Characterisation and Management of Drilling Fluids and Cuttings in the Petroleum Industry

This fact sheet describes the process for onshore petroleum operators to:

- assess and characterise waste drilling fluids and cuttings (which for this fact sheet also includes rock materials, solids and fines); and
- develop ways to manage wastes produced from drilling activities that address environmental risks and are consistent with the requirements of Queensland’s environmental legislation.

There are various drilling fluid systems used in the petroleum industry including freshwater, saltwater, oil, synthetic-based and pneumatic (e.g. air, foam) fluid systems (West et al., 2006). The term ‘mud’ is frequently used interchangeably with the term 'fluid'. The term ‘mud’ is used because of the thick consistency of the fluid system (Caenn, 2011). In general, drilling fluids in the petroleum industry are used to aid tools during the drilling of wells. The main functions of drilling fluids are:

- carrying cuttings from the hole
- cooling and cleaning the drill bit
- reducing friction
- maintaining the stability of the bore
- maintaining down-hole hydrostatic pressure
- to be non-damaging to the formation.

Drilling fluids contain a variety of specialty chemicals (called ‘additives’) each having a different purpose. For example:

- killing bacteria and adjusting pH (West et al., 2006)
- controlling viscosity, reducing fluid loss to the formation and inhibiting equipment corrosion (Ghazia, 2011).

The additives in drilling fluids are adjusted according to the physicochemical conditions of geological formations which invariably change with depth (Ghazia, 2011). In addition, drilling fluids are to be non-hazardous to the environment and personnel.

Drilling fluids are normally formulated in-situ by mixing the different additives in a dedicated storage tank, or less preferably, a sump that has been excavated within the drill site.

After drilling activities are complete, the waste fluid becomes contaminated with formation material and the final result is a large volume of liquid and solid waste that must be managed. The exact amount of waste drilling fluid produced is dependent upon numerous factors, including the depth of the well being drilled. For example, one company estimates that for a single coal seam gas well, there will be 45–55 cubic metres of cuttings and 200 cubic metres of fluids (Australia Pacific LNG Pty Limited & Worley Parsons, 2010).

Types of drilling fluids

Drilling fluids are a complex system of water-based, oil-based or synthetic-based fluids with several chemical and mineral additives (Ghazia, 2011).

Oil-based fluids are generally selected for their superior temperature stability, lubricity and hole stabilisation attributes (Caenn, 1996) but tend to have poor environmental performance in terms of their ecotoxicity and their tendency to persist in cuttings piles (Department of Industry and Resources, Western Australia, Drilling Fluids Management 2006).

Environmental concerns have been raised on oil-based fluid systems, in particular diesel-based fluids, as diesel is considered toxic to various organisms (Caenn, 1996).

Synthetic-based fluids are intended to replace either diesel or mineral oil, in oil-based fluids.

The Department of Environment and Heritage Protection (EHP), as the environmental regulator of petroleum activities in Queensland, typically does not permit the use of oil and synthetic-based fluids via conditions on environmental authorities (EA) for petroleum activities issued under the Environmental Protection Act 1994 (EP Act).

Regulatory framework

EHP regulates the management and disposal of wastes in Queensland under the provisions of the EP Act, the Waste Reduction and Recycling Act 2011 (WRR Act) and subordinate legislation.

EHP must consider the object of both the EP and WRR Acts when regulating the management and disposal of drilling fluids. The object of the EP Act is to promote ecologically sustainable development. The object of the WRR Act is complementary to this in that
it promotes waste management principles such as waste avoidance, reduction, and resource recovery and efficiency actions. Accordingly, drilling fluids should be used in such a way that enables drilling activities to be carried out efficiently and effectively but also in a way that minimises waste generation and protects the environment from adverse impacts.

Schedule 7 of the Environmental Protection Regulation 2008 (EP Reg) identifies particular wastes as regulated wastes. Waste drilling fluids and/or cuttings can be considered as ‘regulated waste’ if they contain any of the items or even residues of any of those items listed in Schedule 7 of the EP Reg.

