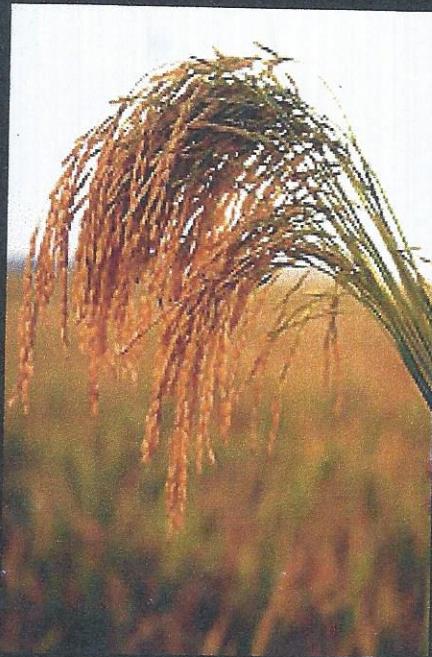


AGRICULTURE

Zeolite uses in Agriculture



Zeolite use is popular around the world for a wide range of agriculture benefits. It is only recently, that the North American agriculture industry is benefiting from adopting zeolite into their operations for soil conditioning, composting, feed, and odour control.

Zeolite for the Agriculture Industry can be utilized in a variety of applications due to its porosity and cation ion exchange. Confined Feedlot Operations (Beef, Hogs, Poultry) for Reduction of Odour and Greenhouse Gases, Improved Bedding Lanes (Controls Moisture and Reduces Bedding Lane Waste), Composting Amendment, Wastewater Filtration, Feed Supplement, Feed Binder. Zeolite provides dramatic results for crop yields as a soil conditioner by maximizing fertilizer effectiveness, balancing pH, reducing alkalinity, improving aeration, retaining moisture and reduces clay clumping. It is important to note that Zeolite is 100% natural for organic farming operations.

ODOUR CONTROL

AGRICULTURE ANIMAL MANURE MANAGEMENT



Odor Suppressant & Moisture Control for Livestock Operations

Natural zeolite provides a healthy and economical solution for odour and moisture control at barns, stables, pens and CFO (confined feedlot operations). Zeolite is non-hazardous, non-corrosive, non-toxic, and 100% natural. It is simply mined from quarries and meshed to various sizes for various applications. Zeolite treats manure in bedding lanes and provides pen management by:

- 1) Reducing ammonia odours in the bedding lanes and pens.
- 2) Controlling moisture content of the bedding lane & pens.
- 3) Improving integrity/longevity of pens & bedding lanes.
- 4) Reducing NH₃ CO₂ & other Greenhouse gases.
- 5) Absorbing nitrogen & improving manure compost.
- 6) Improving air quality & reducing groundwater contamination.

These and other operational advantages lead to economic, health and aesthetic improvements over current operations that try to react with or mask odours.

The zeolite mineral is the simple, innovative and natural solution the agriculture industry has been looking for to vastly improve existing operations.

Controlling Ammonia Odours



Zeolite will eliminate urine-generated ammonia odours from stables, feedlots, paddocks, pens, litter boxes, hog & poultry houses, barns, and transportation trailers. Capturing and holding ammonia (NH_3) provides a safer and more comfortable environment for the animals, the operators and the neighbouring community. The zeolite structure via CEC (cation exchange capacity) traps and holds ammonia and other animal odours without

the need for chemical additives (ie: lime and deodorants). The trapped ammonia allows for a natural slow-release nitrogen fertilizer. The capture of ammonia prevents the loss of valuable nitrogen nutrients into the atmosphere which is common in present operations. Secondary benefits include the reduction of fly populations at the barn and manure pile. Currently, a study has concluded with a leading feedlot in Alberta, Canada with very positive results.

Ammonia, when inhaled can cause severe damage to the respiratory tract in both animals and operators. Even low concentrations of ammonia have proven to reduce or depress airway

defense mechanisms. Atmospheric NH_3 depresses the intrapulmonary phagocytosis and the bacteria from the airways and lungs. This results in a higher incidence and severity of pneumonia which is often encountered in young livestock. Studies have revealed that higher concentrations of NH_3 over prolonged exposure periods result in decreased animal weight gain and conversion rates.

