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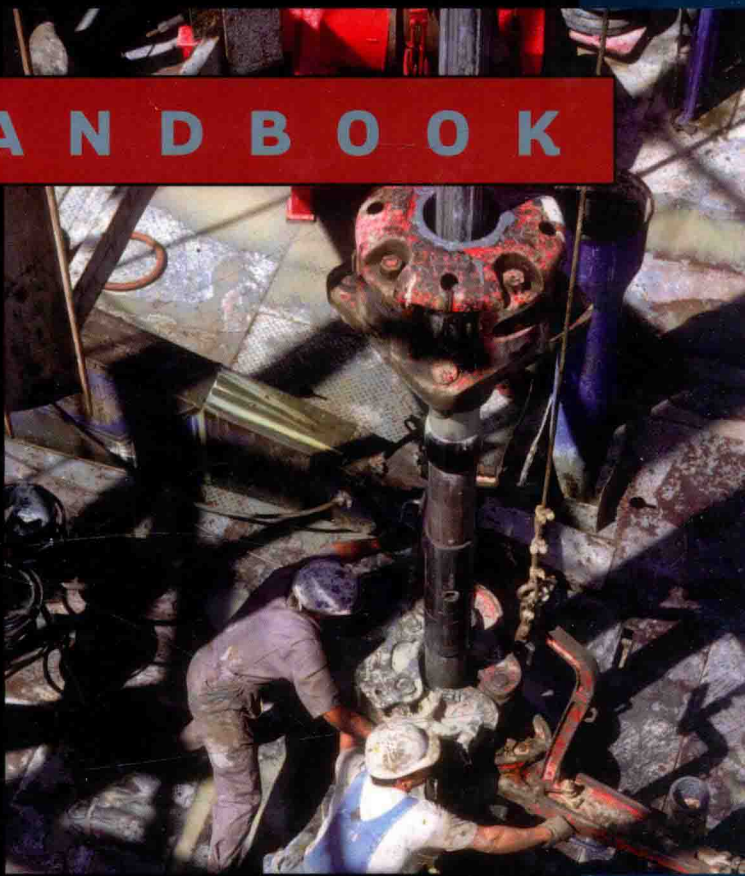
Drilling Fluids Processing

HANDBOOK



ASME Shale Shaker Committee

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DRILLING FLUIDS PROCESSING HANDBOOK

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DRILLING FLUIDS PROCESSING HANDBOOK

BIOGRAPHIES

Bob Barrett received his BSAS from Miami University and his MBA from Northern Kentucky University. From 1997 through 2003 he worked as the Screen Manufacturing Engineer for SWECO, developing manufacturing processes and technologies for industrial vibratory separator screens. Since 2003 he has served as the Senior Development Engineer of oilfield screens for MI-Swaco.

Eugene Bouse has a degree in petroleum engineering from Louisiana State University and has worked in drilling fluids for over 40 years, specializing in solids control for the past 15. He is a past chairman of the American Society of Mechanical Engineers (ASME) Drilling Waste Management Group and is a member of the Society of Petroleum Engineers (SPE) and Mensa.

Brian Carr has his BSME from the University of Louisville's Speed Scientific School. From 1993 through 2001 he worked as the New Product Development Engineer/Engineering Manager for SWECO-Division of Emerson Electric, developing new technologies for industrial and oilfield screens and vibratory separators. Since 2001 he has worked as the Engineering Manager of Shakers, Screens, Hydrocyclones, and Gumbo Removal for M-I SWACO.

Bob DeWolfe has extensive field, technical services, and operational management experience in the energy industry with drilling fluids, solids management, and refinery waste management. He has had specific assignments in Europe, Africa, the former Soviet Union, Southeast Asia, Latin America, and the United States. He is presently working in the Middle East.

Fred Growcock has been serving as Product Applications Team Leader and R&D Advisor for M-I SWACO since early 1999, and, most recently, as director of a U.S. Department of Energy-funded project on the fundamentals of aphron drilling fluids. Prior to joining M-I SWACO, he

worked at Brookhaven (NY) and Oak Ridge (TN.) National Labs on coal liquefaction and gasification, and problems related to gas-cooled nuclear reactors; Dowell Schlumberger (Tulsa) on reservoir stimulation, acid corrosion inhibition, and foamed fracturing; and Amoco (Tulsa), now BP, on drilling-fluid development. Fred holds BA/BS degrees in chemistry from the University of Texas at Austin and MS/PhD degrees in physical chemistry from New Mexico State University.