The term ‘regulated waste’ is defined in section 65 of the EP Reg as ‘commercial or industrial waste, whether or not it has been immobilised or treated and is of a type, or contains a constituent of a type, mentioned in Schedule 7 of the EP Reg’.

The full list of regulated wastes is listed in Schedule 7 of the EP Reg and can be viewed at www.legislation.qld.gov.au (search for ‘EP regulation’).

Schedule 1 of the Environmental Protection (Waste Management) Regulation 2000 (EP WM Reg 2000) provides a list of trackable wastes that are also ‘regulated wastes’.

Trackable wastes have special record keeping requirements and material handling responsibilities that apply to generators, transporters and receivers of the waste. These requirements can be found in sections 23, 24 and 25 of the EP WM Reg respectively.

The full list of trackable wastes is listed in Schedule 1 of the EP (Waste) Reg and can be viewed at www.legislation.qld.gov.au (search for ‘waste regulation’).

Assessing waste drill fluids and cuttings

To provide guidance to the petroleum industry on the appropriate management and disposal of waste drilling fluids and cuttings and any associated storage device, EHP recommends the following systematic characterisation of the waste.

Assessment of waste drilling fluids

The assessment of waste drilling fluids should include:

1. characterising the waste in relation to the items in Schedule 7 of the EP Reg and Schedule 1 of the EP WM Reg 2000
2. considering the environmental risks of each of the additives present in the drilling fluids and the mixture.

This approach is recommended because:

- drilling fluids contain variable, and in certain instances, only trace amounts of the chemical listed as regulated waste
- contamination may be caused by naturally occurring substances present in the geological formations being drilled.

1. Characterisation of waste drilling fluids

In order to establish whether waste drilling fluid and/or cuttings are regulated and trackable waste, the material must be characterised by assessing whether it contain compounds, or result from processes, listed in Schedule 7 of the EP Reg.

The relevance of the items listed in Schedule 7 to waste drilling fluids and cuttings will depend on the additives used in the fluids and the characteristics of the geological formations being drilled.

Items listed in Schedule 7 that may be relevant to waste drilling fluids and cuttings include, but are not necessarily limited to:

- Item 1—acidic solutions (e.g. if drilling in acid soils such as ASS/PASS)
- Item 7—alkaline solutions (e.g. if potassium sulphide has been added)
- Item 20—ethers
- Item 28—inorganic sulphides (e.g. if potassium sulphide has been added)
- Item 34—mineral oils
- Item 36—non-toxic salts (e.g. if potassium chloride has been added)
- Item 37—hydrocarbons and water mixtures or emulsions (including oil and water mixtures or emulsions)
- Item 39—organic solvents
- Item 45—phenols and phenol compounds, including chlorophenols
- Item 54—surface active agents (surfactants) containing principally organic constituents, whether or not also containing metals and other inorganic materials
- Item 63—vegetable oils.

There are also a number of items in Schedule 7 relating to metals which must also be considered in making a determination as to whether the waste is regulated.

Oil-based and synthetic-based fluids will most likely trigger the regulated and trackable waste classification because of either Item 37—hydrocarbons and water mixtures or emulsions (including oil and water mixtures or emulsions) and, potentially, Item 63—vegetable oils.

If drilling is being carried out in any acid sulphate or potential acid sulphate soils, it is possible the waste drilling fluids and/or cuttings will be acidic and...
therefore trigger the regulated waste classification under Item 1—acidic solutions. In this instance, the waste will also be trackable.

2. Environmental risk considerations of waste drilling fluids

In addition to the waste characterisation step described above, environmental risk information for each additive used in formulating the drilling fluids must be considered by petroleum operators. The information must be from a referenced source such as a Material Safety Data Sheet and/or scientific publications. The environmental risk information must include:

- chemical composition
- chemical-physical properties (such as pH, solids content, emulsive properties, solubility in water)
- environmental fate and transport
- ecotoxicity (including chronic and acute)
- biodegradation (under anaerobic and aerobic conditions) and consideration of the risk of any metabolites
- potential for bioaccumulation
- potential pathway to sensitive receptors and the receiving environment.

