ilc resources

MINERAL *Writes*

THIRD QUARTER 2010

CALCIUM
Feed-grade calcium products are available in a wide variety of particle sizes, from liquid suspendable products to large particle products for laying hen diets.

DICALCIUM PHOSPHATE
Both 18.5% and 21% phosphorus products are available.

SODIUM BENTONITE
Bentonite products are available in a wide variety of particle sizes suitable for any purpose.

POTASSIUM
ILC Resources has both potassium chloride (KCl) and potassium magnesium sulfate (K/Mg/S) available.

All products are available in both bag and bulk.

For additional information contact

Richard H Bristol, MS
ILC Resources Director of Nutrition and Technical Services

ILC Resources
10536 Justin Drive
Urbandale, Iowa 50322-3730
(515) 243-8106
Fax (515) 244-3200
1-800-247-2133

www.ilcresources.com

richardb@ilcresources.com

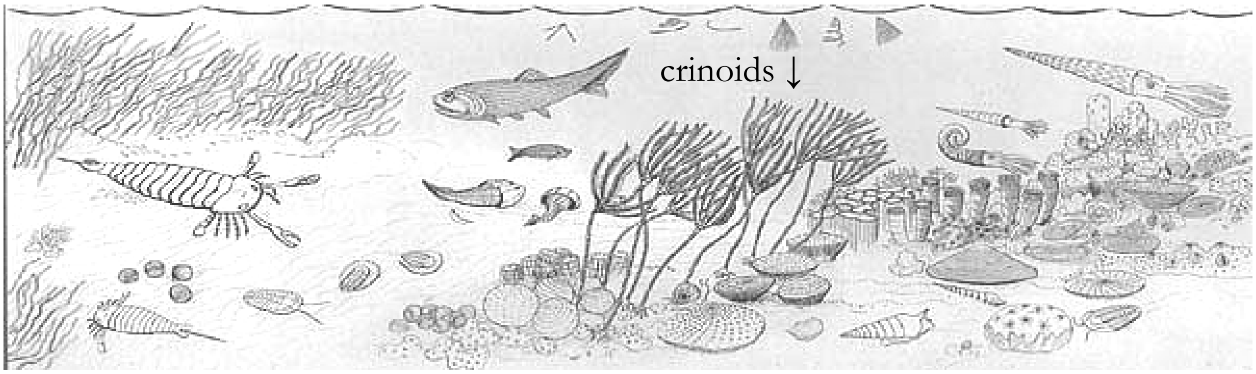
An editorial…

Food Safety Starts with Safe Ingredients…

Most days we start off with eating breakfast. It may be as simple as a banana or even a donut and a *cup o' coffee* on the way to work. It might be more elaborate such as bacon, eggs, toast and orange juice or a bowl of breakfast food and maybe some fruit. Usually, about noon we find ourselves having lunch and eating all over again – maybe going home for a meal or catching a sandwich nearby or even a full meal in a café. Then, by early evening there we are again, bellied up to the table and eating supper. This scene could be at home, at a drive-through, or a nice restaurant. For the most part, we repeat this progression every day with possible snacks in between. Whether each of these times and meals is a good idea or not is pretty much left up to our individual thinking. Eating is undeniably necessary to support life. Amounts of food, frequency of eating and choices of what we eat are important health issues also that confront us, and we either dismiss those concerns or we respond in some fashion that points to better health. However important this may be, health is not really this editorial's focus. For a moment, let's pause and ask ourselves "How safe is what I am eating?" If I'm having a candy bar driving down the road, have I made sure it is ***safe*** to eat before I rip open the wrapper and take a bite? Going into a café to order a hamburger and fries for lunch, am I mainly concerned about how safe it is before I sit down and eat? Arriving home in the evening to a well-prepared meal with the family, do I even pause for a second to wonder if I might get sick after supper? I surmise most of us hardly give this possibility a thought. Certainly from a traditional perspective, we mostly have assumed food safety with confidence as we start to eat under the wide array of conditions already touched upon here. Can we continue such nonchalance in attitudes toward the food we eat and provide for our families? Personally, I am not convinced that food in America is really becoming increasingly dangerous. That confidence is not shared by all, of course, and there are situations and environments that perhaps do spell justifiable concerns. On the other hand, it certainly behooves society to pause and examine the safeguards in our food supply chain to assure what is eaten is safe to be eaten. Healthiness is another separate topic entirely.