Tim Harvey holds degrees from Oklahoma State University and the University of Florida. He has worked in drilling fluids, solids control, and drilling waste management for over 30 years in the USA, Middle East, West Africa, and the Far East. Tim has served on various API and Drilling Waste Management Group (DWMG) workgroups and is currently based in Kuala Lumpur as Manager of Technical Services for Oiltools International. He is a member of the Society of Petroleum Engineers and is affiliated with American Association of Drilling Engineers (AADE), API and ASME.

Jerry Haston is a graduate of the University of Oklahoma with a degree in petroleum geology. He has spent his entire career, more than 40 years, in oil and gas exploration and production. Most of those years have been drilling-related. Jerry's experience includes international operations world-wide and industry-wide domestic operations. He is currently supervising drilling operations for a major international oil and gas company.

Michael Kargl is a mechanical engineer from Southern Illinois University. Since 1995, he has been the chief engineer for shale shaker electric vibrators at Martin Engineering Company. Prior to that time, he was an engineering group leader at Underwriter's Laboratories Inc. for 13 years, working mostly on design reviews and testing of explosion-proof motors and generators.

Todd H. Lee is the marketing manager for National Oilwell, with 13 years' experience sizing, training, and troubleshooting centrifugal pumps. He has been a business owner and product manager, and has worked in product design of centrifugal pumps.

Bob Line has over 30 years' experience in the oilfield, with major areas of expertise in wellhead and valves, pressure control, subsea controls, drilling instrumentation, and solids control. He spent 7 years in mechanical engineering design, and sales and marketing. For the past 9 years, Bob has been with M-I SWACO and is currently the Global Capital Equipment sales manager. Bob has a BS degree in mechanical engineering from the University of Houston.

Hemu Mehta is one of the founders and current president of KEM-TRON Technologies, Inc. Previously, he was Manager of International Operations for M/I Drilling Fluids. He holds degrees in chemical engineering, petroleum engineering, and international finance. Mr. Mehta's background in chemical engineering and solids control equipment allowed him to help develop today's most advanced dewatering technology. Mr. Mehta grew up in India and has lived in Houston, Texas since 1972 with his wife and two children.

James Merrill has been involved in the design and manufacturing of shale shakers and shale shaker screens for the past 17 years in the petroleum, mining, and utilities business sectors. His vast knowledge of wire cloth and shaker screens has allowed him to solve screen problems around the world. His career has taken him from a roughneck on drilling rigs around the Gulf Coast to Technical Manager of a leading solids control company.

Mark C. Morgan has been the Technical Services Manager for Derrick Equipment Company since 1994. Prior to this he worked as a drilling fluids engineer and seaplane pilot for NL Baroid. Then he worked as a drilling fluids and solids control consultant for 10 years, mainly working offshore of Angola for Texaco. Mark has a BS in professional aviation from Louisiana Tech and a BS from the University of Southwestern Louisiana in petroleum engineering.

Mike Morgenthaler has been involved with the drilling fluids and solids control equipment since 1980, when he joined IMCO Services as a mud engineer. Mike has a degree in mechanical engineering from the University of Texas. Mike is a principal consultant for CUTPOINT, Inc. and specializes in technology for drilling waste management.

Nace S. Peard has over 23 years experience in the oilfield, initially as a drilling engineer with Gulf Oil/Chevron. He later managed exploration and development drilling projects for a large independent oil and gas company. Since early 2000, he has been vice president of sales and marketing for DF Corporation. Nace is a registered PE in Texas, and has a degree in petroleum engineering from Purdue University.

William Piper worked over 20 years with Amoco as a drilling engineer and environmental specialist for the international drilling group. Upon his retirement in 1998, he formed Piper Consulting to continue working in the specialty niche market of environmental affairs relating to the drilling industry. He is recognized as one of the foremost experts in drilling waste management, as well as other environmental issues in drilling. He has been published extensively on the subject

of environmental practices in drilling, including an article in the *Encyclopedia of Environmental Analysis and Remediation.* He continues to teach a course in drilling waste management for the ChevronTexaco/BP drilling training alliance and has developed a series of software programs to aid drilling engineers with their environmental issues. Mr. Piper has a BS in chemical engineering from the University of Colorado and is active in the SPE.

Bill Rehm is an underbalanced drilling and completions consultant in Houston, Texas. He, at various times, has been a mud engineer, well control supervisor, president of directional drilling company, R&D manager, and drilling consultant. He has written some 50 papers on such subjects as Solids Control, Well Control, and Underbalanced Drilling.

