices	159	
	6.1	Oil Price History	161	
		Pricing Strategies	164	
		Oil Price and Analysis		
	6.4	The Anatomy of Crude Oil Prices	172	
	6.5	The Anatomy of Gasoline Prices		
	6.6	Effect of Refining Capacity	178	
		6.6.1 Refinery Types and Crude Slate	179	
		6.6.2 U.S. Refining Capacity	182	
		6.6.3 World Refining Capacity	182	
		6.6.4 Refining and Refinery Economics	184	
	6.7	Outlook	187	
	6.8	References	191	
7	The Crude Oil Market			
	7.1	The Crude Oil Market	195	
	7.2	Global Oil Consumption	199	

viii Contents

	7.3	Refining and The Markets	205
	7.4	Profitability	211
	7.5	References	212
8	Oil	Supply	215
	8.1	Physical Factors	216
		Technological Factors	220
		Economic Factors	223
	8.4	Geopolitical Factors	228
	8.5	Peak Oil	231
		8.5.1 Peak Oil Theory	231
		8.5.2 Effects and Consequences of Peak Oil	235
	8.6	The Impact of Heavy Oil and Tar Sand Bitumen	237
	8.7	References	242
9	The	Future	245
	9.1	Undiscovered Oil	249
	9.2	Coal	252
	9.3	Oil Shale	255
	9.4	Liquids from Biomass	260
	9.5	Energy Independence	264
	9.6	Energy Security	270
	9.7	References	275
C	onve	rsion Factors	281
G	lossa	ry	283
	dex		311