Controlling Moisture in Bedding Lanes:

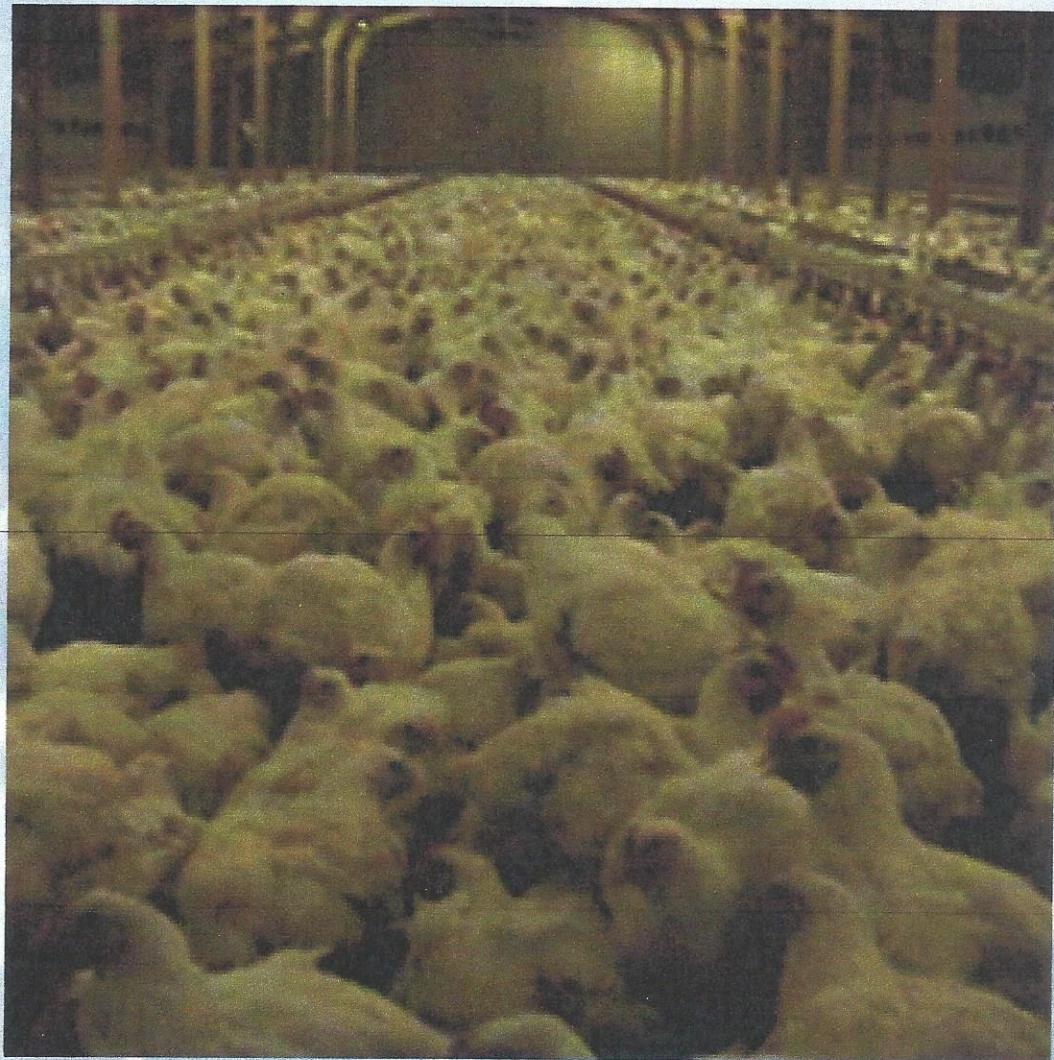
Zeolite also absorbs moisture from livestock bedding. Zeolite, added to bedding lanes is proven to ensure bedding lane longevity. Up to 40% savings in operations is experienced in large feedlots by the addition of zeolite to bedding lanes due to reduced stall maintenance and change-outs. A zeolite enhanced bedding lane provides many advantages, both economic and

operational: reduces fly infestation, does not burn or crack animals hooves (as does lime) and prevents sinking. The granular form of zeolite is non-dusting. It is important to keep the bedding dry especially for new-borne and animals confined due to illness



Zeolite will retain moisture and air in the soiled bedding. This accelerates manure composting. Zeolite will not break down under trampling therefore providing better traction for animals and personnel even when the material is wet. Tagging is also reduced since the moisture is controlled. It is important to note that zeolite is easy to spread over the bedding lane and is effective with the first application.