Mike Richards has worked with Brandt in varying capacities since 1979, including product development manager, engineer, senior project manager, training coordinator, and in technical sales. Many performance parameters of mechanical agitators and mud hoppers were calculated and documented while Mike was manager of Product Development at Brandt. He has a BA degree from the University of Houston.

Leon Robinson has been teaching drilling classes for Petroskills/OGCI since retiring in 1992 from a 39-year career with Exxon Production Research. He earned a BS and MS degree from Clemson, a PhD in engineering physics from N.C. State, the 1985 SPE Drilling Engineering Award, and the 1999 AADE Meritorious Service Award.

Wiley Steen has been involved in drilling and production since the mid-1960s, both domestically and internationally. He lived overseas in both Europe and Southeast Asia from 1970 to 1975 where he served as manager for IMCO Services Division Halliburton. Since 1976, Wiley has worked as an independent consultant in both domestic and international theaters. He was one of the four founding Officers of the SPE Singapore Chapter (serving as secretary), and one of the 12 founders of Houston's AADE Chapter. He has served two terms as Houston AADE president and on the AADE National Board.

Mike Stefanov is currently a Regional Drilling Superintendent for BP and is involved in international deepwater drilling operations. Mike has over 27 years experience managing drilling operations in isolated locations both offshore and on shore, from conception through to maturity in Africa, the Middle East, Far East, Gulf of Mexico (Deepwater), South America and in the Indian Ocean. He has been involued in rig

construction and upgrades in Europe, the Far East and North America. Mike began his career in North America with Seismogrph Service Corporation, moving into international operations with Amoco International Oil Company, as a drilling engineer. Mike has worked as a Drilling Foreman, Drilling Supervisor, Drilling Superintendent and Drilling Manager throughout his career. He holds a BS degree in mechanical engineering from the University of Connecticut and is a registered professional engineer in the state of Texas. He has supervised inititiatives such as Technical Limits, HTHP Practices, International Operations' Practices, Floating Rig Construction and Outfitting, and Deepwater Drilling and Testing Practices.

PREFACE

In the early 1970s, the International Association of Drilling Contractors (IADC) formed a committee to study solids control on drilling rigs. After 10 years of work, we published the IADC *Mud Equipment Manual*. The committee started with only six members and ended with about 27. Many members remained on the committee when they changed employers, and employers wanted to stay represented and active on the committee. Others heard about our work and asked to join. The 11 handbooks in the *Mud Equipment Manual* discussed individual components of a drilling fluid system. Each subject was discussed in a series of seminars/conferences presented by local IADC districts all around the United States. Writing the *Manual* was a great education, and the discussions of all components of the material enticed members to remain engaged. After the *Manual* was published, the committee formed a new group, the IADC Rig Instrumentation and Measurements Committee (RIM). RIM was responsible for many publications relating to measurements and information transfer around a drilling rig. After several years of this work, the committee decided that the *Shale Shaker Handbook* needed to be revised; a majority of the committee had been involved in writing the first edition. When it was published, linear motion shale shakers were not available. New technology made the rewrite necessary. After a disagreement on final editing procedures, the committee left the IADC and went in search of a new sponsor.

Culminating a discussion of several offers, the Houston chapter of the American Association of Drilling Engineers (AADE) was selected, and the board of directors at that time enthusiastically welcomed the committee. Many of the original committee members continued to work on the committee and some new members from the AADE joined. The group assembled information and published the AADE *Shale Shaker*

Handbook. Since that book focused primarily on shale shakers, other components of the drilling-fluid system were relegated to a subordinate position. Gulf Publishing Company, which had published the IADC *Mud Equipment Manual*, published the *Shale Shaker Handbook* and retained the copyright for both books.

The committee decided that assigning relative contributions of all of the authors would be too difficult, if not impossible, for purposes of distributing royalty payments equitably. Hence, it requested that Gulf Publishing Company reduce the cost of the books by the amount that would normally be distributed in royalty. The AADE *Shale Shaker Handbook* found a comfortable niche in technology enlightenment. Gulf Publishing sold their book division and now Elsevier owns the copyright to the book.

Immediately after the *Shale Shaker Handbook* was published, the American Petroleum Institute (API) decided to revise RP (Recommended Practices) 13C, "Solids Control," and RP 13E, "Screen Designation." API Subcommittee 13 requested that the committee use the technology discussed in the *Shale Shaker Handbook* to modify the RP. The committee accepted the challenge. While working with the concepts and details available, the committee recognized that some additional technology and new methods needed to be developed. This quest required about five years before the final document was written.

