

Interactive Website for Drilling Waste Management

Brandy Fidler
Department of Chemical Engineering
University of Tulsa

Drilling waste management practices vary by region, governed by regulatory agencies charged with the protection of human health and the environment. Within the United States, regulations vary by state to address the environmental issues of each geographic location. Regulations for offshore and international drilling vary as well. This website is being developed to provide technically sound, unbiased information about drilling waste management options including feasibility and associated costs. The website will include components such as a *technology description module* to familiarize readers with available options, a *regulatory module* to summarize existing state, federal, and some international regulations concerning drilling waste, a *case-study module* to exhibit successful implementations of various technologies, and an *interactive component* to help users identify waste management options available for their region. This information system will benefit operators by providing easy access to regulations and waste management options, thus allowing them to choose the option with the most environmental and economic benefit. Another benefit is to provide unbiased information to countries developing drilling waste regulations in anticipation that those countries will allow operators to use the most economic, environmentally acceptable waste management option rather than restricting operators to only options familiar in that country.

INTRODUCTION

Argonne National Laboratory is developing an interactive website for the United States Department of Energy to provide information on the technical and economic aspects of drilling waste practices and a review of up-to-date state and federal regulations on waste management. Argonne is working with Marathon Oil and ChevronTexaco as industrial partners on this effort.

Oil and gas exploration and production (E&P) operations generate large volumes of drilling waste every year. Drilling wastes include drilling muds, drill cuttings, wash water, and other related wastes. According to an API survey of onshore and coastal operators in the United States, 109 million bbl of liquid drilling waste and 39 million bbl of solid drilling waste were generated in 1995 (1). These numbers indicate that drilling waste management is a significant issue for the oil and gas industry. Drilling waste management practices are governed by regulatory agencies charged with the protection of human health and the environment and vary by location. In the United States, drilling waste regulations vary by state to address the environmental issues of each geographic region. Offshore and international drilling regulations vary as well. The variation in regulations may cause confusion among operators as to the waste management options allowed or best suited for a particular location. This website is being developed to provide technically sound, unbiased information about drilling waste management options including feasibility and associated costs. The website will include components such as a *technology description module* to familiarize readers with available options, a *regulatory module* to summarize existing state and federal regulations concerning drilling waste, a *case-study module* to exhibit successful implementations of various technologies, and an *interactive component* to help users identify waste management options available for their region. Figure 1 is a schematic of the website components, other components may be added before this website is published.

This information system will benefit operators by providing easy access to regulations and waste management options, thus allowing them to choose an option with the most environmental and economic benefit. Another benefit is to provide unbiased information to countries developing drilling waste regulations in anticipation that those countries will allow operators to use the most economic, environmentally acceptable waste management option rather than restricting operators to only options familiar in that country.

TECHNOLOGY DESCRIPTION MODULE

This module will provide short descriptions of waste management options to acquaint operators with current technologies. Waste management options are categorized in three tiers, in descending order of environmental benefit (and in some cases economic benefit). The three tiers of the waste management hierarchy are: Tier 1 - waste minimization, Tier 2 - reuse or recycle waste, and Tier 3 - waste disposal. Tier 1 is the preferred waste management option since it is the most cost effective and

environmentally acceptable, while Tier 3 is the least preferred. Waste management options listed as Tier 1 options include materials substitution, directional drilling, coiled tubing drilling, physical separation of drill cuttings and fine particles from drilling mud, closed loop mud systems, and designing systems with smallest possible volumes of drilling mud. These options minimize the volume of waste or the toxic components of waste, thereby reducing disposal costs and increasing regulatory compliance. Although waste cannot be eliminated entirely, operators can benefit in many ways by reducing waste. Tier 2 options include recycling and reusing oil-based and synthetic-based muds, and roadspreading drill cuttings on lease roads or as a base material for commercial roads. Another Tier 2 option is to thermally treat drill cuttings using low temperature thermal desorption (LTTD) to recover mud and use the treated cuttings for applications such as landfill cover, concrete aggregate, or construction fill. One use for treated cuttings that may hold promise is their use as a substrate for restoring coastal wetlands. This use for cuttings has not been tested in the field but laboratory results indicate that it can be done successfully (2) (3). The Tier 3 disposal options include land treatment, bioremediation, evaporation, burial in pits and landfills, offshore surface discharge, incineration, underground injection, and sending wastes offsite for commercial disposal. Underground injection may be categorized further into three categories: injection into naturally cracked formations, slurry injection above fracture pressure, and salt cavern injection. The waste management hierarchy is summarized in Table 1.