Hog & Poultry Operations



Air scrubbers using media containing zeolite are used to improve hog and poultry-house environments by extracting NH₃ without heat loss that accompanies ventilation during cold weather operations. Zeolite can either be applied directly to the droppings on a regular basis or used in the filter units suspended above. Considerable cost savings can be experienced by larger operations for odour control.

COMPOSTING

AGRICULTURE COMPOSTING

Basic Principles of Zeolite in Composting Operations

Zeolite has two methods of holding cations such as ammonium and plant nutrients. The first method is by absorption in its porous matrix. The second method is by cation exchange (CEC) - zeolite holds ammonium and other plant nutrients in the crystal structure where they are not water-soluble but are plant-accessible on an as-needed time-release basis.

Zeolite Adds Value to Manure and Compost.



Zeolite has a high affinity for the ammonium ion. This is a plant usable form of nitrogen. One of only three forms of nitrogen that is plant accessible (ammonia/ammonium, nitrates and nitrites). The introduction of zeolite with the manure, compost, or lagoon water to the soil has the added benefit of increasing water retention, holding the nitrogen and other micro-nutrients in the growth zone, providing a medium for the future capture of nitrogen, increasing the ion exchange capacity of the soil, and enhancing infiltration and aeration of the soil. NASA has been experimenting with zeolites as an efficient means of holding water and plant nutrients in a growing media for deep space flights.

How does Using Zeolites Benefit my Soil?

Using zeolite will cut fertilizer and water costs by holding the nutrients and water in the root zone until the plant is ready to utilize them. Thereby requiring less fertilizer and water to be applied. This promotes good stewardship of the land by reducing pollution brought on by fertilizers leaching to the groundwater or running off into surface water sources. Zeolites, when used properly, can yield some impressive results in regards to faster germination times, faster growth rates, larger plants, crop yields and reduced fertilizer and water applications.

Reduces water requirements during irrigation as zeolite holds moisture in the growth zone.

Zeolite has a high CEC that enables a greater loading of plant nutrients such as nitrogen & micronutrients. The nutrients are held in the growth zone and are plant accessible but not water-soluble.

Reduces nitrogen fertilizer requirements as a large portion of nitrogen fertilizers leach through the growth zone and into the aquifer. Zeolite will hold nitrogen and prevent the pollution of the water table by nitrates and nitrites.

Zeolite prevents compaction, increases infiltration, and helps the aeration of deep root systems due to its high surface area and porosity.

Zeolite is 100% natural for organic operations and when composted with manure, it becomes a natural fertilizing system.

Zeolite Use in Compost or Dry Stacked Manure

The compost or dry stacked manure should be top-dressed with a thin layer of zeolite after it is turned or after the addition of a new layer of manure.

Alternatively, a layer of zeolite should be placed in the area of the barn receiving the fresh manure. Composting is an important process that (1) converts organically bound nitrogen that is not plant accessible to ammonium hydroxide, ammonium nitrate, and ammonia that are all plant accessible, (2) kills the pathogens, (3) reduces or eliminates the odor, (4) dries the manure, (5) reduces the flies, and (6) kills weed seeds. Composting should be conducted in-vessel to prevent groundwater and air pollution. Wash down operations are no longer environmentally acceptable due to groundwater pollution of nitrates, nitrites, and hydrogen sulfide.

The following two articles outline a project involving zeolite for the compost industry:

Part 1 – Zeolite Retaining Nutrients in Compost, and

Part 2 – Zeolite Reducing Manure Odours

This project involves Zeocan zeolite and is managed by a leading agriculture college in Alberta, Canada. The project is funded by a Canadian Federal grant as part of its mandate to provide value added agriculture in the years to come.

PART 1 – Incorporating Zeolite in Manure Compost Retains Nutrients & Reduces Greenhouse Gas Emissions

Project Applicant - Dr. Abimbola Abiola, Olds College School of Innovation

The Challenge - To show through an on-farm demonstration project that the incorporation of zeolite into livestock manure during composting reduces the production of nitrous oxide and methane, while retaining valuable nutrients.