Assessment of drill cuttings

Drill cuttings and fine solids are typically removed from the fluids by filtration and separation respectively and they can contain contaminants which come from the additives present in the drilling fluid and/or the geological formations being drilled. Accordingly, petroleum operators should carry out an assessment of drill cuttings against the criteria in the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999 to determine whether the material is suitable for any intended use/reuse, or be disposed to landfill.

Managing waste drill fluids and cuttings

Applications for petroleum EAs where wells or bores are proposed to be drilled as part of the project must include the characterisation and assessment steps described above and a proposed management strategy. This will assist EHP to assess the proposal and develop site specific conditions in the EA for managing environmental impacts associated with the handling, storage, treatment, transport and disposal of the drilling fluids and/or cuttings including the design and construction standards for pits, sumps or ponds that may be proposed. Having prescribed conditions on an EA to manage these issues will benefit applicants because they will have certainty about their legal obligations in relation to drilling fluid management.

Depending on the environmental risks (e.g. if the waste fluids have low toxicity, easily biodegrade and are demonstrated as having little effect on the environment) the waste drilling fluids and/or cuttings may be temporarily (i.e. less than 28 days in a calendar year) stored in pits/sumps and disposed of or land-farmed on site with site-specific authorisation conditions prescribed on the EA.

Waste drilling fluids and/or cuttings can also be used either by a petroleum company or another party. Beneficial uses of drilling fluids and/or cuttings include road construction, brick/concrete/block manufacturing, fill and composting/soil conditioning. In most instances, the beneficial use of the waste will require a beneficial use approval (BUA) under the WRR Act.

A BUA will be required where waste drilling fluids and/or cuttings that are regulated waste are proposed to be beneficially used in composting/soil conditioning activities. These BUA applications will need to be accompanied by an assessment of the waste material as described above, along with details on the volumes proposed to be beneficially used and a demonstration that the waste is suitable for the intended beneficial use.

The full list of application requirements for a beneficial use approval under the WRR Act can be viewed at www.legislation.qld.gov.au. Other information that is required to support a BUA application can be viewed at www.ehp.qld.gov.au.

The use of waste drilling fluids and/or cuttings can be authorised under an existing approval (e.g. a development approval for a composting and soil conditioning manufacturing facility) provided that the waste is not regulated. In these instances, the development approval/amendment application should include an assessment of the waste material as described above in addition to details of quantities, onsite storage methods and suitability. For composting and/or soil conditioning, the approval/amendment application must also demonstrate that the use of such inorganic wastes will not impact any biological degradation process (e.g. not be biocidal) and not result in environmental harm.

If the waste drilling fluids and/or cuttings are regulated waste, there are legal requirements for how they are to be transported and lawfully disposed of.

Regulated wastes must be transported by a person/company who holds a licence to transport such waste. This requires a registration certificate and code of environmental compliance under the EP Act. Tracking receipts must be completed by the generator, transporter and receiver of all trackable wastes. Regulated waste must only be transported in suitably designed vehicles, tanks, containers or secondary containers that are appropriate for containing the waste being transported.

In addition to having specified waste acceptance criteria, many landfills are not authorised to accept
liquid wastes (i.e. greater than 30 per cent moisture content). If they do, it will be to a dedicated liquid waste disposal facility and not to the landfill cells. Where waste drilling fluids and/or cuttings are to be disposed of, waste acceptance criteria for each landfill must be observed. Only certain landfills have approval to receive and dispose of regulated wastes and these landfill operators will have specified requirements for which type of wastes can or cannot be received and disposed on-site.

For general enquiries about drilling fluids in petroleum activities please contact the Queensland Government call centre on telephone 13 QGOV (13 74 68).

References