REGULATORY MODULE

In the 1970's the U.S. Congress passed laws to protect the environment. Three federal laws govern the disposal of drilling waste: Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), and Clean Water Act (CWA). Subsequently, states began developing waste management regulations to meet the environmental requirements of their geographic region and their business community. States have the lead role in regulating the disposal of oil field E&P wastes; however, the state regulations must meet or exceed the federal regulations. The regulatory module will familiarize readers with the federal regulations governing drilling waste as well as state regulations. International regulations may be included as they are available.

Federal Regulations

Resource Conservation and Recovery Act (RCRA)

In 1988, the EPA determined that oil and gas E&P wastes would be exempt from the hazardous waste requirements of RCRA Subtitle C but not the Subtitle D solid waste regulations. Although E&P wastes are not subject to federal hazardous waste regulations, this does not preclude them from state hazardous waste requirements nor does it mean that they could not pose a hazard to human health and the environment if managed improperly (4). The hazardous waste exemption includes waste materials intrinsically derived from primary field operations associated with the exploration, development, or production of crude oil and natural gas but excludes wastes from transportation and manufacturing operations. The EPA has provided example lists of exempt and non-exempt E&P wastes along with a more detailed explanation of the exemption on their website at <http://www.epa.gov/epaoswer/other/oil/index.htm> or you may contact the

RCRA call center at 1-800-424-9346.

Safe Drinking Water Act (SDWA)

The SDWA mandates that the EPA establish regulations to protect human health from contaminants present in drinking water. EPA developed national drinking water standards and created a joint federal/state system to ensure compliance with these standards. The underground injection of liquid wastes is regulated by the EPA through the Underground Injection Control (UIC) program which was established by SDWA. The purpose of UIC is to protect current and future underground sources of drinking water through proper site location, construction, and operation of injection wells. UIC regulates five classes of injection wells, most E&P wastes are defined as Class II injection wells. States may apply to have primary enforcement responsibility (primacy) for the UIC Program. Currently, thirty three states have obtained primacy for all classes of injection wells and seven states share primacy with the EPA. The EPA administers UIC programs for the remaining states. For more information on SDWA you may call 1-800-426-4791 or visit <http://www.epa.gov/ogwdw>

Clean Water Act (CWA)

The Water Pollution Control Act is commonly known as the Clean Water Act (CWA) and is designed to restore and maintain the integrity of the nation's surface waters. CWA controls direct discharges to surface waters or stormwater systems from industrial activities and controls indirect discharges to publicly owned treatment works (POTWs) by requiring industry to pretreat their waste before sending it to a public sewer. Under the CWA, the EPA must establish effluent limitations guidelines (ELGs) for most major industrial categories. ELGs prohibit the discharge of most oil field wastes to surface water with the exception of offshore wells and wells in Cook Inlet, Alaska. These wells are allowed to discharge most types of oil field wastes, subject to the requirements of National Pollutant Discharge Elimination System (NPDES) permits. To learn more about CWA you may call the EPA Office of Water at 202-260-5700 or visit their website at <http://www.epa.gov/ow/>

NPDES Permits require: numerical limits, self-monitoring, operational measures and controls, reporting, and recordkeeping. Numerical limits are based on the more stringent of: technology-based limits (ELGs, BAT, NSPS) and best professional judgment or water quality-based limits (considers dilution and mixing in stream). NPDES permits may be obtained through the state environmental protection offices in most cases, however some states have not received EPA approval to issue permits and they must be obtained through regional EPA offices.

State Regulations

The Interstate Oil and Gas Compact Commission (IOGCC) is made up of representatives from 37 oil and gas producing states, including 30 members and 7 associate members. The IOGCC has compiled guidelines to help states develop and improve their regulations (5). A map of the United States will be displayed on the website and users will click on the desired state to see a listing of that state's regulations or be directed to the state's on-line regulations. Since regulations change frequently, the latter is the preferred method of displaying state regulations.

CASE-STUDY MODULE

This module will present case studies where particular technologies have been successfully implemented. Examples from each of the three waste management hierarchy tiers will be included. Case studies will be particularly helpful to demonstrate the possibility of new or seldom-used technologies.

INTERACTIVE COMPONENT

Perhaps the most unique feature of this website will be the interactive component where users answer a series of questions to determine drilling waste management options that make the most sense for their geographic and environmental situation. The purpose of this module is to acquaint operators with alternative drilling waste management options to reduce waste impact and increase profitability. Several options will be presented to the operator since each option will have advantages and disadvantages. A flowchart will be developed to illustrate the options given for various user answers.

ADDITIONAL COMPONENTS

Some additional components that will be included in this website are a search engine and a list of definitions and acronyms that can be accessed from other parts of the website or browsed as a whole. Other items under consideration include an email list/forum for users to post questions and answers, participate in group discussions, and search through previous discussions. An email-based notification system or newsletter is also under consideration to alert subscribers of changes in regulations that may affect them.

