National Organic Standards Board
Crops Subcommittee
Petitioned Material Proposal
Ammonium Citrate
February 5, 2019

Summary of Petition for Ammonium Citrate:

Alpha Chelates has petitioned for the inclusion of ammonium citrate on the National List at §205.601 (synthetic substances allowed for use in organic crop production). This re-petition follows a petition in 2016 of Ammonium Citrate during which time the NOSB determined in its fall 2016 recommendation that alternatives exist, including lignin sulfonate, humic acids, fulvic acids, and non-synthetic citrate. Also on file for these materials are four petition addendums; the first addendum was submitted in response to a request for additional information by the Crops Subcommittee in 2016; the second addendum was volunteered by the petitioner in 2016; the third addendum was volunteered by the petitioner in 2016. An addendum to the current petition and second addendum were submitted in 2018. At its Fall 2018 board meeting, the NOSB presented a petitioned materials discussion document to solicit stakeholder feedback. Questions were posed regarding the need expressed by farmers for the petitioned material and the efficacy of the petitioned chelating agent over currently approved chelating agents.

Ammonium citrate is used as a chelating agent with inorganic metal micronutrients copper, iron, manganese, or zinc for high pH soils. Chelates are used to provide micronutrients that are readily available to plants in deficient soils. Ammonium citrate is not being petitioned to be applied to crops alone but in its chelated forms.

During its 2016 review, the Board determined that there was insufficient information in the justification statement regarding the necessity of this material for organic crop production. Chelates occur naturally in soils, so chelates, *per se*, are not incompatible with a system of sustainable agriculture; however, overreliance on synthetic materials is not compatible with a system of sustainable agriculture. The subcommittee determined that there were insufficient grounds for adding this substance to the National List as there are natural alternatives and one allowed synthetic already available, and as far as the NOSB knows, the permitted products are adequate to meet farmers' needs.

The most recent re-petition was submitted on the premise that "the technology concerning chelating agents and micronutrient chelates has been significantly misunderstood by [the] NOSB". Additionally, the new petition refers to the results of a field trial of wheat in high pH soil in Australia in which chelated micronutrients led to an increase in yield over unchelated micronutrients. A significant component of the original and second petitions put forth a case that the use of the term "chelating agent" in the regulations needs to be revisited. The petitioner requests that the NOP define which bases can be used to neutralize specific acids used to synthesize chelating-agent-salts. Additionally, the petitioner asks for "recognition that the species and strength of acid and base are needed for accurate and reproducible neutralization; hence the suitability for use of 'nature identical' acids and bases". Other clarification and revision appeals are explained in the second petition.

A technical report (TR) was not requested as part of the 2016 review; however, a **2018 TR** was solicited in response to the second application, both to review the petitioned material and to investigate the broader issue of nomenclature and technical errors elaborated by the petitioner.

Summary of Review:
The Crops Subcommittee determined that in its fall 2016 recommendation that alternatives to the proposed substance exist as stated earlier. The most recent repetition by Alpha Chelates asserted "the technology concerning chelating agents and micronutrient chelates has been significantly misunderstood by [the] NOSB". To address this concern a revised technical review was requested by the Crops Subcommittee. The revised technical review, dated October 5, 2018, was provided to the Crops Subcommittee shortly thereafter. The Subcommittee asked that the technical review address twelve questions ranging from the Subcommittee's interpretation of language related to the physical chemical definition of terms to the environmental fate of the proposed materials to whether or not tractable alternatives exist. On the latter two points, if used as proposed, ammonium citrate has no known adverse environmental impacts; however, the report reiterated that many alternatives exist and are currently available for use in organic production.

On the Subcommittee's use and interpretation of language regarding "chelates" and "chelating agents," a point the petitioner asserted the subcommittee had misapplied, the technical review concluded we were in fact interpreting their meaning correctly and had consistently done so in past reviews. The October 5, 2018 technical review provides a detailed review (top of page 4 through the middle of page 6) of terms and definitions of those terms pertaining to "chelates", "chelating agents" and "ligands." Specifically, the technical review went on to state: "the NOP requested technical clarification of the terms "ligand," "chelating agent," and "chelate." The petitioner claims that NOP has used "chelating agent" incorrectly and suggests replacing the term "chelating agent" with "ligand." Therefore, it seems that, prior to the analysis of NOP's usage of the term "chelating agent," a discussion of the two terms may be helpful. A ligand has been defined as an ion or molecule that is covalently bonded to a metal atom that can also have an independent existence. A chelating agent is a specific type of ligand and is characterized by its ability to form multiple bonds to the metal center from multiple attachment points (i.e., a polydentate ligand). Based on these definitions, it is technically correct to classify all chelating agents as ligands. However, in the United States (the petitioning company is Australian), it is far more common to refer to these polydentate ligands as "chelating agents," rather than the more general "ligand." Moreover, the term chelating agent is typically reserved for ligands that not only have the capacity to form multiple attachment points, but also ligands that tend towards forming these attachment points as a rule—a tendency that results in a specific set of properties and applications. In conclusion, the term ligand is *not* synonymous with chelating agent, with chelating agents comprising a specific mode of coordination while ligand refers to anything molecule or ion that coordinates to a metal atom."

Category 1: Classification

1. For CROP use: Is the substance _____ **Non-synthetic** or ___X____ **Synthetic?**
   Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources? [OFPA §6502(21)] If so, describe, using NOP 5033-1 as a guide.