Funding Allocation - The Greenhouse Gas Mitigation Program (GHGMP) for Canadian Agriculture has allocated \$2.1 million for beef sector projects over three years ending March 31, 2006. The GHGMP has contributed \$87,500 toward this project.

With manure composting growing into an economical and practical method for managing cattle manure, improving the process by retaining more of the valuable nutrients, and reducing odour and greenhouse gas emissions are also becoming important considerations for cattle producers.

The Olds College School of Innovation will demonstrate how to achieve all these objectives when composting beef cattle manure by incorporating zeolite into the compost windrow. The goal is to produce a high-quality compost that can be used as a bio-based soil amendment. Along with nutrient value, compost also can help improve soil quality characteristics.

"Preliminary results of earlier research suggest that when zeolite is ingested by cattle through feed, it may reduce methane production in the rumen," explains Abiola. "With this project, we intend to show we can achieve a similar reduction in greenhouse gases by adding the compounds to feedlot manure in the composting process. By retaining more of the nitrogen in the compost, less is released as nitrous oxide, a greenhouse gas."

Naturally occurring zeolites are commonly used in a number of industrial applications. Zeolites, which can filter, remove odour and absorb gas, are often used in water softeners



A bucket of zeolite to be mixed with manure.
photos are courtesy of Olds College

Zeolite is part of a larger group of compounds known as aluminum silicates and silicates are derived from silicon. "If you think of carbon as being the backbone of life, then silicon is the backbone of soil," says Abiola. "The key characteristic of zeolites are their ability to perform filtering, odour removal and gas absorption tasks."

Methane and nitrous oxide are two of the greenhouse gases produced during the composting process. Both gases are more potent than carbon dioxide. Aluminum silicates can sequester reactive ions such as nitrates, sulfates and hydrogen ions, which may reduce methane and nitrous oxide production during the composting process. It has been estimated that the use of aluminum silicates may reduce methane and nitrous oxide emissions by 20 percent.

Assisting Abiola on the project is Tanya McDonald, a research technician at the Olds College School of Innovation. McDonald says despite the tough year agricultural producers have experienced, there is still the need to examine manure management options.

"As agriculture moves towards larger farm sizes and increased animal numbers, there is a greater need for effective methods of dealing with manure," she says. "Composting is one management strategy that results in improved nutrient retention, reduced odour and pathogen content, and reduced volume of manure to be handled."



Turning the Compost Windows.
photos are courtesy of olds college.

Turning manure into rich compost

The first year of the project is intended to produce a nutrient-rich compost suitable for use as a bio-based soil amendment, using a process that reduces production of greenhouse gases such as methane. "Properly composted material should not produce methane gas," says Abiola. "Methane is only produced under an anaerobic environment (without oxygen), while proper compost is made in an aerobic environment (with oxygen)."

The Olds College demonstration site involves a 10,000 m² clay-based pad for the compost windrows. Manure and bedding material from the college feedlot will form four composting windrows. The windrows will be approximately two meters tall, four meters wide and 50 meters long.

The zeolite will be added to the windrows. Three windrows will contain zeolite in various percentages, with the fourth windrow being the control.

"Zeolite has proven benefits in many industries," says McDonald. "Zeolite is used in everything from plant growth media, health applications, feed additives, wastewater filtration and composting. It has an excellent ability to bind ions." It is also widely used in horticultural, construction and industrial applications. It can improve aeration and moisture retention, which makes it a useful product to include in the demonstration.

A Scarab compost windrow turner will work the product into the manure. Windrows will be monitored to ensure that temperatures reach 55 C, needed for the destruction of pathogens and weed seeds, and the windrows will be turned five times within the first fifteen days.

Gas monitoring will be done on the first day of the project, and then again on days 10 and 30. Gas samples are collected using a flux chamber situated on the top of the compost pile. These samples are analysed for carbon dioxide, methane and nitrous oxide concentrations.

These measurements will be related to the various amounts of zeolite added.

"Our objective is to not only show how the zeolite works in reducing greenhouse gas emissions, but also to determine the economics," says Abiola. "We need to determine the economic ratio of aluminum silicates for the amount of manure being composted and the benefits achieved."

