

Alaska Oilfield Biocides Manual



Category Eighteen

In general, applicators who apply pesticides to property other than their own or their employer's property must obtain certification from the Alaska Department of Environmental Conservation (ADEC) Pesticide Program. Applicators who apply restricted-use pesticides, regardless of location, must also be certified.

In many cases, **individuals who apply biocides during the process of oil and gas exploration, production, storage, or transport** are required by their employer to become certified as Oilfield Biocide Applicators under Category Eighteen. This manual provides the information needed to successfully complete a written examination to obtain that category of certification.

The information needed to successfully complete the written core examination required for all certified pesticide applicators in Alaska includes:

1. National Pesticide Applicator Certification Core Manual;
2. Alaska Core Manual; and
3. State of Alaska Pesticide Regulations in Title 18, Chapter 90 of the Alaska Administrative Code (18 AAC 90)

The information needed to successfully obtain certification in Category Eighteen in Alaska is covered in this Alaska Manual.

Learning Objectives

- Describe four main problems that oilfield biocides may be used to control.
- List some considerations when selecting an oilfield biocide.
- List some of the health and safety risks to handlers and applicator from oilfield biocides.
- Describe some precautions that should be taken when working around biocides.

BIOCIDE USE

In the oil industry in Alaska, biocides are used to prevent or treat for various types of bacteria and algae in drilling fluids and pipes. Bacteria and associated enzymes are a problem because they can degrade the fluids, corrode or cause pitting in pipes and equipment, and may create hydrogen sulfide, a highly toxic and dangerous gas.

Biocides are typically used in all stages of oilfield development and extraction, from the initial drilling of the wells, during production of oil and gas, in pipelines, oil storage, and other aspects of the maintenance of the field.

Pesticide applicator certification is not required for many of these uses, because the pesticides involved are general use pesticides and are being mixed and applied on the employer's property. While we recommend that anyone handling pesticide products in any capacity receive training, certification is not required in these locations.

However, pesticide mixing, application, or use on any property not owned by the employer (typically limited to drilling rig locations) does require pesticide applicator certification. As a result, the focus of this manual is limited to drilling mud uses.

OILFIELD BACTERIA

Biocides are typically used to control:

- Sulfate-reducing bacteria (SRB) – These bacteria consume various sources of carbon. During this process, sulfate ions, SO_4^{2-} , into S^{2-} and HS^- are converted into sulfides, which may result in hydrogen sulfide (H_2S). Natural starches and gums in water muds provide a carbon source, making these substances especially vulnerable.
- Iron-oxidizing bacteria - These bacteria combine iron with oxygen to produce ferric hydroxide [$\text{Fe}(\text{OH})_3$]. This is an insoluble compound that can cause damage to the formation. Iron-oxidizing bacteria can also cause corrosion of metal equipment, and may also cover and protect other types of bacteria.
- Slime-forming bacteria – These bacteria can produce mats of high-density slime that may result in pore plugging, and may also cover and protect other types of bacteria.
- Polymer attacking bacteria – Some bacteria attack polymers in fracture and secondary recovery fluids, degrading the fluid and potentially resulting in a biomass which could plug the formation and reduce permeability.

BIOCIDES USED IN DRILLING MUD

Currently in Alaska, biocides used in drilling muds include glutaraldehyde (glut), Methylisothiazolinone, Bronopol, Hexahydrotriazine, THPS, and Acrolein.

Biocides used in drilling mud are applied in batches. Biocides are added to drilling mud, usually prior to delivery to the drilling sites. A drilling rig conducts tests to determine how much drilling mud is needed. Once they have ordered new mud, the mud is mixed in the plant by adding the required amount of biocide, water, and dry mud mix into a large vat or mix pit. The drilling mud (including biocides) is then pumped into a tanker truck, driven to the well site, pumped into a holding tank, and then into the well.

Batch treatment has a short contact time, usually 4-8 hours, and is usually done on a weekly to monthly basis depending on testing results of bacteria or biocide concentration in the mud.

