Formal Recommendation
From: National Organic Standards Board (NOSB)
To: the National Organic Program (NOP)

Date: November 18, 2016

Subject: Petitioned Material - Sodium Bisulfate

NOSB Chair: Tracy Favre

The NOSB hereby recommends to the NOP the following:

Rulemaking Action:

Guidance Statement:

Other: X

Statement of the Recommendation:
The NOSB voted to classify sodium bisulfate as synthetic. The vote to add sodium bisulfate as petitioned at §205.603 failed, based on the availability of alternatives.

Rationale Supporting Recommendation (including consistency with OFPA and Organic Regulations):
Although sodium bisulfate was found to be compatible with a system of sustainable agriculture, the Board determined that there are alternatives currently in use, including management practices such as proper air exchange in barns, removing caked areas and keeping litter areas dry. Therefore the NOSB does not support listing a synthetic poultry litter amendment.

NOSB Vote:

Classification Motion:
Motion to classify sodium bisulfate as petitioned as synthetic:
Motion by: Ashley Swaffar
Seconded by: Harriet Behar
Yes: 14 No: 0 Abstain: 0 Absent: 1 Recuse: 0

Motion Passed

Listing Motion:
Motion to add sodium bisulfate as petitioned at §205.603
Motion by: Ashley Swaffar
Seconded by: Tracy Favre
Yes: 0 No: 14 Abstain: 0 Absent: 1 Recuse: 0

Motion Failed

National Organic Standards Board
Livestock Subcommittee
Petitioned Material Proposal
Sodium Bisulfate
June 21, 2016

Summary of Petition:
In April 2014 the NOP received a petition to add Sodium Bisulfate to the National List of synthetic substances allowed for use in organic livestock production 7 CFR 205.603 as a poultry litter treatment.

Summary of Review:
Manufacture and Uses of the Substance:
The petitioned purpose for sodium bisulfate, in the form of the commercial product PLT®, is to control ammonia in poultry houses for all species of domestic fowl in the Galliformes order (includes chickens, turkeys, quail, pheasant, etc.) and Anseriformes, which includes waterfowl. It is intended as a topical litter and dirt pad treatment. It is not intended for use in feed, food or drinking water. It is being petitioned for addition to §205.603 as a poultry litter additive. According to the petitioner, litter amendments such as sodium bisulfate minimize ammonia volatilization, improve poultry health and maximize the litter's agronomic, environmental, and financial value.

Sodium bisulfate is used as a top dressing to poultry litter to control ammonia in poultry houses. It is widely used in the commercial poultry industry (Blake and Hess 2001). It is also used in the dairy industry to reduce bacterial counts in bedding and ammonia emissions, preventing environmental mastitis and calf respiratory stress (Sun, et al. 2008). Sodium bisulfate has been successfully used in commercial applications in a wide variety of animal housing types, including dry litter in broiler, turkey and layer facilities; deep bedding for horses (Sweeney, Scanlon, et al. 2000), swine and cattle; and free-stall and dry lot dairy housing systems. Specific application rates and application timings are necessary for reduction in environmental ammonia levels, as well as for reduction of food-borne pathogens and fly control purposes. Floor-raised poultry are typically kept on litter that starts out as new bedding and becomes a mixture of decomposing manure, spilled feed, feathers and bedding throughout the life of the flock. For commercial broiler houses in the U.S., bedding is typically placed in the poultry house once per year and then reused repeatedly over several flocks (Moore, et al. 1995). This is known as built-up litter. Built-up litter is a major source of volatilizing ammonia, and litter management is a key factor affecting ammonia levels and emissions. Sodium bisulfate is typically added to poultry litter prior to the placement of chicks. The high temperatures during brooding (28-34°C or 82-93°F) enhance ammonia volatilization at a time when chicks are most susceptible to the health challenges associated with elevated ammonia levels (more than 25 ppm).

Sodium bisulfate application rates of 93-100 lbs. per 1,000 ft2 controlled ammonia levels for up to 30 day relative to the untreated control (McWard and Taylor 2000). By this time the critical brooding period is over. Multiple applications at the manufacturer's recommended rate in two-week intervals reduced ammonia concentration by 56.6% and 21.8% at days 42 and 57, respectively (Purswell, et al. 2013). Growth rate and feed efficiency were not affected by repeated additions of the sodium bisulfate litter amendment with the birds present.