Once the active phase of composting is complete, the compost will be left to cure. Samples will be analysed for nutrient content prior to field application of the product as a bio-based soil amendment.



Equipment monitors greenhouse gas emissions.
Photo courtesy of Olds College.

Using the product

In the second year of the project, team leaders will use the manure compost as a bio-based soil amendment for field crops and compare the results with synthetic fertilizer. The compost will be divided into four equal parts. Half the compost will be broadcast applied to the pasture, with split applications of the material in the fall and spring. This application will not be incorporated. The other half of the compost will be used on barley silage with the same split application timing, but the compost will be incorporated.

Project leaders expect a comparison between compost and commercial fertilizer applications will showcase the performance of compost against synthetic fertilizer in field crop applications.

"Zeolite is an excellent product for enhancing plant growth," says McDonald. It provides aeration and improved moisture retention. Zeolite acts as a slow release fertilizer, releasing nutrients as they are required by the crop. It should perform very well in the field."

The benefits

Adding zeolite to the composting manure is an effective way to manage manure, says Abiola. Essential nutrients are retained while greenhouse gases naturally produced during the composting process are minimized. Odour from the manure is also greatly reduced.

Producers will be able to see first hand the economic benefits of adopting such a process for their operations. Confined feedlot operators will be able to maximize the value of manure as a bio-based soil amendment on their own land. There's also potential to market composted manure as a commercial product.

"Composting beef manure provides a cost effective solution to many manure management issues, such as volume and odour reduction," says Abiola. He adds that there may be an opportunity for producers to trade carbon credits if that market develops.

Abiola notes the success of these two projects will have national implications. If shown to be both practical and economical, livestock producers across Canada would be able to implement the system. The GHGMP supports a broad range of projects across Canada.

PART 2 – Aluminum Silicate (Zeolite) Reduces Manure Odour & Cuts Greenhouse Gas Emissions

Olds, Alta., September 15, 2004

The Olds College School of Innovation will demonstrate that adding an aluminum-based mineral to composting beef manure will help reduce odour and greenhouse gas emissions, while retaining valuable nutrients, providing moisture and aeration.

The aluminum silicate product is a volcanic mineral called Zeocan Zeolite. This naturally occurring mineral is also commonly used in a number of industrial applications.

"Preliminary results of earlier research suggest that when this mineral is ingested by cattle through feed, it reduces methane production in the rumen," explains Dr. Abimbola Abiola, project leader. "With this project, we intend to show we can achieve a similar reduction in greenhouse gases by adding the compounds to feedlot manure in the composting process."

The process will produce a high quality compost, to be used as a bio-based soil amendment.

Along with nutrient value, compost also helps improve other soil quality characteristics.

The demonstration project is being funded in part by the Greenhouse Gas Mitigation Program for Canadian Agriculture (GHGMP). The federal program is designed to promote awareness of agricultural practices that reduce atmospheric levels of greenhouse gas or increase carbon storage in soils. The Canadian Cattlemen's Association (CCA) administers the delivery of the beef sector component of the program.

The project site is located at the Olds College Composting Technology Centre. In the first year of the project, four windrows were assembled using manure from the Olds College feedlot, says Abiola. One windrow, without any treatments, will be used as the control, while the other three windrows include a combination of manure and zeolite in various percentages.

The windrows will be turned at specific times to ensure effective aerobic composting. Gas emissions will also be monitored to measure methane, carbon dioxide and nitrous oxide production. Gas measurements will be related to the amounts of zeolite added to the compost.

"Our research is not only to show how the silicates work in reducing greenhouse gas emissions, but also to determine the economics," says Abiola. "We need to determine the economic ratio of zeolite for the amount of manure being composted and the benefits being achieved."

Once the active composting process is complete, the compost will be left to cure. In the second year of the project, the treated and untreated composts will be applied to field crops and pastures and compared to commercial fertilizer.

Abiola says adding zeolite to the composting manure is an effective way to manage manure. Essential nutrients are retained, while greenhouse gases naturally produced during the composting process are minimized. The Olds College demonstration is intended to show the environmental and economic benefits of composting. He says feedlot operators will be able to expand their manure management options and use this valuable bio-based soil amendment on their land. There may also be opportunities to sell the composted manure as a commercial product.

"Composting beef manure could provide a cost effective, environmentally friendly solution to many manure management issues such as volume, odour and timing of application," says Abiola.