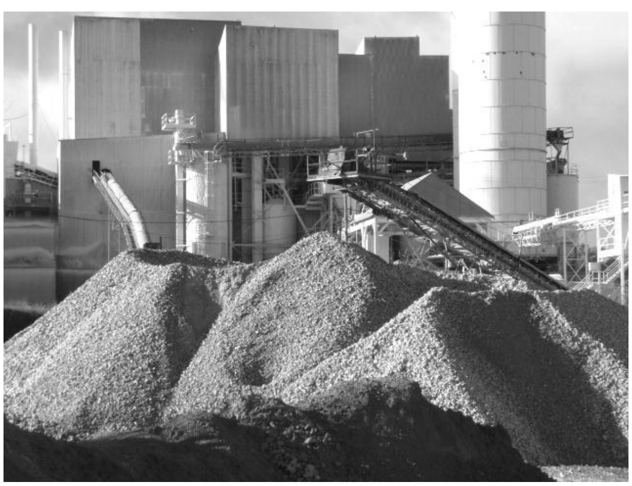
Food safety is a subject of nearly gargantuan proportion. This treatise will attempt to deal with just one small area providing assurances to safe food. Products supplied to the livestock/poultry feeding industry from ILC Resources are "safe for use." Previously, *Mineral Writes* has visited this issue actually three times already – in 2003, again in 2007 and yet a third time in 2009. In essence we can never tell this reassuring story too often. Our industry is analogous to a parade. It is always changing and the players walking by yesterday are replaced or joined by new ones today and will again change tomorrow. Thus, let us spend a few moments reviewing measures ILC Resources practices daily that we believe ensure safe mineral ingredients to be fed to livestock and poultry in the ultimate making of safe food for human consumption.

First, we start by evaluating the inherent safety of the calcium carbonate products we process by examining the origins of calcitic limestone deposits we harvest. The origin of calcitic limestone rock comes from natural sedimentation of ancient marine organisms called crinoids (akin to modern day star fish) that lived some 350,000,000 years ago. Geographically one of the inland seas supporting crinoidal life was part of today's Midwest regions of the United States.



Crinoidal life flourished in shallow inland seas over some 35 million years or more in antiquity. Sedimentation of skeletal remains packed and hardened, forming calcitic limestone rock chiefly consisting of calcium carbonate ($CaCO_3$). From these prehistoric inorganic mineral deposits nature has furnished ILC Resources a rich ingredient that supplies calcium for such diverse roles in life as bones and teeth formation, blood clotting and regulation of heartbeat, muscle contractions and nerve impulses, enzyme activation and hormone secretions. Calcium is a major component of milk production and supports both quality and integrity of egg shell formation. Purity of $CaCO_3$ deposits range upwards from a minimum of 95%. The remaining 5% or less mostly consists of other inorganic sedimentation as well as minor mineral traces left over from crinoidal sources. There is little room for harmful contaminants simply due to purity over immeasurable time. Certainly no residual organic contaminants remain.

Secondly, we should evaluate the mechanical processing of calcitic limestone into $CaCO_3$ products. There are no chemicals or additives of any kind introduced whatsoever. In its simplest imagery, large rock is hammered into smaller stones, dried completely and further ground into a variety of smaller particles from pebbles down to finely ground powder, screened into separate gradation products ranging from larger particulates to granules to powder. Once separated, the products are stored individually until loaded and shipped out. If during transportation of raw rock from the quarry to the crushing site any possible pathogenic organisms should be carried along, drying at the start of processing reaches material temperatures over 200° F, destroying any organisms. Calcium carbonate is inorganic and will not support microbial life. Along with drying, this assures that products do not contain harmful organisms. All points of processing from plant entry to load out for shipment are within a **closed system**. Contaminant entry into material stream is not really feasible, certainly not practically possible.