In addition to the control of ammonia levels in poultry houses, litter treatments have also been found to be effective in reducing litter microbial populations. This can be beneficial in controlling food-borne

pathogens such as Campylobacter and Salmonella (Line 2002). Reducing the level of microbial contamination of litter is also important when the litter is removed and used as a fertilizer. Potential contamination of fresh fruits and vegetables grown on fields with applied animal manures is an increasing food safety concern (Hanning, Nutt and Ricke 2009).

The use of sodium bisulfate as a litter amendment reduces atmospheric ammonia content and reduces the frequency and populations of the human pathogen Campylobacter. A further benefit discovered includes significant reductions in the population of darkling beetles, a common poultry house pest (Terzich 1997).

For many years sodium bisulfate has been used as a pH reducer in a variety of agricultural, industrial, and food applications. The anti-bacterial properties of sodium bisulfate have been exploited in its application as a toilet bowl cleaner (EPA Reg #1913-24-AA) and as a preservative in EPA method #5035 "Closed-System Purge-and-Trap & Extraction for Volatile Organics in Soil and Water samples" to prevent microbial activity leading to release of volatile organic compounds (VOC).

Historically sodium bisulfate is a by-product from the manufacture of nitric acid from sodium nitrate and sulfuric acid. The by-product is referred to as niter cake. Today there are two methods for producing sodium bisulfate. One involves mixing sodium hydroxide with sulfuric acid which will react to form sodium bisulfate and water as shown in the equation below. This method, produced by JOST Chemical® (Jost Chemical 2014), results in a sodium bisulfate monohydrate which is used as a laboratory reagent.

$NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$

The petitioner states that they use another sodium bisulfate production method that involves reacting sodium chloride (salt) and sulfuric acid at elevated temperatures to produce sodium bisulfate and hydrogen chloride gas as shown in the equation below.

$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

According to the petitioner, the liquid sodium bisulfate is then sprayed and cooled so that it forms solid beads. The hydrogen chloride gas produced is dissolved in water to produce hydrochloric acid, which may be sold as a by-product.

During the Spring 2016 in-person public comment session at the National Organic Standards Board meeting in Washington, DC, the board received one public comment that stated there are OMRI listed poultry litter amendments currently in use. The Board was provided information from a manufacturer of a poultry litter amendment product, which is currently OMRI listed, that expressed concerns they had with the TR. The commenter felt that the board should not approve synthetic poultry litter amendments when there are already effective OMRI listed products being used in the marketplace.

Category 1: Classification

1. **Substance is used for:** Livestock

2. **For LIVESTOCK use:**
   a. Is the substance agricultural or non-agricultural? This substance is non-agricultural

b. If the substance is non-agricultural, is the substance: non-synthetic or synthetic. This substance is synthetic

3. **For LIVESTOCK**:
   This product would be listed at 205.603 Livestock Production-Synthetic. Sodium bisulfate is a synthetic substance in that it is manufactured using a chemical process where sodium hydroxide interacts with sulfuric acid.

   A) Sodium bisulfate contains sulfur (S) in the form of bisulfate (HSO4-). It is not a toxin produced from bacteria. Sodium bisulfate is not a pheromone, horticultural oil, fish emulsion, treated seed, vitamin or mineral. Although not a soap, sodium bisulfate is a key ingredient in several cleansers. Sodium bisulfate is not a livestock parasiticide or medicine. It is not a physical production aid such as netting, insect trap, sticky barrier, etc. It does function as a production aid in that it is a litter amendment to control ammonia levels in the poultry house.

   B) Sodium bisulfate is an inert ingredient which is not listed on EPA List 4 (7 U.S.C. §6517(c)(1)(B)(ii)), but is exempt from a requirement of a tolerance per 40 CFR part 180. An EPA final rule published in the Federal Register (Federal Register 2014) established an exemption from the requirement of a tolerance of residues of sodium bisulfate when used as an inert ingredient in antimicrobial formulations on food contact surfaces. This exemption applies to its use in public eating places, dairy processing equipment and food processing equipment and utensils at no more than 2,000 ppm in final formulation. The regulation was effective June 6, 2014.