Continuous treatment is more commonly used for pipelines, or at injection wells or producing wells. In this treatment, biocides are injected directly into the system at a rate based upon flow or production.

BIOCIDES SELECTION

Selecting biocides for oilfield use should include the following steps:

1. Review manufacture technical data and information.
2. Laboratory testing to determine product efficacy in the specific location/situation.
3. Field trials.

Manufacture Technical Data And Information

Biocide suppliers are usually able to provide much of the data required to assess which biocide is the most suitable. This would include compatibility or effects of:

- Brines - Biocidal activity can be considerably less in sea water and formation water than it is in fresh water.
- pH and temperature - Biocidal activity can alter with changes in pH or temperature. High efficacy and stability during use and storage in pH and temperature extremes is needed for use in drilling muds.
- Light sensitivity - Some compounds are vulnerable to degradation by light. Lighting during testing must match lighting encountered during actual use to determine accurate degradation rates.
- Compatibility with other chemicals that are being used - Reactions with other chemical additives have the potential to alter the efficacy of one or both chemicals, produce solids, or result in other interactions.
- Corrosiveness of the biocide – Less corrosive products are necessary for use in drilling muds because of potential to damage metal and other equipment.
- Safety of handling – Many biocides have significant potential health risks. Some products or formulations are easier to use safely or have less risk.
- Environmental effects – products with lower environmental impacts during use or potential spills are desirable. Characteristics to evaluate include toxicity, biodegradability, and bioaccumulation.

There are many biocides which are marketed under more than one trade name. In evaluating products, compare active ingredients, solvents, stabilizers and the percentages of each to ensure that identical products are not being assessed.

Laboratory Testing

Once suitable products have been identified, it is recommended to test the products in the laboratory under conditions similar to those in the proposed use, including temperature, pH, lighting, and with similar bacteria. There is evidence that biocide concentrations and contact time which are effective against planktonic (mobile) bacteria are not sufficient to kill sessile bacteria (those with little to no movement). Prospective biocides should be compared to one of known efficacy. Typically the manufacturer will conduct lab tests for their products.

Field Trials

After laboratory testing results are evaluated, biocide products are selected. The efficacy of these products in the field should be evaluated to ensure adequate performance under actual use.

BIOCIDES PRECAUTIONS

Various types of biocides are used in oilfields. Some products have significant risks to handlers and applicators, including the potential for permanent, severe damage to eyes, respiratory damage, and severe skin irritation. It is very important that all individuals working with or near

these products become familiar with the precautions and instructions provided on the EPA approved pesticide labels.

As with all pesticides, strict compliance with label instructions is mandatory by law. Safety Data Sheets provide valuable information about a product, but the pesticide label contains legally required instructions that are specific to the way that the product is being used.

Additional precautions to consider when handling biocides:

- Many face shields alone do not offer total eye protection against eye contamination. Splash-proof mono-goggles or the combination of safety glasses with side shields and a wraparound full-face shield can provide adequate eye protection.
- Many labels require eyes be continuously flushed for at least 30 minutes if product comes into contact with eyes. Adequate eyewash stations with ample water must be available in all locations where these products are in use.
- If vapors are strong enough to be irritating to the nose or eyes, additional ventilation or respiratory protection is likely necessary.
- Even small spills, leaks, drips, or splashes present a hazard, and should be addressed immediately.

The primary concerns with oilfield biocides are related to concentrated product. Once the biocide is mixed into the mud, the dilution reduces many of the risks. It may still result in skin irritation or be harmful if absorbed through the skin, and may cause irritating vapors. As a result, proper PPE and precautions should still be used around any drilling fluids that contain biocides.

CALCULATIONS

Precise and accurate application is important for every pesticide application. However, calculations required for correct application of oilfield biocides are generally less complex. For this category, math skills will not be tested.

Before Using Any Pesticide

STOP

**All pesticides can be harmful to health
and environment if misused.**

**Read the label
carefully and use
only as directed.**