2016 TENORM Sampling Results from Drill Cuttings

Introduction

Naturally Occurring Radioactive Materials (NORM), Naturally Accelerator Radioactive Materials (NARM) and Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) are often regulated under similar conditions. Some states separate NORM from TENORM, while others consider them as being in the same category. Kansas is in the latter group.

In general, the Conference of Radiation Control Program Directors (CRCPD) suggests for NORM/NARM/TENORM regulations have exemptions for anything with concentrations of Radium (all isotopes) below 5 pCi/g. The typical methodology for drill cutting disposal in Kansas is to place them in pits near the drill site. This is problematic due to the presence of shales in the Kansas underground. These thin slabs tend to trap Uranium, making them much more radioactive than limestone, dolomite or many other rocks or soils. When shales are brought up to the surface, they may exceed the 5 pCi/g limit. Drilling muds can be constantly recycled and can concentrate radioactive materials, also possibly exceeding the 5 pCi/g limit. It was thus necessary to create a study focusing on the contents of future pits.

Site Selection and Sampling Process

During 2016, well locations were selected by a state geologist for their locations both across the state of Kansas and representing different geological formations. Six samples were taken from each well site. GPS locations of each sample were taken with a Garmin GPS III Plus. One center sample was taken from the center of the pit. Two edge samples were taken at least 90 degrees from each other and at least 1.5 feet from the edge of the pit with one sample in the downgrade direction. Two additional mid samples were taken from points considered likely to have the greatest exposure to drilling mud and other NORM concentrating factors based on distance from the drilling site and likely effluent pipe arrangements. An additional sample of dried drilling mud was taken the center of the pit. During the sampling, a survey was taken for radiological exposure rate by walking about and across the pit in figure eights and averaging the result. Each sample filled a gallon zippered plastic bag. This bag was labeled with the county name, a letter for location (C for center, M for mid, E for edge), and the GPS coordinates.

For each sample, a GeoProbe 6600 was used to take continuous discrete samples until the mud layer is reached at the bottom of the pit. The cuttings from the auger after the first meter were mixed together and sampled into a 0.5L polyethylene cup using a stainless steel trowel. If the pit was not deep enough to fill the 0.5L beaker from the auger cuttings, another cutting was made next to the original.

Analysis

All samples were analyzed according to EPA 901.1m (modified for solids) by the Iowa State Hygienic Laboratory. The resulting data is included in Table 1. According to procedure, samples were dried in an oven, ground into a fine powder and sealed airtight. At least 22 days passed between sample preparation and counting to allow for the buildup of radon gas and progeny. Samples were counted on an HPGe detector.

Table 1. Radium-226 Concentrations in the Six Pits.

Site (County)	Background (pCi/g)	Average pCi/g	Average pCi/g over Background	Max pCi/g over Background	Max pCi/g
Lyon	0.5155	0.825875	0.310375	0.5695	1.085
Barber	0.802	0.8585	0.0565	0.13	0.932
Sedgwick	1.1	0.6135	-0.4865	0.075	1.175
Ellis	0.7885	0.787375	-0.001125	0.3315	1.12
Stanton	0.7975	0.9545	0.157	0.2205	1.018
Logan	1.135	1.0775	-0.0575	0.005	1.14

Conclusion

Based on this limited data it appears that even at the highest natural concentrations of NORM, if the drilling pits are covered by one meter of soil, future-use scenarios are covered.

The suggested CRCPD 5 pCi/g regulatory exemption limit for Radium (all isotopes) appears sufficient to address Kansas drill cuttings. Concentrations must be determined by laboratory analysis, because a radiological exposure rate may not be reasonable to determine radiological safety at drilling pits due to the relative shallowness of readings taken at the top of the pits.

From this limited data it appears that using pits to dispose of drill cuttings in Kansas is safe from a radiological standpoint so long as proper precautions for salinity, including placing safe set back distances for the pits, are followed. Equipment may require an alternate disposal pathway. Drilling muds may require an alternate disposal pathway, but have not yet been tested in Kansas soil.

Disclaimer

This preliminary and limited study provides information to guide future studies and discussions related to drill cuttings. No data or conclusions from this report shall be used to set policy or contradict existing published radiation statutes or regulations.