Alden Plant

Weeping Water Plant

What potential contamination hazards are identifiable and what actual risk do they pose for ILC products? We are continually alert to hazards of concern and assure ourselves they either do not exist in our system or our practices are controlling them. Once the raw rock from quarry or mine is initially crushed and material is conveyed inside the plant itself, all pathways of drying, grinding, screening and storage plus conveyance out of storage to load out bins and/or bagging bins are contained within a closed system. The following section lists and evaluates known potential hazards to livestock/poultry feeding:

1. Dioxin/PCB tolerance Issues –Processed material test results < 0.5 ppt (below detection levels). Processing conditions do not congregate necessary elements to create dioxins [high temperatures, cyclical carbon chains, source of chlorine]
2. Feed Additives issue – none in plant, none added in operation whatsoever
3. Heavy Metals – well within nutritional tolerances (only background levels from crinoidal origins)
4. Mycotoxins – no organic matter in operation or material, thus, no medium for growth
5. Pesticide tolerances – none used in processing plant nor bagging and warehousing, thus, not a possible contamination
6. Industrial contaminant – only possibility is lubricants used on moving equipment parts. None come in contact with product processing stream either bulk or bags.
7. Compliance with the FDA Title 21 CFR 589.2000/589.2001 -- "BSE Feed Rule". Only possible area of contamination of outgoing products exists at site of load out if vessel to be loaded is contaminated prior to presentation for load pick up. Safety procedures with incoming trucks for order pick up at ILC Resources' plants are in place to ensure minimal risk.
8. Pathogenic microbes (e.g. *Salmonella, E. coli*) – (a) $CaCO_3$ is an inorganic mineral; thus, nothing to support microbial life, (b) Flow of $CaCO_3$ material during drying reaches temperatures exceeding 200° F which destroys any possible pathogenic organisms entering the processing stream through the plant.

Incoming mineral ingredients – Feed grade phosphates, Potassium chloride, Potassium-Magnesium-Sulfate and Sodium Bentonite: (a) segregation from processing stream of $CaCO_3$ products, (b) dedicated pathways for storage leading to bagging and/or bulk load out prevent mingling with $CaCO_3$ products, (c) inspection protocols in place to minimize contamination risk upon receiving, plus (d) qualifying supplier vendors – all minimize risk of contaminations.

Thus, products are safely produced and stored awaiting shipping of orders. Incoming trucks presenting themselves for order pick up must sign in first to pick up paperwork for specific orders. Notice is given at this point regarding need for contaminant free vessel before loading. Transporter must declare what was hauled last on trailer, accepting his responsibility for presenting contaminant free vehicle for loading. Prior to loading at ILC Resources' company facilities, trailers must pass visual inspection for any noticeable signs of contaminants. ILC Resources' affiliated plant locations carry out analogous procedures for prior load material declarations and hauler sign off on vessel's readiness to receive product.

Our vigilance has allowed for various documents of certification to be issued upon request regarding potential concerns. One such that is most current is a declaration regarding possible Salmonella in our products. In light of major concerns in the egg laying industry, we've received specific requests for our status on Salmonella. Referring to points #4 and #8 above, our material being processed is Salmonella free. Another potential area of Salmonella contamination exists with rodents. Calcium carbonate is inorganic and thus does not attract rodents. Each shift in our plants begins with a check list inspection of work area before commencing. On that check list is observation for any rodent activity which must be noted and signed off on daily, consequently verifying activity if any.