Toward the end of the work on API RP 13C, Elsevier requested that the committee revise the AADE *Shale Shaker Handbook* because supplies were dwindling. The Houston chapter of the AADE, however, was less interested in technology. During the couple of years after the publication of the *Shale Shaker Handbook*, the number of technical committees organized and supported by the Houston chapter of the AADE dwindled from six to one, with only the Deepwater group remaining active. The executive committee of the Houston chapter notified the committee that they would not be a sponsor for the rewrite. Once again the committee went in search of a new sponsor. This time the American Society of Mechanical Engineers (ASME) Petroleum Division enthusiastically assumed that role. This book is, therefore, sponsored by the Petroleum Division of ASME.

Because we had a new sponsor and the need was obvious, the scope of this book was expanded to discuss all aspects of drilling-fluid processing. Most of the people involved with the API work volunteered to write this new book. Several new chapters have been added. Much additional technology has been developed since the AADE *Shale Shaker Handbook*

was published. The committee decided that the activity and structure of this group would be slightly different from previous years. Many members are also still actively participating with the API in rewriting API RP 13C relating to solids control. Some felt that they could not spend the necessary time to participate in both committees.

Each chapter of this book was assigned to one or two recognized industry professionals—most volunteered for their assignment. Many of the chapters from the AADE *Shale Shaker Handbook* were modified and brought up to date by one or two volunteers. Some chapters represent completely new material that was missing from the original book. The writer and/or modifiers of the chapters are recognized below the chapter title. However, many of the chapters also benefited from comments and critiques from colleagues. Sometimes the truth is difficult to find in drilling. This committee comprised only authors. In the past, some of the members acted primarily as editors, and this created a situation that, although educational for committee members, increased the writing times for the documents. Each chapter in this book was assigned to three other authors for editing and comments. Streamlining the process allowed this book to be published more rapidly than either of the other two editions. This procedure, however, resulted in some minor variances of technology. The material in each chapter was not read or approved by all of the committee. Industry professionals do not always agree on all aspects of drilling fluid and its processing; some of this different interpretation may appear in the various chapters. A good example of this is the issue of sand traps. In some drilling situations, some of the committee found sand traps to be very beneficial; others had different experiences. Both viewpoints are presented here and, hopefully, with sufficient information so that the benefits expected can be identified from the discussion in this book.

Each chapter retains some of the individuality of the principle author, but an attempt has been made to provide some homogeneity of styles. Sentences have been examined for clarity, accuracy, and their ability to be readily understood. The latter objective is sometimes the most difficult to accomplish. Words may indicate something with clarity but can still be incorrectly interpreted. Surplus words and personal pronouns have been mostly eliminated. Many of the concepts presented in this book have been discussed in depth and the consensus presented here. The oil patch is filled with misconceptions and erroneous "facts." Every attempt has been made to present balanced, accurate science. In some places, duplicate information is provided because the basic technology needs to be understood for each chapter.

The individuals who have written this book represent a superior group of professionals who not only have great knowledge, but also are willing to dedicate many hours of their time to share it with the industry. Many companies were involved in creating this book, and some of the work was done "on company time." However, the authors dedicated many hours of weekend and holiday time to create this book. The committee has never requested funds from any of the sponsors. All of the work (cost of meetings, preparation of manuscripts, etc.) was supported financially by individuals and some of the companies involved. No royalty was ever accepted for any of the books. Many in this unusual group of individuals have worked together on this committee for many years. Several recently joined to further enhance the prestige of this group of authors. As an interesting fact, Bill Rehm joined the IADC committee when it was organized in the early 1970s, and had to resign because of work assignments. However, he has now returned to the group, with great expertise in underbalanced drilling, to enhance this book.

Very few industry committees retain their identity through two or three decades of work. One of the secrets of this group's longevity has been its commitment to developing meaningful, useful products. Another secret has been the learning experience gained from in-depth technical discussions among people interested in facts and willing to argue without involving personalities or ancestry. The authors, who volunteered for this book, have built a firm basis for the technology involved in processing drilling fluid. This technology has evolved through many years of testing, trial and error, and discussions. Some of the history of that technology is captured in the Historical Perspective section of Chapter 1.

Many who started working with the committee in the beginning have retired or have died. All authors owe a debt of gratitude to the pioneers who preceded us. My association with this group has been one of the best learning experiences possible. I have great respect for all of the many talented, professional people who have shared so much knowledge with me. The association with so many brilliant people is deeply cherished. The past 40 years have been remarkable in the great strides made in technology, and this committee has sought to capture this for the primary benefit of the industry.

Leon Robinson
Chairman of the Rewrite Committee, 2004

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