STATE OF COLORADO

Arauza - DNR, Steven <steven.arauza@state.co.us>

Open Pits- Location #335573

Brett Middleton <bmiddleton@caerusoilandgas.com> Mon, Mar 15, 2021 at 7:00 PM
To: Jake Janicek <JJanicek@caerusoilandgas.com>, "Arauza - DNR, Steven" <steven.arauza@state.co.us>
Cc: Alex Fischer - DNR <alex.fischer@state.co.us>, Blair Rollins <brollins@caerusoilandgas.com>

Steven,

These are the cutting Encana attempted to close via the form 4 you referenced not a pit there are above ground along the cut slope on the pad. Carlos denied the closure and burial of the cutting but he did not deny leaving them in place. Due to the cuttings having low level PAH exceedances the plan at that time was to look for alternative remediation approaches in 2017, Caerus submitted a plan to Carlos to complete a bench test using a cometabolite/fungus to breakdown the PAH concentrations see email attached. It appears that I was not able to upload the form 4, might have been a change of operator issue.

We will be putting together a Form 27 update by the April 15th deadline for the cutting remediation.

The bench test completed on 4/26/2018 Caerus had intended to complete a field test in 2019, unfortunately the field test did not occur.

Historic sampling indicated exceedances for PAH (benzo(a)pyrene @ 0.015 - 0.19, pH @ 8.1 - 9.27, SAR @ 7.95 – 20, and As @ background.

Given the recent rule making changing the PAH allowable concentration limit to 0.11mg/kg (RSL) Caerus will need to complete additional sampling to determine if the cutting are currently compliant and to add the additional constituents of table 915-1. The last sampling event in 2017 were compliant with 915-1 for PAH but that was only 2' below surface so we need a full profile to depth.

Hopefully that adds so clarity/history to this location.

Regards,

Brett

[Quoted text hidden]
[Quoted text hidden]

---------- Forwarded message ----------
From: "Lujan - DNR, Carlos" <carlos.lujan@state.co.us>
To: Brett Middleton <bmiddleton@caerusoilandgas.com>
Cc:
Bcc:
Date: Mon, 21 Aug 2017 23:16:13 +0000
Subject: Re: G29 PAH pilot study
Brett,

It is pretty exciting to read about the proposed pilot test. This may be a breakthrough in dealing with PAHs. I wish you good luck with it. If it works, APEX and Coorain Consulting will get a lot of work from other operators as well.

Note: I'll check tomorrow about the change of name and the form(s) you submitted.

Thanks,
Carlos

Carlos Lujan, Ph.D.
Environmental Protection Specialist
Northwest Region

P 970.625.2497 x7 | F 970.625.2497 | C 970.286.3292
796 Megan Avenue, Suite 201, Rifle, CO 81650
carlos.lujan@state.co.us | www.colorado.gov/cogcc

On Mon, Aug 21, 2017 at 1:56 PM, Brett Middleton <BMiddleton@caerusoilandgas.onmicrosoft.com> wrote:

> Attached is the study I intended to upload via form 4.
>
> Brett Middleton
>
> Sr. Environmental Specialist
>
> Caerus Oil and Gas
>
> 143 Diamond Ave. Parachute, CO 81635
>
> Office: 970-285-2739 | Mobile: 970-987-4650 | bmiddleton@caerusoilandgas.com
>
> **This email, including attachments, may include confidential and/or proprietary information, and may be used only by the person or entity to which it is addressed. Please do not read, copy or disseminate this communication unless you are the intended addressee. If you received this communication in error, please permanently delete immediately. Also, please notify immediately via e-mail that you have received this message in error.**
>
> ---
>
> **From:** Brett Middleton
> **Sent:** Monday, August 21, 2017 1:55 PM
> **To:** Lujan - DNR, Carlos <carlos.lujan@state.co.us>
> **Subject:** G29 PAH pilot study

Carlos,

The G29 facility location is still under Encana Oil & Gas, therefore I will not be able to submit and eForm 4 for the attached PAH pilot study we discussed until it changes over. I know the COGCC is working on updating the operator to Caerus but for the time being e submittals will be on hold.