As recent as within the past several months, ILC Resources' position on key points of concern has been delineated in various key documents in response to customer inquiry. Among others, we've put forth a statement of purity of our $CaCO_3$ products. From a slightly different angle of inquiry, we have also drafted a *Feed Ingredient Safety Agreement* that declares our products to be unadulterated and to be safe for use in animal feeds. Further, calcium carbonate is listed in FDA's Code of Federal Regulations as *generally recognized as safe (G.R.A.S.)* and meets AAFCO's definition 57.1 as *a product true to its name which contains a minimum of 38% calcium (Ca)*. As an inorganic mineral, $CaCO_3$ does not contain genetically modified organisms (GMO) nor does it contain known allergens. Yet another requested document we've responded to is a statement that our business practices are in accordance with *current good manufacturing practices* (FDA title 21 CFR § 225). Still other documents have reflected these points and more as they address specific inquiry, but these encompass any concern we've received regarding the safety of feed-grade calcium carbonate.

All of these documents act as reassurance of ILC's longstanding reputation of providing consistent, quality, safe products to the livestock/poultry feeding industries. More importantly, action backing up these documents is the real assurance. Both internal and customer auditing have validated strong approval. We started with this premise in 1924 as we began serving agriculture by supplying $CaCO_3$ and have maintained persistency in that commitment throughout the ensuing decades. Frankly, the course we've taken is only *good business*, but in today's uncertainties it is also paramount.

When I go to lunch today, will I be thinking about ILC Resources' role in providing safe food for me to eat? Will my confidence be justified as I order an egg salad sandwich knowing that the calcium going into that eggshell was contaminant free and no Salmonella is lurking? If **all** steps of the food chain from feed ingredients to the dinner table do their part in providing safe food including actual meal preparations, then we are justified in not giving this issue much thought and simply enjoy eating well assured of safety. We believe ILC Resources is doing its part.

Interactions of Calcium, Magnesium on Phosphorus in Dairy Cows

Much focus on calcium research has centered on poultry, especially eggshell quality issues. However, calcium plays vital roles in other species as well. Bone formation and teeth development are paramount in all species. Blood clotting and regulation of heartbeat, muscle contractions and nerve impulses, enzyme activation and hormone secretions are perhaps less noticeable roles and yet equally essential for life. Also, calcium is a major component of milk production. This aspect to calcium takes on particular significance as we consider dairy nutrition. Not only is calcium a vital element of milk but plays a substantial interactive role with other nutrients such as magnesium and phosphorus. In proper proportions they may act synergistically for greater common good or antagonistically to either the animal or the environment. To illustrate this point, let's look at a recent research study involving dairy cows.

Calcium/Magnesium Effects on Phosphorus Solubility in Lactating Dairy Cows

This June's issue of the Journal of Dairy Science had an interesting study reported from the University of Florida in Gainesville. Concerns over phosphorus (P) movement from dairy cow manure to off-farm locations prompted Florida researchers to explore the effects that modifying dietary calcium (Ca) and magnesium (Mg) may have on reducing the water solubility of P in feces. "The objective of this study was to evaluate the effects of increasing the dietary concentration and water solubility of Ca and the dietary concentration of Mg on lactation performance and solubility of fecal P from lactating dairy cows receiving diets formulated to the same concentration of phosphorus." It is well recognized that repeated application of manure to agricultural land can lead to build up of P in the soil over an extended period of time. Accumulation of soil P increases the potential for involuntary off-site movement of water-soluble P, with potential detriment to quality of surface water. Excess P is the most common cause of eutrophication of freshwater lakes and streams. Eutrophication is the depletion of oxygen in water by dissolved nutrients such as P promoting growth of oxygen-depleting plant life resulting in harm to other aquatic life. Much focus has been on reducing dietary P in dairy cow diets, thus reducing excretion of P in the manure. However, cows do have need for dietary P and practical limits on dietary concentration reductions must be recognized. Adequacy of milk production performance cannot be sustained below P requirements. Other dietary strategies may influence P excretion and solubility in manure of lactating dairy cows without sacrificing production due to low P intake attempting to lower fecal P levels. Previous studies have shown that increased ratio of Ca:P transformed soluble Ca-P forms into a less soluble form of inorganic P. Magnesium phosphate complexes are common in manure and also influence P dynamics. The Florida researchers examined changing the source and amount of Ca and Mg intake to see if perhaps fecal insoluble phosphates could be formed to alleviate environmental impact.