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)]**

   TR LINES 434-441

   Sodium bisulfate should not be mixed with chlorine bleach or ammonia cleansers. In addition, sodium bisulfate should not be mixed with sodium carbonate or sodium hypochlorite, which are both approved substances for use in organic production. Sodium carbonate is a §205.605 (a) nonsynthetic allowed substance, and may be used as a natural cleaning product on organic operations. Sodium hypochlorite is on §205.601 as a synthetic allowed as an algaecide, disinfectant and sanitizer. Sodium hypochlorite is also on §205.603 as a synthetic allowed for disinfecting and sanitizing facilities and equipment. Sodium sulfate should not, therefore, be used when sodium hypochlorite has been used for disinfecting and sanitizing poultry facilities.

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)]**

   TR LINES 346-368 and 375-387

Sodium bisulfate is hygroscopic in that it attracts water. Sodium bisulfate dissociates completely in water into sodium (Na+), hydrogen (H+) and sulfate (SO4-2). As a mineral acid, sodium bisulfate is not expected to contaminate ground water or soil or to accumulate in the food chain (EPA 1993).

Without the addition of the sodium bisulfate, the nitrogen present in the litter would be lost as volatile ammonia. Sodium bisulfate captures this nitrogen, increasing the nitrogen content of the litter (Choi and Moore Jr. 2008). Sodium bisulfate-treated chicken litter also provides a nitrogen source in a form that plants can use immediately (ammonium sulfate). Ammonium sulfate is available to plants as a nitrogen source. In the soil the ammonium ion is released and forms a small amount of acid, lowering the soil pH while contributing nitrogen for plant growth. In commercial fertilizers, nitrogen is supplied in the form of ammonium nitrate. The nitrogen content of ammonium sulfate is lower – 21% nitrogen and 24% sulfur, compared to ammonium nitrate (NH4NO3) with 34% nitrogen.

Bacterial levels in poultry litter have been shown to decrease as pH decreases. The use of PLT® has been shown to reduce survivability of E. coli and Salmonella in broiler house litter (Pope and Cherry 2000). As such, sodium bisulfate may be a beneficial component for pathogen reduction, and could play a role in an on-farm HACCP (Hazard Analysis and Critical Control Points) program, although further research is needed (Pope and Cherry 2000).

PLT® is reported to be 93.2% pure, with 6.8% sodium sulfate as an impurity. Sodium sulfate is also produced in the reaction of sodium bisulfate and ammonia, but has not been shown to be a concern for the welfare of the flock or the environment. In fact, sodium sulfate can be used as a source of sodium without chloride in poultry diets (Jankowski, et al. 2011).

The mode of action of sodium bisulfate with ammonia is unrelated to the type of litter used. The only effect of litter type is the amount of moisture and thus the amount of ammonia produced. For example, sand, grass and newspaper litters volatilize greater amounts of ammonia than wood shavings (Garces, Chilundo and Jairoce 2013). Bedding materials help absorb moisture, limiting the production of ammonia gas and growth of harmful pathogens. Historically, pine shavings have been used as poultry bedding and are the standard to which other materials are compared. There are some regional variations in bedding material, with peanut hulls sometimes used in Georgia and Florida, or rice hulls in Arkansas and Mississippi. Other bedding materials studied include, but are not limited to, pine bark, chipped pine, mortar sand, ground hardware pallets, chopped straw, ground door filler, and cotton-gin trash (Bilgili, et al. 2009). While bedding material in poultry houses must be absorbent, it must also dry quickly. Paper products absorb moisture well but do not dry out appropriately. This can lead to caking, especially around the waterers, which can cause increased ammonia production, footpad lesions and breast blisters (Bilgili, et al. 2009).

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

TR LINES 393-428

The hydrogen chloride gas produced in the production of sodium bisulfate is absorbed in water to produce hydrochloric acid which can be sold as a co-product. There are no other materials

requiring disposal. Quality control measures used in the manufacturing of sodium bisulfate ensure that all the starting materials are converted to final products so that no waste is generated.