Regards,

Brett Middleton

Sr. Environmental Specialist

Caerus Oil and Gas

143 Diamond Ave. Parachute, CO 81635

Office: 970-285-2739 | Mobile: 970-987-4650 | bmiddleton@caerusoilandgas.com

This email, including attachments, may include confidential and/or proprietary information, and may be used only by the person or entity to which it is addressed. Please do not read, copy or disseminate this communication unless you are the intended addressee. If you received this communication in error, please permanently delete immediately. Also, please notify immediately via e-mail that you have received this message in error.

2 attachments

PAH_BenchTest_ProposedScope.pdf
150K

Re: G29 PAH pilot study.eml
27K

Subject: Re: G29 PAH pilot study

Lujan - DNR, Carlos <carlos.lujan@state.co.us> Mon, Aug 21, 2017, 5:1
to Brett Middleton

You are viewing an attached message. State.co.us Executive Branch Mail can't verify the authenticity of attached messages.

Brett,

It is pretty exciting to read about the proposed pilot test. This may be a breakthrough in dealing with PAHs. I wis you good luck with it. If it works, APEX and Coorain Consulting will get a lot of work from other operators as well.

Note: I'll check tomorrow about the change of name and the form(s) you submitted.

Thanks,
Carlos

Carlos Lujan, Ph.D.
Environmental Protection Specialist
Northwest Region

P 970.625.2497 x7 | F 970.625.2497 | C 970.286.3292
796 Megan Avenue, Suite 201, Rifle, CO 81650
carlos.lujan@state.co.us | www.colorado.gov/cogcc

On Mon, Aug 21, 2017 at 1:56 PM, Brett Middleton <BMiddleton@caerusoilandgas.onmicrosoft.com> wrote:

> Attached is the study I intended to upload via form 4.
>
> Brett Middleton
> Sr. Environmental Specialist
> Caerus Oil and Gas
> 143 Diamond Ave. Parachute, CO 81635
> Office: 970-285-2739 | Mobile: 970-987-4650 | bmiddleton@caerusoilandgas.com
>
> CAERUS OIL AND GAS LLC
>
> **This email, including attachments, may include confidential and/or proprietary information, and may l used only by the person or entity to which it is addressed. Please do not read, copy or disseminate t**

May 11, 2017

Mr. Brett Middleton
Environmental Specialist
Encana Oil & Gas (USA) Inc.
143 Diamond Avenue
Parachute, Colorado 81635

RE: Scope of Work
Piceance Basin, Colorado

Dear Mr. Middleton:

Apex Companies, LLC (Apex), prepared this scope of work (SOW) for Encana Oil & Gas (USA) Inc. (Encana) to provide you with a brief overview of the proposed approach for conducting a bench test to evaluate the effectiveness of using white rot fungus and bacteria to remediate polycyclic aromatic hydrocarbon (PAH) constituents present in drill cuttings on Encana's G29 well pad in the North Parachute Ranch (NPR). The proposed SOW includes the following steps:

Scope of Work

1. Using previous sample results, collection points will be identified at the stockpile.
2. Collect two 5-gallon buckets of drill cuttings from the G29 stockpile.
    a. To provide meaningful results from the bench test, material with low PAH concentrations should be collected along with the targeted high concentration material.
3. Submit samples to ESC to confirm collection of materials with target PAH concentrations.
4. Ship samples via UPS next day air to Laramie, WY for bench test completed by Coorain Consulting, LLC. (see attached SOW for details on bench test protocols)
    a. The bench test is anticipated to take 2-3 months to complete
5. Review results and prepare a final report.

Sincerely,

Apex Companies, LLC

Chris Hines
Project Manager
970-261-1127
chris.hines@apexcos.com

Attachments

- Subcontractor SOW

Proposal for bench testing cuttings contaminated with Polycyclic Aromatic Hydrocarbons (PAHs)

Introduction

Coorain Consulting, LLC (Coorain) has been asked by Apex Company of Grand Junction, CO to assist in the generation of a treatment protocol to remediate a collection of oil well drill cuttings held by one of Apex's clients. The legacy cuttings are low in TPH but exceed the Colorado Oil and Gas Conservation Commission (COGCC) Table 910.1 requirements for benzo(a)pyrene (BaP), benzo(a)anthracene, and benzo(b)fluoranthene. Apex's client needs to reduce the three PAH concentrations to meet the COGCC limits and dispose of the cuttings, and wishes to explore bioremediation processes to accomplish this task.

