ilc resources

MINERAL WRITES

SECOND QUARTER 2005

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

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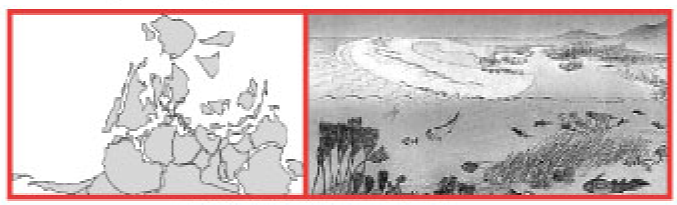
Limestone: An Essential Rock of Ages

How can something seemingly as basic and simple as quarrying and processing rock be so vital and versatile in its many applications? Isn't limestone basically road rock used also in construction, landscaping, retaining walls, and gravel walkways in gardens? Isn't limestone just plentiful and cheap hard rock buried beneath the ground?

Limestone is truly a "rock of ages." Travel back in time to before the Ice Age and wooly mammoths inhabited the earth nearly 20,000 years ago. Envision a world even before dinosaurs roamed the wilds some 150 to 200 million years ago. Try to imagine the world of some 350,000,000 years ago!

Today



350,000,000 years ago

If we use distance as a measurement of time, picture a single year as being just one inch. That 350,000,000 years would equate to almost 6,000 miles — the distance from New York City to Los Angeles and back to NYC again! Our company's 81-year use of this incredible resource would be just two long strides in this long journey through time.

Back then, small aquatic life existed in inland seas. Crinoids, which have evolved into starfish, were the most prevalent among a group of invertebrates called echinoderms. Crinoids had a long stem anchored to the sea floor. Their tentacle-like arms drew in bits of plankton to feed on as they floated in the water's current.
As their life cycle ended, crinoids settled to the sea bottom, where their hard-shell remains solidified into sedimentary deposits of calcium carbonate. Spanning over 35 million years, this sedimenta-

(Continued on page 2)

Limestone (cont. from page 1)

tion process formed great limestone deposits around the world, varying from 15 feet to more than 100 feet thick.

Returning to the present, ILC Resources is harvesting calcium carbonate ($CaCO_3$), not limestone from such calcitic limestone deposits. This mineral tests in excess of 38% calcium and is valued not as simply limestone rock, but as a high quality source of calcium. While there are many uses of this material, as calcium carbonate it is vital in animal and human nutrition as well as soil enhancement.

Calcium is the fifth most abundant element in the earth's crust, existing mainly in the form of $CaCO_3$. It is the most abundant mineral found in the body (animal and human). The body is 1-2% calcium (Ca), of which 98-99% is located in bones and teeth. The remaining 1-2% is in soft tissues, mostly blood. While bone formation and teeth development are key functions, egg production (shell quality in poultry) and milk production rely on calcium. A number of other essential functions require small quantities for blood clotting, muscle contraction, nerve impulse transmission, heart beat regulation, enzyme activation and hormone secretion. Calcium even plays a role in reproductive processes (see page 4). These critical functions are enabled due to supplemental calcium being supplied by $CaCO_3$, not really limestone per se. This is a very significant distinction.

As a soil enhancer, $CaCO_3$ neutralizes low pH soil (acidic) to create a desirable condition — proper soil pH — for healthy plant growth. Plant roots won't penetrate acid soil to reach and take up needed nutrients. While this soil amendment process is called agliming or "liming," it's the carbonate (CO_3) portion of $CaCO_3$ that reacts with acid to neutralize the soil. The Ca is released as a vital nutrient for use by the plant. Here, calcium carbonate — not simply limestone — is the material needed.

Many everyday foods and supplements depend on $CaCO_3$. Eggs, milk and even antacids for treating indigestion are good examples. Limestone may be a "rock of ages," but $CaCO_3$ harvested and processed from these ancient deposits is what is essential to life itself today.

Improved *in*

ILC Resources has changed its laboratory protocol regarding determination of acid solubility of our products. For some 15 years we have relied on a study by Dr. Craig Coon (then University of Minnesota, now University of Arkansas), that recommended an ideal solubility range on large $CaCO_3$ for optimum eggshell formation in laying hens.

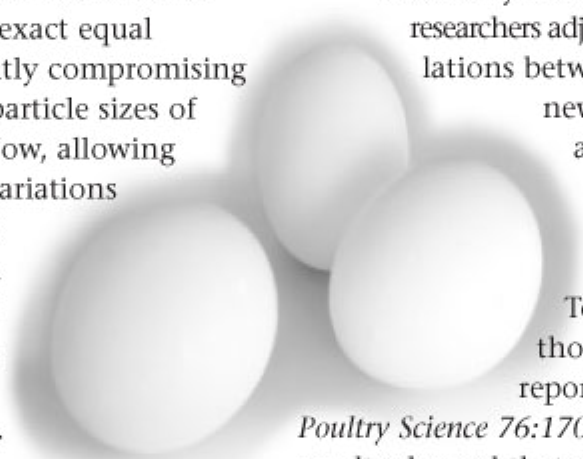
In 2004 we studied more research by Dr. Coon that examined an improved method for determining acid solubility of $CaCO_3$. While the newer method incorporates much of the same protocol as before, the differences lie in three related areas: sample weight size, amount of hydrochloric acid (HCl) used to dissolve sample, and normality (acid concentration) of HCl used.