Greenhouse Gas Mitigation Program for Canadian Agriculture
Beef Sector Administered by the Canadian Cattlemen's Association.

FEED SUPPLEMENT

Feed Supplement



The following section provides an overview of using zeolite for various feed operations. In the accompanying literature are the cattle, swine and poultry applications. Please scroll down to find your desired section.

OVERVIEW

Zeolite is widely being used by livestock farmers as a feed additive for beef cattle, dairy cows, swine, poultry (boilers & egg production), and sheep. Since zeolite is the world's only naturally-occurring negatively-charged mineral a great number of benefits in the feed process can result from this basic chemistry.

Zeolites are inert, stable and non-toxic. This, combined with their other unique characteristics, allows them to be used as feed additives with multiple, complementary benefits. Zeolite will also absorb odours from spoiled grain or feed grain and will substantially reduce odours in enclosed animal facilities.

The introduction of zeolite into animal feed provides the following rewards:

- 1) Improved animal growth and weight gain by increased food conversion rate efficiencies (less feed required per pound of weight gain)
- 2) Strong affinity for ammonium provides superior odour control and a healthy environment. Also protects the penetration of ammonia into the bloodstream
- 3) Zeolite is a rumen buffer for the total digestive tract of high performance dairy cattle. Higher CEC means more buffering (see below for an actual case)
- 4) Reduction of scours, acidosis, diarrhea, enteritis and other gastrointestinal diseases
- 5) Strong affinity for ammonium that aids in digestion and nutrient absorption and improves the value of milk, gradable eggs and the meat index

- 6) Improved dispersion of feed ration ingredients by reducing agglomeration
- 7) Increased NPN for ruminants and improves rumen microbial activity (see next section)
- 8) Better phosphate utilization
- 9) Enhances effect of carbamide in cattle feed. Absorbs NH 4+ released by carbamide hydrolysis
- 10) Reduces acidosis (grain poisoning)
- 11) Anti caking/flow agent for feed and increased feed pellet durability
- 12) Improved bone growth
- 13) Reduced mortality
- 14) Has no caloric value and is not a therapeutic
- 15) Approved for use in animal feeds (CFR 582-2727)
- 16) Myco-Toxin binder. Zeolite has EU approval for use in the swine and poultry industry. Though not currently approved in North America for mycotoxin binding, zeolite is the standard for a mycotoxin binder in many countries and also Europe by absorbing a broad spectrum of toxins. It also helps control aflatoxins in animal feed which lowers mortality rates from digestive stress and reduces the need for antibiotics and medicines. In Europe antibiotics are not used when using zeolite in feed

After years of successful field testing many feed suppliers and end-users have included a zeolite feed additive (of only ½% to 5%) in their feed supply program. There is an overall improvement in growth and health of these animals as a result of zeolite in their diets that translates to better profits.

Increased NPN for Ruminants

Many animals such as hogs and poultry need preformed protein from plants and animals. Ruminant animals such as dairy cows, beef cattle, sheep, goats, etc have microorganisms in their first stomach (rumen) that make protein from simple nitrogen compounds. They convert the non-protein nitrogen (NPN) to ammonia and then convert the ammonia to amino acids, which are then converted to proteins.

The benefit of adding NPN (primarily urea) is that it is less expensive than feeding protein nitrogen. One pound of urea contains as much nitrogen as five pounds of high protein feed such as soybean oil meal. High feed rates of NPN result in the generation of large amounts of ammonia that are adsorbed into the blood and create a change in the acid-base balance of the blood. This creates the following toxic symptoms:

- 1) Bloat - from excess ammonia
- 2) Labored Breathing - occurs when the animal tries to correct the acid-base imbalance by adjusting blood carbon dioxide levels
- 3) Lack of Coordination when the electrolyte imbalance affects the brain.

When zeolite is fed to the animal it adsorbs much of the ammonia generated from the NPN. It acts as a reservoir and slow release mechanism for the nitrogen. This can allow the feeding of up to 4 to 6 times more NPN.

During rumination, a portion of the contents of the first stomach is returned to the mouth for additional chewing and saliva additions. Saliva introduced during mastication contains sodium which replaces the ammonium. This results in the slow release of the un-reacted ammonia which is then converted to protein amino acids by the microorganisms.