EPA's Envirofacts Master Chemical Integrator (EMCI) (EMCI 2009) references the Environmental Defense Fund's Chemical Score Card for sodium bisulfate (Chemical Scorecard 2011). The chemical scorecard summarizes information about the health effects, hazard rankings, industrial and consumer product uses, environmental releases, risk assessment values and regulatory coverage for different products. They use a three ranking system looking at human health, ecological health and integrated environmental rankings. They rank products from least hazardous to most hazardous in a scale from 0-100. Worker exposure hazard score for sodium bisulfate was 18. The environmental hazard value score was 15, and the total hazard value score was 12. Sodium bisulfate has a safe ranking for EPA's Design for the Environment (DfE) program (DfE 2014).

In general, mineral acids such as ammonium sulfate (by product of sodium bisulfate treated litter) will dissociate and release hydrogen ions in the environment thus decreasing the pH. The extent and duration of this decrease in pH will depend on the amount of neutralizing ions present, the buffering capacity of the medium, and the amount of dilution possibilities. However, ammonium sulfate only exerts a small decrease in pH. For example, the application of an ammonium sulfate fertilizer 21-0-0 at 10 lbs per 1000 square feet changes the soil pH from 7.5 to 7.4 (Mason 2008). There was no literature to suggest that repeated applications of sodium bisulfate treated litter would lead to decreases in soil or water pH. .

Sodium bisulfate is harmful if swallowed in large amounts (ScienceLab.com MSDS 2014). Symptoms of swallowing more than one tablespoon of sodium bisulfate include burning pain in the mouth, diarrhea, vomiting and severe low blood pressure. If sodium bisulfate touches human skin, symptoms may include blisters, burns and painful red skin. If sodium bisulfate gets in eyes there may be decreased vision, eye pain, eye redness and tearing (ScienceLab.com MSDS 2014).

Sodium bisulfate is incompatible with strong bases, strong oxidizing agents, sodium carbonate and sodium hypochlorite. It should not be mixed with chlorine bleach or ammonia cleansers.

The levels at which sodium bisulfate is added to poultry litter in broiler houses has been shown to have no statistically significant effect on the incidence of foot pad lesions (Nagaraj, Wilson and Saenmahayak, et al. 2007). Multiple additions of the product PLT during broiler grow out effectively controlled ammonia volatilization from litter with no reduction in foot pad quality (Purswell, et al. 2013).

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

TR LINES 506-511

Sodium bisulfate is typically spread mechanically on litter prior to bird placement. It must be hand applied when birds are in the house. Sodium bisulfate is considered hazardous by the

OSHA Hazard Communication Standard (29 CFR 1910.1200) in that it causes serious eye irritation, may cause respiratory irritation, and may be harmful if swallowed. When handling sodium bisulfate, it is important to use personal protective equipment. Breathing in dust must be avoided. It is important to wash thoroughly after handling sodium bisulfate. The material is hygroscopic and will readily absorb moisture.

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)]**

TR LINES 445-484

According to the EPA website (EPA 2014), toxicity tests of sodium bisulfate with mosquitos, green algae and water fleas showed that it is not acutely toxic. The research, however, is very old (Anderson 1946, Dowden and Bennett 1965). More recent data could not be located. Sodium bisulfate is used as a means of chemically preserving soil samples to prevent the microbiological degradation of volatile organic compounds (Hewitt 1995).

Soil pH is an important chemical property because it affects the availability of essential plant nutrients (Lucas and Davis 1961). Most of the common crops have a wide range of pH adaptation. As an example, alfalfa, corn and small grains grow well in soil pH ranging from 5.7 to 8.1. No research could be found on the maximum level of sodium bisulfate that could be added to soil before it would have an adverse effect on soil chemistry. No research showing effects of fertilizing with PLT-treated litter on soil ecosystem could be found, indicating a need for research in this area. The use of PLT-treated litter in the Delmarva Peninsula, a region with heavy broiler production, has not been shown to have negative effects on the soil when applied at levels applicable to the nutrient requirement of the crop being grown (Guo, N. Tongtavee and Labreveux 2009).

