



Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Jonathan P. Steverson
Secretary

September 25, 2016

Via Electronic Mail to Joe Rossabi at:
rossabi@redox-tech.com

Joe Rossabi, Ph. D., P.E.
Redox Tech, LLC
200 Quade Drive
Cary, North Carolina 27513

Re: **Diammonium Phosphate**

Dear Mr. Rossabi:

The Florida Department of Environmental Protection's Division of Waste Management (Division) hereby accepts Diammonium Phosphate (also known as DAP and DAP 18-46-0) to be used in aqueous solution at concentrations of 0.06 % by weight or less to enhance biodegradation of contaminants including but not limited to petroleum hydrocarbons.

The remedial process utilizes Diammonium Phosphate to provide nutrients for biological growth and metabolic function of petroleum consuming microorganisms to help degrade the contaminants of concern to form the end products carbon dioxide and water. DAP is typically mixed with water at a concentration of no more than 0.06 % by weight prior to injection into the soil and groundwater through the use of wells and/or borings. Supplemental information is provided in Enclosure 1. Regulatory information is provided in Enclosure 2.

While the Florida Department of Environmental Protection (FDEP) does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from an environmental standpoint with respect to applicable rules and regulations, and the interests of public health and safety. Vendors, upon receipt of an acceptance, must market their product or process on its own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace. This acceptance letter shall not be construed as either an approval of the product or a certification of its performance.

It is not a requirement that a remediation product or process obtain an acceptance from the Department in order to be proposed for use in a site-specific Remedial Action Plan, but the plan must contain information to show that it meets all applicable and appropriate rules and regulations.

For Diammonium Phosphate, a copy of this acceptance letter containing regulatory compliance advice should be included in the appendix of each site-specific Remedial Action Plan that proposes its use.

The Department reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, Department acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site-specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site-specific design details must be provided in a Remedial Action Plan. If you have any questions, contact Elena Compton at (850) 245-8911, through Mail Station 4580 at the letterhead address, or by e-mail at Elena.Compton@dep.state.fl.us.

Sincerely,



Elena Compton, M.S., P.E.
Professional Engineer II
PRP Team 2, FDEP
850-245-8911

Enclosures: (1) Supplemental Information
(2) Regulatory Information

ec: Kenneth Busen, P.G. - FDEP/Tallahassee – Kenneth.Busen@dep.state.fl.us
John Wright, P.E. - FDEP/Tallahassee - John.Wright@dep.state.fl.us

SUPPLEMENTAL INFORMATION

1. Manufacturer/ Distributer: MOSAIC, 13830 Circa Crossing Dr., Lithia, Florida 33547
www.mosaicco.com
2. Description: Diammonium Phosphate (DAP) is an agricultural fertilizer typically supplied as a dry granular material that is soluble in water. It is usually mixed with water at a concentration of no more than 0.06 % by weight prior to injection into the soil and groundwater through the use of wells and/or borings.
3. Chemical Properties: Per submitted information and per MOSAIC's web. site, DAP is derived from rock phosphate and ammonium. It is manufactured by reacting phosphoric acid and ammonia and contains two ammonia molecules. In alkaline soil conditions, one of the ammonia molecules in Diammonium Phosphate will revert to ammonia. DAP itself is alkaline with a high pH, exceeding 7.5.
4. Formula: $(\text{NH}_4)_2\text{HPO}_4$.
5. Chemical Composition (per the manufacture's provided MSDS):

Phosphate as P_2O_5 : 45.5 – 46.6 %

Nitrogen as N: 17.5 – 18.3 %

Water: 1.5 – 2.6 %

Fluorides as F: 2 – 4 %

Note: The laboratory analysis for fluoride reported lower value of 50 mg/Kg (or 0.005%)

6. Laboratory analyses:
 - a. Redox Tech, LLC, provided analysis of Diammonium Phosphate for total phosphorus (P_2O_5), ammonia nitrogen (NH_3), sulfate, fluoride, chloride, arsenic, and cadmium, performed by Innophos on May 23, 2016. The data demonstrated a negligible amount of chloride. Small amounts of sulfate (200 mg/Kg), fluoride (50 mg/Kg), arsenic (3mg/Kg), and cadmium (3 mg/Kg) were also reported.
 - b. Per the FDEP's request, Redox Tech, LLC, provided analyses of Diammonium Phosphate for sixteen (16) metals – all "total" reporting values - for aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, iron, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc, performed by Waypoint Analytical on September 2, 2016, and for uranium, performed by Gel Laboratories on September 12, 2016. The assay demonstrated that aluminum, antimony, arsenic, barium, cadmium, mercury, nickel, selenium, silver, thallium, and vanadium are not present in DAP (undetectable). The laboratory data reported negligible amounts of beryllium, iron, lead, uranium, and zinc. A small amount of chromium (6 mg/Kg) was measured in Diammonium Phosphate.

