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Comments on TAP reviews for Calcium Oxide and Calcium Hydroxide

By – Morris L. Preston, PE, QEP, President of Preston Engineering, Inc.

Thank you for this opportunity to offer comments concerning the petitions for calcium oxide and calcium hydroxide. I want to make a number of informational comments to supplement the initial petition and to add to the statements made in the TAP review. I originally drafted and assembled the petitions. Review of the TAP documents indicates that there are informational items that need reinforcement.

The petitions were crafted to pave the way for the use of specially formulated complex calcium complex such as Bio-Cal for organic crop production. Bio-Cal has a long history of beneficial use by farmers who wished to be certified as organic. They wanted to use Bio-Cal but needed a product that could be approved by NOSB. A product formulated from natural limestone (calcium carbonate), gypsum, and lime dust (CaO) would meet the needs of these farmers, particularly for increasing the calcium and mineral content of forages fed to dairy cows. During the formulation of Bio-Cal water is added which then results in calcium oxide hydrating to calcium hydroxide. Initially we petitioned the NOSB for inclusion of complex calcium compound on the list. This petition was rejected and we were advised that we must apply for specific chemical compounds and so we resubmitted petitions for Calcium Oxide and Calcium Hydroxide for use in crop production. Restrictions were requested that assure the materials could only be in a form that is buffered and complexed in a manner that eliminates harmful effects.

Meeker Farms can produce a material from limestone, gypsum and lime fines that is beneficial for crop production and should be considered for use in organic farming. The lime fines presently come from Linwood Mining and Minerals in Buffalo, Iowa. They are a producer of high quality lime. The lime is produced in a rotary kiln by calcining high purity limestone. This process releases carbon dioxide from the limestone and results in calcium oxide (the chemical name for lime). The lime comes out of the kiln in either granules or fines. Pebble lime is a material that is over 92% calcium oxide and is sold for drinking water purification, wastewater treatment, flue gas treatment, and steel making. Linwood produces another product called Terra-Loc, which is used in construction to stabilize foundation soils. This material typically has a fine particle size. It contains a 40% lime and 38% calcium carbonate. This is a lower priced product compared to pebble lime and is overproduced during the production of pebble lime. Excess material is stockpiled at Linwood's facility. This material is a wonderful ingredient for Bio-Cal. It is mixed with water and other natural ingredients in a multi-step process, which gives off heat and forms a larger particle size suitable for field application. Meeker Farms simply uses the excess material that Linwood makes while producing pebble lime. Therefore there is no net increase in energy used. There is less energy used than for natural limestone, which has to be mined and crushed to produce fine sized calcium carbonate.

The TAP review says lime is the byproduct of industrial processes such as cement production and expresses concerns about cement plants burning hazardous wastes. Lime production in a lime plant and Portland cement production in a cement plant are two different processes. They may look the same but they operate differently, they use different raw materials and they produce different products. A cement kiln produces clinker, which consists of complex calcium compounds containing silicate, aluminum or iron. The clinker is then ground with gypsum to produce products such as Portland cement. Portland cement production requires significant volumes of minerals such as silicate, aluminum and iron in addition to limestone. Lime production on the other hand only needs high purity limestone.

Another observation is that terms like cement plants and lime plants and lime kiln dust and cement kiln dust are being used interchangeably. This is a mistake and a gross oversimplification. The industrial

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processes, raw materials, and products are not the same. I do not believe any additional pollution results from the production of a product like Bio-Cal. Since it in part replaces materials that would otherwise have to be mined and processed, it reduces the pollution that comes from mining, blasting and processing the limestone it replaces. This petition is not about the use of cement kiln dust.

The TAP review discusses the ratio of feed to final product in producing lime. It is an industry rule of thumb that it takes two pounds of limestone to make one pound of lime. One reason is that the molecular weight of calcium carbonate is 100 while the molecular weight of lime is 56. Carbon dioxide with a molecular weight of 44 is given off. If the calcining process is 100% efficient, the most lime you can get from 100 pounds of calcium carbonate is 56 pounds. Some of the very fine limestone passes through the kiln without being calcined. This pass through material is captured as a mixture of lime and limestone fines which is one of the ingredients used in Bio-Cal. A reader of the TAP might conclude that limestone has 50% impurities, which is certainly incorrect. A more typical situation is that 44% of the limestone is given off as carbon dioxide and 6% is not captured in the primary product because of process inefficiency.

The TAP Review indicates that the use of synthetic calcium oxide contributes to the increase of energy use and fossil fuel consumption. I think the opposite is true. The previous paragraph indicates that lime production is an inefficient process where approximately 6% of the feedstock is not converted to the primary product, high dollar pebble lime. Utilizing the 6% of the feedstock that is not effectively utilized does not increase the energy usage and dependence on foreign oil. This material is currently being produced and is being underutilized. Using it beneficially will not increase demand on foreign oil or other forms of energy. Production of limestone requires energy for mining, hauling, crushing, screening, and site restoration. The use of lime fines avoids use of virgin limestone. So there is a net energy reduction.