   No

2. Reference to appropriate OFPA category:
   Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: [§6517(c)(1)(B)(i)]; copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and

minerals; livestock parasiticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers; or (ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern?

No. Ammonium citrate does not contain any of the materials listed in (A). However, as copper is an essential micronutrient for plant development, it may be used in concert with ammonium citrate in the form of a chelate. In this form, the copper is unlikely to be reactive due to the multiple coordination points of the citrate, although the water solubility of the copper (if used) is likely to be increased.

When used as petitioned, ammonium citrate serves as an inert ingredient for the delivery of micronutrients. The citrate chelated micronutrients are inert due to their multiple points of attachment to the micronutrient. The petitioned substance is not listed by the EPA as an inert of toxicological concern and is not listed in 40CFR 180, per (B).

Category 2: Adverse Impacts

1. What is the potential for the substance to have detrimental chemical interactions with other materials used in organic farming systems? [§6518(m)(1)]

   Chelates occur in nature and are used at low rates in organic farming, so there should be no detrimental chemical interactions with other materials used in organic farming systems.

2. What is the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment? [§6518(m)(2)]

   Ammonium hydroxide and citric acid are introduced in a reaction vessel to produce ammonium citrate, a salt. The amino acid citric acid is neutralized by the alkali ammonium hydroxide. Ammonium citrate is reacted in a solution with copper, iron, manganese, or zinc salt to form a liquid chelate of the given metal. Chelates are applied in low dosages; application rates for the chelates manufactured by the petitioner are 1.2-2.5 kg/ha.

3. Describe the probability of environmental contamination during manufacture, use, misuse or disposal of such substance? [§6518(m)(3)]

   The petition states that there is minimal chance of environmental or human contamination during the manufacturing process as the reaction takes place inside a sealed vessel. As stated above, the petitioned substance is an ingredient in a finished product and is converted into a metal salt chelate and is therefore not subject to questions of disposal. However, ammonium hydroxide is used in the manufacture of the substance, and ammonium hydroxide is produced by the reaction of ammonia with water. Ammonia can be harmful to human health and aquatic life if spilled or improperly handled.

4. Discuss the effect of the substance on human health. [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i); §6518(m)(4)].

The petition states that “in the unlikely event of contact of reaction vessel contents with human skin, there is a very low level of hazard as the substance is at a low concentration, is not toxic, and can be easily washed off with water”.

5. Discuss any effects the substance may have on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. [§6518(m)(5)]

   The Subcommittee is not aware of negative effects of the petitioned material on biological and chemical interactions in the agroecosystem.

6. Are there any adverse impacts on biodiversity? (§205.200)

   None known.

Category 3: Alternatives/Compatibility

1. Are there alternatives to using the substance? Evaluate alternative practices as well as non-synthetic and synthetic available materials. [§6518(m)(6)]

   Yes, alternatives exist. There are a range of natural chelating agents that are excreted by plants and microorganisms, or are produced from the decomposition of organic matter, and aid in the delivery of micronutrients in the soil. These compounds are broadly classified as phytosiderophores or phytometallophores. These compounds are wide ranging and include organic (carboxylic) acids and non-synthetic amino acids. However, organic or amino acids must first undergo a neutralization reaction with bases in the soil before they are able to acts as chelating agents. In basic (alkaline) soils, the application of these natural organic and amino acids will result in their neutralization, and the subsequent anions may act as chelating agents for micronutrient sources already existing in the soil.

   There are a variety of synthetic substances approved in 7 CFR 205.601 that may be used in place of the petitioned substance as a means of increasing the water solubility of micronutrients. Most of these substances are acids, which would result in a pH change in the soil, converting insoluble hydroxide salts into more soluble micronutrient salts. The approved acids are the following: peracetic acid, boric acid, humic acids, and sulfurous acid. However, like the application of natural organic and amino acids to access natural chelating agents, the application of approved synthetic acids could result in the negative outcomes associated with soil acidification.

   Lignin sulfonate, or lignosulfonate, is a synthetic chelating agent that is approved by the NOP for use in organic agricultural production at 7 CFR 205.601. Like ammonium citrate, lignosulfonates can form chelates with cationic micronutrients, increasing their water solubility and bioavailability. Lignosulfonates are derived from the biopolymer lignin via the pulping process. Studies have shown that these chelating agents increase the uptake of both zinc and iron micronutrients in crops.

2. In balancing the responses to the criteria above, is the substance compatible with a system of sustainable agriculture? [§6518(m)(7)]

In so far as this substance is a synthetic material designed for enhancing uptake of micronutrients, a process which naturally occurs in soils, and for which a range of alternatives already exist, it is difficult to see how the substance is compatible with a system of sustainable agriculture.

Classification Motion:

Motion to classify ammonium citrate as synthetic
Motion by: Dave Mortenson
Seconded by: Harriet Behar
Yes: 7 No: 0 Abstain: 0 Absent: 1 Recuse: 0

National List Motion:

Motion to add ammonium citrate as petitioned at §205.601
Motion by: Dave Mortenson
Seconded by: Emily Oakley
Yes: 0 No: 7 Abstain: 0 Absent: 1 Recuse: 0

Approved by Steve Ela, Subcommittee Chair to transmit to NOSB, February 9, 2019