Note: At the proposed maximum 0.06% DAP injecting concentration, possible maximum 0.0018 mg/L of arsenic, 0.0018 mg/L of cadmium, and 0.036 mg/L of chromium in the DAP solution are significantly below the primary ground water standards for arsenic of 0.010 mg/L, for cadmium of 0.005 mg/L, and for chromium of

0.100 mg/L and do not impose immediate environmental threat. However, due to the tendency of metals to accumulate in the subsurface, any repetitive injections may be prescribed cautiously.

- c. Redox Tech, LLC, also provided analyses of the 0.24% (four times maximum concentration of 0.6%) aqueous solution of Diammonium Phosphate for sixteen (16) metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, iron, lead, mercury, nickel, selenium, silver, thallium, vanadium, zinc and 0.12% (two times maximum concentration) aqueous solution of Diammonium Phosphate for fluoride, sulfate, and chloride, performed by Pace Analytical on August 12, 2016. No exceedances of the regulatory standards were reported.

REGULATORY INFORMATION

1. Groundwater cleanup standards: The onus shall be on users of Diammonium Phosphate to ensure that all applicable groundwater standards will be met at the time of project completion for the contaminants of concern being remediated, and any by-products produced as a result of chemical or biochemical reactions induced or assisted by Diammonium Phosphate. The following chapters of the Florida Administrative Code (F.A.C.) are cited: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C., for groundwater classes and standards; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation projects; Chapters 62-780, 62-782, and 62-785 F.A.C., for cleanup criteria; and Chapter 62-777, F.A.C., for cleanup target levels.
2. Injection well permit: Per Rule 62-528.630(2)(c), F.A.C., the issuance of an enforceable, site-specific Remedial Action Plan Approval Order by the Department for injection-type aquifer remediation constitutes the granting of a Class V injection well construction/clearance permit.
3. Underground Injection Control (UIC): Remedial Action Plans proposing injection-type aquifer remediation shall include the information required by Rules 62-528.630(2)(c)1 through 6, F.A.C., for the purposes of the UIC program. Reviewers of those plans, upon issuance of a Department-enforceable Remedial Action Plan Approval Order must transmit this information to the UIC program in Tallahassee by submitting a completed copy of the "UIC Notification". The notification is in the form of a memorandum currently located on the Internet at www.dep.state.fl.us/waste/categories/pcp/pages/innovative.htm.
4. General information about temporary Zones of Discharge (ZOD): For groundwater remediation, the composition of a fluid to be injected must meet the primary and secondary drinking water standards set forth in Chapter 62-550, F.A.C., and the minimum groundwater criteria of Chapter 62-520, F.A.C. [and Chapter 62-777], pursuant to UIC Rule 62-528.600(2)(d), F.A.C. Aquifer remediation products that do not meet these requirements must seek relief from water quality criteria by one of two mechanisms as follows. Permission for a temporary ZOD may be obtained via Rule 62-520.310(8)(c), F.A.C. If permission for a ZOD cannot be obtained by rule, then it will be necessary to seek a variance from Department rules in accordance with Section 120.542, Florida Statutes.

Rule 62-520.310(8)(c), F.A.C., allows for a temporary ZOD for closed-loop re-injection systems, for the prime constituents of the reagents used to remediate site contaminants, and for groundwater secondary standards. In order to obtain permission for a temporary ZOD by rule, a site-specific Remedial Action Plan must indicate: (a) the chemical ingredients of concern in the fluid to be injected that will be present in excess of groundwater standards; (b) the size of the ZOD that is needed; (c) the amount of time that the ZOD will be needed; and (d) a plan for monitoring the injected chemical ingredients of concern. The size of the temporary ZOD will usually be the injection well radius of influence when the treatment system is a single injection point. For a multiple point system, the ZOD can usually be expressed and illustrated as the total area covered by all the injection points, located side-by-side with overlapping radii of influence.