The TAP review also expressed some concern about worker safety. I believe that the workers exposed to a formulated calcium product are at a similar risk as applying limestone to the field. The main concern is airborne dust. Products like Bio-Cal are thoroughly hydrated. This reduces dust formation as well as the risk of inhalation. Limestone on the other hand can be very dusty if it is dry and fine. Airborne dust can impact the respiratory system no matter the source. Masks or air purifying filters should be worn in high dust situations encountered in agriculture. Either MSHA or OSHA regulates work places whether lime or limestone is being produced. They establish the same level of protection for workers at these plants.

Another technical concern is measurement of the heat given off when a formulation of calcium oxide and calcium hydroxide is mixed with water. Information from a commercial laboratory was forwarded that describes the heat given off when mixing lime dust with water and when mixing the formulated product with water. The formulated product yielded a negligible amount of heat when mixed with water. The petition suggested that a condition of one degree of heat rise or less is allowed as a part of the restricted use. The TAP review was concerned about the validity of the test method for measuring this heat rise. From a research standpoint our suggested method may be crude. However it is a practical on the farm technique that can be performed repeatedly and inexpensively with equipment already available on most farms. ASTM method C472 (A collection of Test Methods for Gypsum products) describes a similar approach to measuring temperature during mixing of water and gypsum. More precise procedures that measure in hundreds of degrees are not needed and would have to be performed in the laboratory. I feel that a field test is much better.

Please consider these comments on both the TAP reviews for Calcium Oxide and Calcium Hydroxide. Please feel free to contact me at 563/388-8288, fax 562/388-9003, or e-mail mlp@prestonengineering.com.

Response to TAP Review of Calcium Oxide, Calcium Hydroxide

We would like to correct some misinformation in the TAP review and clarify some facts regarding the request for CaO and $Ca(OH)_2$ to be listed as allowed synthetics for use in crop production with specific restrictions and/or annotations.

Possible contaminants

—Our petition requested material from lime kilns only, not to include cement kiln dust. We strongly recommend that only CaO & $Ca(OH)_2$ from lime kilns be considered for organic use.

—It's a clean product, extensively tested, originating from limestone mines and is used in water treatment for human consumption.

Alternatives

—Calcium in organic production is a vital plant nutrient. In liming materials it *only* becomes available if the carbonate it is bound to neutralizes soil acid (i.e pH less than 6.5). For neutral pH soils, lime is not an efficient calcium source. Calcium is vital to plant growth and health, is involved in building cell walls, and prevents invasion by disease pathogens. It's the trucker of all minerals, influencing plant mineral uptake. For organic farmers to be successful, they need healthy mineralized soils. Healthy mineralized soils produce healthy mineralized plants, which when fed to livestock result in healthy, productive animals.

—In much of the upper Midwest and many other parts of the country, no high calcium lime or gypsum exists (none in Wisconsin), so those materials must be hauled in. This fine calcium complex requires less application than lime (at least half) to provide the available calcium needed by soils and crops. This level of calcium activity is usually not obtained with limestone. Transportation energy is saved.

Availability

—Piles of calcium complex (production over runs) already exist and require little energy to process for soil use.

—The product is an overrun (lower CaO than desired) and available at many locations throughout the country. How it is cured (handled) makes it safe and a good choice for organic production. The product would be landfilled if not used.

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Soil Microorganisms

—Numerous research studies using this mixture have shown no ill effects on soil microbiology and in some cases, microbial activity was improved.

—These studies support strong anecdotal reports from the field.

Energy & Cost Savings

—Because soils and crops are healthier, less disease, weed, and insect problems exist. Less material for controlling problems and fewer trips across the field are needed for the organic farmer, saving energy and reducing costs.

—Due to increased crop mineral uptake, less minerals need to be supplemented to livestock, again saving energy, costs and unneeded off-farm purchases.

—This calcium complex is more sustainable than using limited supplies of virgin limestone or gypsum ores for soil. It is, in essence, recycled.

Worker & Farmer Safety

—OSHA workplace standards are already in place covering workers at lime kilns where this product is produced.

—Limestone also has health concerns associated with dust. Appropriate measures need to be taken to avoid breathing dust regardless of the source.

The petitioner believes that these products are valuable and viable inputs for organic producers. The petitioner further believes that (as stated in the application and by TAP Reviewer #3) these inputs should be approved with restrictions; such restrictions to include, but not be limited to, applying to fields in amounts necessary to raise soil minerals to optimum levels based on soil tests and as a part of a managed program to remineralize soils.

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