The biggest environmental concern with respect to animal manures, including poultry litter, is currently phosphorus runoff (Moore Jr., et al. 1995). Phosphorus is normally the limiting nutrient for eutrophication, which has been identified as an important water problem in United States surface waters. Manure typically has a low nitrogen-to-phosphorus ratio and, if manure is applied to meet the nitrogen requirement of the crops being fertilized, there is a buildup of phosphorus in agricultural soils. Much of this soil phosphorus is lost in runoff from pastures fertilized with manure. As a result, much of the manure must be applied based on crop phosphorus requirement, limiting the potential of poultry manure as an organic fertilizer. Increasing the nitrogen content of the manure, by preventing volatilization, improves its value as an organic fertilizer, thereby reducing phosphorus buildup (Moore Jr., et al. 1995).

To control ammonia levels in animal houses, including poultry houses, sodium bisulfate is added to the bedding or litter. In a study looking at the effect of sodium bisulfate on skin and hooves of horses, it was concluded that sodium bisulfate was safe for use in horse barns (Sweeney, Habecker and Russell 2000). In the study, sodium bisulfate was applied to clipped intact skin after a single and repetitive application. Sodium bisulfate was also applied to the sole of both front hooves and covered with wet gauze. Contact with moistened sodium bisulfate had no effect on pony skin. There were no gross changes, but contact with sodium bisulfate for 6 hours

on 10 consecutive days did cause mild to moderate microscopic changes. However, the duration of contact in the study was in excess of that expected under typical husbandry conditions.

The addition of PLT® to poultry litter in broiler houses had no statistically significant effect on the incidence of pododermatitis4 (Nagaraj, Wilson and Saenmahayak, et al. 2007).

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

TR LINES 346-368

Sodium bisulfate is hygroscopic in that it attracts water. Sodium bisulfate dissociates completely in water into sodium (Na+), hydrogen (H+) and sulfate (SO4-2). As a mineral acid, sodium bisulfate is not expected to contaminate ground water or soil or to accumulate in the food chain (EPA 1993).

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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)]**

Alternatives to litter amendments include management practices such as proper air exchange in barns, removing caked areas and keeping litter areas dry.

TR LINES 517-555

A new type of litter amendment has become available which is based on dried Yucca schidigera whole plant. This is Eco-Gest YS® (Nova Microbial Technologies 2014), however it is unknown if it has been approved for use on an organic farm by any certifier or material review organization. Yucca extract products have already been employed as a feed additive for the control of manure odors in organic production (Prince Yuccaplus and Bioliquid 3000®).

There is also a group of litter additives that can be applied to built-up litter to speed the release of ammonia, which is then flushed out of the poultry house before the chicks are placed. This would include such products as agricultural lime (CaCO3), the least effective, and burnt lime (CaO), the most effective, with the effectiveness of hydrated lime (Ca(OH)2) falling in between. This method for controlling ammonia levels in the poultry house shifts the flux in gaseous nitrogen to outside the poultry facility, which can have associated negative impacts on the surrounding environment (Kelleher, et al. 2002).

Another group of litter amendments that have been used to control ammonia in poultry litter are clay-based products that adsorb odors and reduce ammonia release by absorbing moisture. This would include zeolite (natural clay material). Zeolite from Clean Age Minerals, Inc. (Clean Age Minerals 2014) has been approved by the third party material review organization, OMRI (it is "OMRI Listed"). Additional OMRI Listed products include Barn Fresh Plus and Activated Barn Fresh (Absorbent Products 2012), which are combinations of diatomaceous earth and calcium montmorillonite6 with added citric acid. These products are possible alternatives for sodium bisulfate for control of ammonia

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

Yes, but it is unclear if this substance is needed in organic agriculture as alternatives exist. The subcommittee would like to pose the following questions:

1. Are there alternatives available to reduce ammonia in poultry barns?
2. Do the alternatives work in the area of reducing or eliminating Salmonella that could be present in barns?

Classification Motion: Move to classify sodium bisulfate as petitioned as synthetic:
Motion by: Ashley Swaffar
Seconded by: Harriet Behar
Yes: 7 No: 0 Abstain: 0 Absent: 1 Recuse: 0

Listing Motion: Move to add sodium bisulfate as petitioned at §205.603
Motion by: Ashley Swaffar
Seconded by: Tracy Favre
Yes: 0 No: 7 Abstain: 0 Absent: 1 Recuse: 0