Basically, 1) increasing the amount of sample used for testing reduces potential errors due to fluctuations in large particles and the difficulty to weigh precise sample weights, 2) increasing the amount of acid used for dissolution reduces possible limitation on needed amounts of acid for proper reaction, and 3)

vitro Method of Solubility Determination

using greater concentration of acid reduces potential limitation of acidity necessary for reaction with samples.

The earlier method necessitated careful, precise weighing of samples resulting in much time and painstaking effort to obtain all test samples of exact equal weight, frequently compromising representative particle sizes of test product. Now, allowing minor weight variations among samples eliminates both exact weighing as well as exact replication of sample weights.



The newer method results in larger reported solubility values than the older method. This is primarily due to unrestricted solublizing by using more acid of higher concentration. Thus, interpretations of results need to be adjusted.

The old method was based on closely simulating digestive conditions in the GI tract of poultry, predominantly with particular low concentration of HCl. However, *in vitro* (lab) testing never has nor likely ever will completely simulate *in vivo* (inside the live bird) conditions. Therefore, it seems more reasonable and consistent to use lab solubility determination to distinguish among calcium sources than to strictly simulate *in vivo* conditions. Subsequent *in vivo* studies by Dr. Coon and his researchers adjusted correlations between the newer *in vitro* analyses and *in vivo* conditions.

To summarize those studies (as reported in *1997 Poultry Science 76:1702-1706*), the results showed that solubility *in vivo* is reversely related to solubility *in vitro*. New guideline recommendations were established. Larger particles of $CaCO_3$ with lower *in vitro* solubility (within a range of 30-50%) accumulate and are retained in the gizzard and actually result in higher *in vivo* solubility (94% maximum depending on dietary Ca level and *in vitro* solubility). Improvements in gizzard retention time for $CaCO_3$ favor sources of lower *in vitro* solubility values, but only if particle sizes are larger than 800 microns. Low retention in the gizzard of small particle $CaCO_3$ is due to high rate of passage on account of physical size limitations and not due to corresponding high *in vitro* solubility. Among similar particle size products, however, sources with lower *in vitro* solubility retain more $CaCO_3$ in the gizzard than sources with higher *in vitro* solubility values, and thus, will be more valuable for providing necessary calcium to the bird for eggshell production.

They also found that the amount of $CaCO_3$ retained in the gizzard was affected by dietary Ca levels. The amount of $CaCO_3$ retained in the gizzard increased when dietary levels increased. However, after dietary Ca concentrations exceeded around 4.0%, decreased amounts of larger particulate $CaCO_3$ were retained. This is due not to any increase in solubilization of Ca and thus improved utilization. It seems to be due to $CaCO_3$ particles being expelled from the gizzard due to ingestion of additional large particulate $CaCO_3$ in subsequent meals.

Coon concluded that lower

(continued on page 4)

But did you realize calcium also.....?

We already know that calcium — the most abundant mineral in the body — is essential for bone formation, proper teeth development and many other body functions (see story, page 1). That 1-2% of calcium present in extra-cellular tissues — predominantly in the blood — even plays a role in the proper regulation of heart beat, blood clotting during injury, muscle contractions, nerve transmission, hormonal secretions, and enzyme activation. But, did we realize that calcium is also essential for proper reproductive functions?

Inadequate supplies of calcium may result in a condition known as *Dystocia,* meaning birthing difficulty. With livestock, it's more commonly associated with beef or dairy cattle, but also observed in swine. Successful uterine retraction in preparation for rebreeding requires calcium. Insufficiency may result in retained placentas and even uterine prolapse. Many mineral feeding programs take into account spring calving and rebreeding considerations that target successful conception rates. Dietary adequacy in providing all necessary nutrients is vital. ILC Resources provides $CaCO_3$ that not only is of highest purity, but available in a variety of precise gradations to meet a diversity of particular needs. Whether using large granular $CaCO_3$ for free-choice mineral feeding or finer granular particles in supplements or complete feeds, $CaCO_3$ from ILC Resources will contribute to successful mineral supplementation.

in vitro *(continued from page 3)*

in vitro solubility of $CaCO_3$ supplements allows for increased gizzard retention and higher actual *in vivo* solubility resulting in release of Ca^{++} in the laying hen at more appropriate times for improved egg shell production. Thus, the effectiveness of $CaCO_3$ particles retained in the gizzard for positive egg shell formation was dependent upon dietary level of Ca, particle size, and solubility.

After much testing of this newer protocol at ILC Resources during the spring and summer 2004, our laboratories switched to this method of determining *in vitro* solubility of products in September, 2004. We are confident that this method's data will improve understanding in making useful recommendations.