Zeolite also provides a reduction of dicalcium phosphate by up to 50% therefore providing a health benefit and pollution prevention. Presently, the most common approach to cutting dicalcium phosphate is to feed 'phytase'.

CATTLE FEED OPERATIONS

Feeding Calves

Studies have shown that clinoptilolite added to the feed of young calves improved their growth rate by stimulating their appetites and decreasing the incidence of scours and diarrhea.



Five-percent zeolite was added to a normal grass and hay diet of 10 and 184 day old heifer calves over a 180 day period. The animals on the zeolite supplemented diets gained 20% more weight on average than those in the control diet. Although the test calves consumed more feed, the feeding costs per kilogram weight gained were significantly less than the control group. The test animals' manure contained less water and fewer particles of undigested solids. The overall health of the test animals was also notably better than the control group.

Another study was done using 2% clinoptilolite, 72% digestible nutrients and 11% crude protein over a 329 day period. This study showed the final weights between the experimental test group (using zeolite) and control group were similar, however, the experimental test group steers showed larger body dimensions and reportedly dressed out to give higher quality meat. These differences were reflected in higher prices obtained for the test animals and a 20% greater profit.

5 Ways using Zeolite is Better than Bicarbonate:

- 1) University and field research trials have proven the efficacy and favorable performance of Zeolite over sodium bicarbonate.
- 2) Zeolite is soluble in water and acid, so it is not flushed from the rumen as quickly as sodium bicarbonate. Zeolite continues to neutralize acid even in the lower gut.
- 3) Zeolite releases magnesium and calcium, so it can replace most if not all of the magnesium supplied by magnesium oxide.
- 4) Zeolite does not adversely affect the palatability of feed.
- 5) Zeolite contains zeolite which has anti-caking benefits.

Zeolite for the use as a Rumen Buffer Webster Dairy Farm

Introduction

Dennis Webster operates a small dairy farm near Preston Idaho. He milks 40 Holstein cows that average three to four years in age (third lactation). The cows are sold when they are between their fourth and fifth lactation. He has not purchased any replacement calves for more than 10 years. He feeds primarily barley and corn with some beet pulp for roughage. The hay is kept dry, and he does not use a chopping wagon. The cows average approximately

75 pounds of milk per day per head. A yearly average per cow would be approximately 14,000

pounds of milk. The somatic cell count of the milk is in the range of 100,000 to 150,000. The buyer pays a bonus of \$.30 per hundred if the count is less than 100,000, \$.20 if it is 100,000 to 200,000, \$.10 if it is 200,000 to 300,000, nothing if it is 300,000 to 400,000, and is docked if the count is more than 400,000.

Test to Determine if Zeocan Zeolite Can Be Substituted for Sodium Bicarbonate

Initially the cows were allowed to free choice sodium chloride, dicalcium phosphate, and sodium bicarbonate each placed in half of a 55-gallon plastic drum. The salt consumption was approximately 50 pounds in two weeks, the dicalcium phosphate was approximately 50 pounds in two weeks, and the sodium bicarbonate was approximately 50 pounds per week. Two years ago, minus 40 mesh Zeocan zeolite was introduced in half of a 55-gallon drum. The cows began eating the zeolite rather than the sodium bicarbonate.

The sodium bicarbonate became hard after several months, and after six months the sodium bicarbonate was removed completely. For one and a half years the cows have ate the zeolite with no sodium bicarbonate. At a later date it was noticed that the cows seemed to prefer minus 100 mesh Zeocan zeolite more than the minus 40 mesh. They will lick the barrel clean with minus 100 mesh. When fed the minus 40 mesh, they would leave a small amount in the drum. Should the drum run out, up to 10 cows will stand around the empty drum. When filled they each take a large mouth full and walk away.

Discussion

The use of zeolite as a replacement for sodium bicarbonate as a rumen buffer has been known for years. Some producers of zeolite have also included up to 50% by weight of dolomite (calcium-magnesium carbonate) with the zeolite. The advantages of using zeolite over sodium bicarbonate include better economics, odour control, increased feed efficiency, better retention of the nitrogen in the fertilizer, less sodium delivered to the pasture, less scours, and possible mico-toxin binding.