CONCLUSIONS

An interactive website is currently being developed to provide unbiased, technically sound information on drilling waste management. This information will benefit operators by providing a central location for regulations and technology descriptions. Operators may use the interactive component to determine drilling waste management options best suited for their geographical and environmental needs. Countries developing drilling waste regulations may become familiar with new technologies that may be more cost effective, environmentally acceptable alternatives to current practices. Countries developing their own regulations will also have access to the established regulations of the United States to assist them in regulatory development.

ACKNOWLEDGMENTS

During the summer of 2002, the author worked for Argonne National Laboratory to assemble information to be used in the website. John Veil served as the project manager and was instrumental in helping to formulate the material discussed in this paper. Bob Sullivan and Pam Richmond provided guidance on developing web-based applications and assisted in creating the framework of the website. Markus Puder provided assistance in locating and interpreting relevant regulations. John Gasper provided additional guidance on moving the project forward.

The U.S. Department of Energy, Office of Fossil Energy, National Petroleum Technology Office provided the funding for this project. The author further acknowledges the assistance of the project's industrial partners -- Fred Jones of Marathon Oil, and Carole Fleming and Rene Bernier of Chevron Texaco -- who provided guidance on drilling waste management issues.

Table 1. Waste Management Hierarchy

Tier 1 – Waste Minimization	Tier 2 – Reuse and Recycle	Tier 3 - Disposal
Material substitution	Recycle and reuse oil-based and synthetic-based muds	Land treatment
Directional drilling	Roadspreading drill cuttings on lease roads or commercial roads	Bioremediation
Coiled tubing drilling	Low temperature thermal desorption (LTTD) to recover muds and use treated cuttings (e.g., concrete aggregate, construction backfill, or landfill cover)	Evaporation
Physical separation of drill cuttings and mud		Burial (pits, landfills)
Closed loop mud systems		Offshore discharge to the ocean
Mud systems designed with small volumes		Underground injection (injection below fracture pressure, slurry injection above fracture pressure, salt cavern disposal)
		Incineration
		Offsite disposal

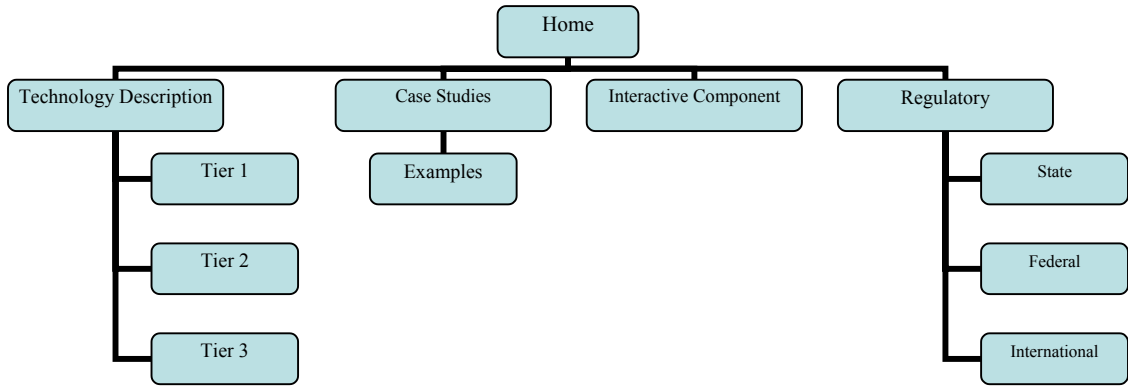


Figure 1. Website Layout

REFERENCES

1. API, "Overview of Exploration and Production Waste Management Volumes and Waste Management Practices in the United States," prepared by ICF Consulting for the American Petroleum Institute, (2000).
2. Shaffer, G. P., Hester, M. W., Miller, S., DesRoches, D.J., Souther, R. F., Childers, G. W., and Campo, F. M., "Restored Drill Cuttings for Wetlands Creation: Results of a Two-Year Mesocosm Approach to Emulate Field Conditions under Varying Hydrologic Regimes," prepared by Southeastern Louisiana University Wetlands Restoration Laboratory, Hammond, LA, for U. S. Department of Energy, National Petroleum Technology Office (1998).
3. Hester, M. W., Shaffer, G. P., Willis, J. M., and DesRoches, D. J., "Restored Drill Cuttings for Wetland Creation: Results of a Mesocosm Approach to Emulate Field Conditions under Varying Salinity and Hydrologic Conditions," prepared by Southeastern Louisiana University Department of Biological Sciences, Hammond, LA, for U. S. Department of Energy, National Petroleum Technology Office (2000).
4. EPA, "Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations," United States Environmental Protection Agency (2002).
5. IOGCC, "IOGCC Environmental Guidelines for State Oil & Gas Regulatory Programs," Interstate Oil and Gas Compact Commission, Oklahoma City, OK (1994).