

TECHNICAL OIL MISSION

REEL TOM 306 (BM53)

BOOK ON ESTONIAN
OIL SHALE

TRANSLATED INTO

ENGLISH

BY

HAROLD W. SOHNS

December 1947

THE ESTONIAN COMBUSTIBLE SHALE KUKERSITE - ITS
CHEMISTRY, TECHNOLOGY AND ANALYSIS
By K. Luts

Unrevised Reprint

1944

Reval Publishing Company, Reval (Tallinn) Estonia

TRANSLATION

BY

Harold W. Sohn

ACKNOWLEDGMENTS

With respect to this translation acknowledgment is made to W. I. R. Murphy, chemical engineer, Petroleum and Oil-Shale Experiment Station, Bureau of Mines, Laramie, Wyoming, and A. J. Kraemer, assistant chief, Oil-Shale Research and Demonstration Plant Project, Bureau of Mines, Washington, D. C., for special assistance.

Acknowledgment also is due to S. Klosky, research analyst, Bureau of Mines, Washington, D. C., and H. A. Wahl, Fuels and Lubricants Branch of the Quartermaster General's Corps, Washington, D. C., for their assistance in translating Russian and Estonian references.

The writer expresses his thanks to J. C. Antweiler, Petroleum and Oil-Shale Experiment Station, Bureau of Mines, Laramie, Wyoming, for preparing the illustrations and to Helon S. Faulder, Helena D. Belnap and Letha J. Smith, also of the Laramie Station, for their assistance in preparation of the manuscript.

TABLE OF CONTENTS

	Page
CHAPTER I. - KUKERSITE	7
Occurrence and formation	7
Normal profile and description of the layers	14
Properties of combustible shale	21
Average analysis	27
Obtaining combustible shale	42
Literature	48
 CHAPTER II. - COMBUSTIBLE SHALE AND ITS WEATHERING PROCESS	 49
Historical	49
Weathering process	55
Normal kukersite	65
Ultimate analysis	66
Heating value and heat of combustion	74
Artificial oxidation at higher temperatures	82
Oil yield	87
Effect of weathering upon oil yield	90
Hydrogen content, oil yield, and heat of combustion	91
Effect of weathering on the composition of the oils	95
Specific gravity and oil yield	96
Distillation of the shale under pressure	100
Distribution of sulfur in the distillation products	101
Heat of carbonization	102
Drying of the shale	105
Nitrogen and chlorine content	105
Reaction of chemical reagents	107
Occluded gases	115
Decomposition of kukersite	117
Literature	117
 CHAPTER III. - THERMAL DECOMPOSITION - CRACKING - OF THE SHALE	 119
Distillation of the shale in liquid phase	133
Hydrogenation of the shale	134
Gasification of the shale	139
Literature	144
 CHAPTER IV. - OIL PRODUCTION FROM COMBUSTIBLE SHALE	 145
General remarks concerning shale oils	145
Oil production in industry	151
Carbonization furnaces of the State Combustible Shale Industry	153
Tunnel furnaces of the Oil-Shale Syndicate in Sillamae	162
Tunnel furnaces of Kivioli, Incorporated	168
Bama-Meguine retort	178
Davidson revolving retort of Gold-Fields, Ltd.	180
N.T.U. retort	188
Literature	190

	Page
CHAPTER V. - COMBUSTIBLE SHALE OIL AND ITS MANUFACTURED PRODUCTS	192
Cracking process	192
Reactions of the cracking process	199
Reaction velocity of the cracking process	214
Cracking operations	216
Physical-chemical properties of combustible shale oils	228
Ultimate analyses and heats of combustion	237
Molecular weights of combustible shale oils	242
Neutralization of the oils	244
Crude oil from the Pintsch retorts	244
Bases, acids, chlorine, sulfur, nitrogen, metal organic compounds, iodine numbers, and cyclic hydrocarbons	245
Effect of liquid sulfur dioxide	250
Suitability of combustible shale oils for engine purposes	253
Literature	257
Composition and most important properties of shale power and heating oils	258
Combustible shale gasoline, its properties	260
Refining of the gasoline with plumbite, hypochlorite	269
Action of bleaching agents and carbon	273
Detonation, knock resistance, octane numbers	274
Resin formation (gum)	278
Literature, aniline point	285
Engine kerosine and motor power oil	287
Vacuum distillation and lubricating oils	290
Literature, shale oils as sources of oil gas	295
Hydrogenation of the oils	296
Literature	306
Phenols	307
Preserving properties of the oils	310
Technical phenolate	313
Combustible shale bitumens	322
Literature	321
Properties of esto-bitumens	336
Roof lacquer and bitumen emulsions	338
Mixing esto-bitumens with mineral coal tar, literature	340
CHAPTER VI. - UTILIZATION OF LIMESTONE AND COMBUSTIBLE SHALE ASH	341
Lime from limestone	341
CHAPTER VII. - COMBUSTIBLE SHALE AND PREPARATION OF CEMENT	349
Literature	353

	Page
CHAPTER VIII. - COMBUSTIBLE SHALE AS FUEL	354
Calculation of the amount of air necessary for combustion	359
Puksov's combustion triangle	366
Calculation of shale heat values	368
Literature	372
CHAPTER IX. - ANALYSIS OF COMBUSTIBLE SHALE	373
Taking the sample	373
Determination of moisture	380
Methods of determining ash content of combustible shale	384
Determining the ash content of asphaltized shale	410
Determination of "free carbon" in asphaltized combustible shale	411
Ultimate analyses of combustible shale	412
Calorimetric combustions	418
The Junkers calorimeter	423
Calculation of the heat of combustion of a gas from the data of its ultimate analysis	426
Literature	426
Distillation of the combustible shale in a Fischer aluminum apparatus	427
Literature	434
Analyses of combustible shale oils	435
Concerning the viscosity of oils and its determination	439
Effect of temperature upon the viscosity of oils	449
Determination of large gas quantities	454
Literature	453
Determination of the amounts of oil fog in gases	459
Analysis of phenolates	460