5. Site-specific Remedial Action Plans shall indicate the volume and concentration of the aqueous Diammonium Phosphate slurry/solution that will be injected. Redox Tech, LLC,

indicates that the maximum concentration of Diammonium Phosphate in the fluid to be injected is 0.06% by weight, depending on site conditions and pre-injection aquifer concentrations of nitrogen and phosphorus.

6. Specific ZOD information for Diammonium Phosphate:

In order to comply with UIC ZOD requirements:

- a. Obtain permission for a temporary injection ZOD by way of Rule 62-520.310(8)(c), F.A.C., for ammonia, fluoride, pH, and sulfate.
- b. For the ZOD parameters ammonia, fluoride, pH, and sulfate, reviewers of Remedial Action Plans, when filling out the UIC Notification memorandum, should check the box labeled as follows:
“☒ ZOD permission by rule 62-520.310(8)(c), F.A.C., for reagent chemical species and/or parameter(s) in the fluid to be injected (or re-injected) that exceed secondary groundwater standards. ...”.

7. Required UIC ZOD compliance monitoring for Diammonium Phosphate: In order to comply with Rule 62-520.310(8)(c), F.A.C., the receiving groundwater must be monitored for ammonia, fluoride, pH, and sulfate. Quarterly monitoring should suffice in most cases. Upon expiration of the time period granted for the ZOD by way of Rule 62-520.310(8) (c), F.A.C., the concentrations/ values of these four (4) parameters must meet their respective groundwater standards or their natural-occurring background values at the specific cleanup site, whichever is less stringent. Ammonia is classified as a minimum groundwater criterion contaminant with a current standard of 2.8 milligrams per liter (mg/L) maximum. The others are secondary groundwater contaminants with current standards as follows: fluoride, 2 mg/L; pH, range 6.5 to 8.5; and sulfate, 250 mg/L. Note: Primary standard for fluoride = 4 mg/L.

9. Operating parameters: Remedial Action Plans should identify the Diammonium Phosphate operating parameters to be monitored in the groundwater during the period of active bioremediation. This type of monitoring is not for UIC compliance but rather the measurement of parameters that serve as indicators of biological activity; for example: dissolved oxygen; pH; temperature, oxidation-reduction potential; total organic carbon; phosphorus; electron acceptors such as sulfate and nitrate; etc.

10. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Division of Waste Management has no objection to the use of some wells for the injection of Diammonium Phosphate slurry if the wells are suitable for the purpose. However, no “designated” monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply Diammonium Phosphate. This will avoid a premature conclusion that the entire site meets cleanup goals. By making sure that designated tracking wells are not used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each injection well.

11. Three categories of groundwater monitoring:

- a. Active remediation monitoring for a cleanup site’s contaminants of concern: During the period of active remediation, groundwater shall be monitored in accordance with the requirements set forth in Section 62-780.700, F.A.C.

- b. Post Active Remediation Monitoring for a cleanup site's contaminants of concern: At least one (1) year of quarterly post remediation groundwater monitoring for the contaminants of concern shall be conducted at a minimum of two (2) wells: one located in the area of highest contamination, the other at the downgradient edge of the contamination plume, pursuant to Section 62-780.750, F.A.C.
 - c. Monitoring of the UIC zone of discharge: For Diammonium Phosphate, in order to comply with Rule 62-520.310(8)(c), F.A.C., monitor the ZOD for ammonia, fluoride, pH, and sulfate as discussed in paragraph seven (7) above.
12. Injection operations:
- 1. Avoidance of migration: For injection-type, in-situ aquifer remediation projects, injection of Diammonium Phosphate shall be performed in such a way, and at such a rate and volume that no undesirable migration of either the Diammonium Phosphate or the contaminants of concern in the aquifer results, pursuant to Rule 62-528.630(3), F.A.C.
 - 2. Underground Injection Control operating permit: Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the contamination plume is expected to accompany the treatment process, the Department requests that the information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction details.
13. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from the inventory-tracking list.
14. Open-pit application: There is no objection to the introduction of Diammonium Phosphate to an open excavation pit in which the groundwater has been exposed. Open-pit application is not injection, and it is not necessary to notify the Underground Injection Control Section, but this should not be construed as carte blanche to introduce to the pit any substance at any concentration with no regard to potential toxicological effects. The Division of Waste Management therefore recommends that the groundwater in the area of the pit be monitored for the same zone of discharge parameters that would have been monitored (if any) had the application actually been an injection.
15. Limitation: Diammonium Phosphate is not intended for bulk removal of free product. Remove the bulk of the free product by other means prior to the use of Diammonium Phosphate.
- .