Inorganic Ca sources consisted of calcium carbonate ($CaCO_3$) and calcium chloride ($CaCl_2$). These two Ca sources differ in both site and extent of absorption in the GI tract (GIT). Calcium from $CaCl_2$ is primarily available in rumen, whereas Ca from $CaCO_3$ reacts with abomasal acid solublizing Ca^{++} for absorption in the small intestine. "This study tested the hypothesis that increased amount of soluble Ca in the GIT of lactating dairy cows will favor formation of Ca-P (less soluble form of inorganic P) relative to generally more soluble Mg-P or Ca-Mg-P compounds, with the potential to reduce P solubility in feces."

The treatments were two-fold in a factorial arrangement involving a) two sources of Ca ($CaCO_3$ and $CaCl_2$) at b) two dietary concentrations each – ***r****ecommended formulation* and ***h****igh formulation* designated as RCa/HCa [0.61%/1.0%DM] and RMg/HMg [0.20%/0.35%DM], respectively. Diets were formulated to the same P concentration in all treatments (0.38% of DM). The trial spanned three 21-day periods. Fecal solubility was measured by a water-extractable P (WEP) method from the dairy cow manure.

The solubility in ruminal fluid and in abomasal acidic fluids was 0% and 100% for $CaCO_3$ and 68% and 100% for $CaCl_2$. It is well understood that feeding $CaCl_2$ as an anionic salt prepartum to induce metabolic acidosis will promote Ca^{++} mobilization from bone. Acidosis can be reflected in a drop in urinary pH. Normal urinary pH in dairy cows is ≥ 8. When the recommended Ca diets from both sources were fed, urinary pH was the same ($CaCO_3$ = 8.1, $CaCl_2$ = 8.0). However, at the HCa formulation using $CaCl_2$, urinary pH decreased to 7.0 versus HCa diet from $CaCO_3$ remained at 8.1 pH.

Source of supplemental Ca had no influence on milk yield. Cows fed RCa-RMg diets produced more milk than did cows fed RCa-HMg. When HCa was fed, milk yields did not change with feeding rates of Mg. Milk fat concentration tended to be less for cows fed $CaCl_2$ compared with cows fed $CaCO_3$. Milk protein concentration was also less with feeding $CaCl_2$ than with feeding $CaCO_3$. Further, as dietary Ca concentrations increased, milk protein percentage was reduced. "A reduction in milk protein may occur if the overfeeding of Cl has a detrimental effect on microbial protein synthesis within the rumen."

The study revealed that dietary Ca concentration and Ca source did not affect apparent digestibility of P. "The fact that increasing the dietary concentration of Ca with either $CaCO_3$ or $CaCl_2$ had similar effects on P dynamics indicates that the increased intake of Cl did not have a distinctive effect. Increasing the dietary concentration of Mg did not influence P digestibility."

By WEP testing, the researchers found that feeding $CaCl_2$ resulted in a drop in proportion of soluble fecal P compared with feeding $CaCO_3$. Thus, $CaCl_2$ was more effective than $CaCO_3$ in reducing WEP in manure. However, $CaCO_3$ was preferential to $CaCl_2$ as the supplemental Ca source due to greater production of 4% *fat corrected milk* (FCM), more milk fat, and milk with a greater concentration of both fat and protein. Current economics of mineral ingredient supplementation well favor feeding $CaCO_3$ over $CaCl_2$. Apparent digestibilities of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), Ca, Mg, and P were not affected by increased dietary concentrations of Ca or Mg or by either inorganic source of Ca. Greater consumption of soluble Ca favors a more stable form of fecal P, but has a detrimental effect on the milk parameters of fat and protein. Increasing dietary consumptions of Ca and Mg may potentially increase formation of insoluble phosphates, thus decreasing solubility of P in dairy-cow feces ultimately reducing losses of P from agricultural areas where manure is applied.

From a practical and economical perspective, feeding supplemental Ca from $CaCO_3$ continues to be well justified. On the other hand, perhaps adjusting dietary concentrations of Ca and Mg to force greater formation of insoluble phosphates may be worth further consideration and study.