It is known that bacteria can degrade low molecular weight (LMW) PAHs but are less efficient at or unable to degrade High Molecular Weight (HMW) PAHs. LMW PAHs are generally considered to be those with less than 4 aromatic rings and HMW PAHs are those with 4 or more rings. Since the contaminants of concern (COC) are HMW PAHs, Coorain has advised Apex that the use of a ligninolytic fungi/bacteria mixture may be a viable solution to this problem. Ligninolytic fungi can attack the HMW PAHs and, in concert with bacteria, can mineralize many large molecules such as lignin (the backbone of wood), PAHs, biphenyls, azo dyes, etc. The reason for this division lies in the method of degradation used. Bacteria tend to absorb the material they metabolize prior to initiation of attack while metabolism occurs inside the cell. This process is limited by the physical size that can be transport across the cell wall into the interior of the bacteria. Ligninolytic fungi on the other hand secret potent monooxygenase exoenzymes (lignin peroxidase, manganese peroxidase, lacase, etc.) which function outside the cell and initiate degradation exterior to the cell. The smaller fragments produced are easily absorbed and can be used by the fungi or bacteria. In addition, the partially oxidized compounds are more water soluble and therefore more easily assimilated.

One consideration, however, is that microbes usually actively metabolize only as long as it is energetically "profitable" to them. Once the concentration of a metabolite declines to a point where it takes more energy to synthesize the metabolic machinery necessary for the acquission of the metabolite than the cell can derive from the process, the synthesis of the enzymes will cease. This is part of the reason why bioremediation sometimes can't seem to reach the ultra low concentrations specified by environmental agencies in their regulations. However, it is sometimes possible to "trick" fungi into continuing production by the addition of a cometabolite. An example of this approach would be to feed P. chrysosporium a metabolite such as an azo dye, lignin, or salicylate to induce it to continue producing ligninolytic enzymes capable of degrading the COC. The COC would be metabolizes as collateral damage and not as the primary target. This approach is at the heart of Coorain's plan to remediate these cuttings. Before committing to a full scale pilot project, Coorain believes it would be wise to collect a few samples of the cuttings and perform a series of bench tests using various cometabolic compounds to determine which would be best to use. To this end, Coorain suggests the following protocol outline.

Bench Testing Protocol

Selection of a co-metabolite to treat the cuttings with will be important if this project is to succeed. A search of the literature by Coorain has revealed a number of potential co-metabolites which need to be tested and evaluated for use in this project. It is assumed that only one site will be evaluated initially. The following process will be followed:

- Approximately 50-75 pounds of cuttings will be collected in a bucket
- The sample will be shipped to Coorain's lab in Laramie, Wyoming.
- The contents of the bucket will be removed and thoroughly mixed to ensure good homogeneous sub samples are obtained
- Two (2) kilograms of sample will be placed in a growth chamber and evenly distributed to a level depth
- Twenty (20) grams of finely powdered fungal/bacterial powder will be evenly distributed on top of the sample
- A nutrient solution will be applied to the sample
- A quantity of dissolved co-metabolite will be applied and the moisture and pH levels will be determined
- If needed the soil moisture level will be adjusted to about 40% field capacity and the pH will adjusted to about 5-6 standard units
- The container will be covered with provision for air/CO_2 exchange and set aside for growth
- The container will be observed for signs of growth daily
- The sample will be monitored for pH and moisture levels weekly and will be adjusted as needed
- Once growth is noted,
    - weekly in-house testing for fluorescent compound levels will begin
    - Daily pH and moisture monitoring will begin
    - Photo-documentation of growth changes will begin
- As necessary, 200g samples will be withdrawn for laboratory analysis

This process will be applied to approximately 10 samples as noted in the table below.

Table 1. Bench Testing Sample Composition

Container Number	Weight of Cuttings	Fungal Powder	Co-metabolite weight	Comments
1	2.0 Kg	20g	0	Control Sample
2 -9	2.0 Kg	20g	20g	One co-metabolite per container
10	2.0 Kg	0	0	Blank