HOG FEED OPERATIONS

Many farms have eliminated most of their odour in hog operations and also realized greater animal health, welfare, and production by feeding between $\frac{1}{2}$ to 2% of zeolite (by weight) to the total feed ration. As described in many sections of this website, zeolite traps ammonium thereby vastly reducing odours in hog operations. The overview section outlines the various benefits of adding zeolite to hog feed.

Results from Slovakian Hog Production



The supplementation of zeolite resulted in a reduction in the amount of feed consumed per kilogram of weight gain. A reduction of about 10% was recorded.

<u>Experimental Group (Zeolite)</u>		<u>Control</u>	
		Weight Gain (kg/day)	Feed Conversion (kg/kg)
Farm 1	0.639	3.51	0.655
Farm 2	0.589	3.83	0.565

Letter of Endorsement from Alberta Hog Operations

The following is a paraphrased testimonial of using Zeolite in Feed for a small Alberta Hog Operation.

I am from the old school in which change does not come easy, we have always needed out piglets for scours with garasol and it did the trick, so when I was approached to try something natural (zeolite) I was hesitant as was not sure how it possibly could work? I checked around and found it was 100% safe for my baby piglets. I decided to try the zeolite, I started with just a sprinkle over top of their creep food of a couple of scouring litters I did this twice a day for 3 days – it worked! Even after day 2 you could see improvement on the piglets.

I have now totally eliminated the need to needle my piglets with medicine for scours which means less stress for piglets and more cost efficient. I have also used it when my sows aren't eating again just a small handful in their trough and they are up and nosing around so the smell and texture is appealing to pigs also it seems to act as an antacid for stomach upset.

At any rate I would not hesitate to recommend zeolite for your scouring piglets or most stomach upsets in lactating sows. We also use it as great traction on wet or slippery floors.

POULTRY FEED OPERATIONS



Zeolite increases feed efficiency and decreases ammonia levels in the poultry houses. High ammonia levels decrease gradable egg production in layers and gain in broiler operations. Various state and federal agencies are mandating ammonia levels be reduced. Frequently the ammonia levels in poultry houses exceeds 100 ppm which are considered close to lethal for humans and animals.

The introduction of zeolite in feed is the most effective means of odour control in poultry operations. Many farms in North America have eliminated most of their odour and realized greater animal health, welfare, and production by feeding zeolite between $\frac{1}{2}$ to 2% of the total ration (by weight).

A thin layer of zeolite should be applied to the bedding area or to the predominant manure field.

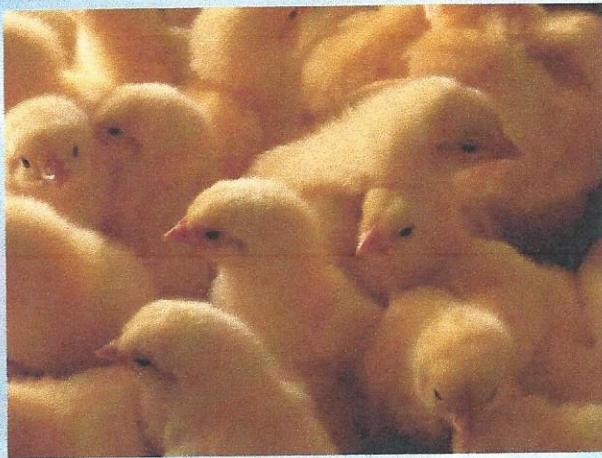
Benefits

In addition to the many benefits outlined in the Feed Supplement Overview at the top of this section, a zeolite amendment in poultry feed also has:

Increased solubility of phosphate in birds. The zeolite exchanges the calcium from dicalcium phosphate and makes the phosphate more soluble and better utilized for bones. The dicalcium phosphate in the feed may be reduced by 50% after testing

- 1) Increased number of gradable eggs, shell thickness and egg production
- 2) Reduced foot pad burns from phosphorus
- 3) Lowered mortality
- 4) Increased shell thickness
- 5) Increased nitrogen content of manure and compost. Zeolite fixes the nitrogen in the manure and compost so that it is plant accessible but not water-soluble. It stops the gassing losses of the nitrogen as ammonia. Many of the areas that have been repeatedly fertilized with chicken manure now have phosphate problems. This is a result of a nitrogen imbalance to the plants in their uptake of phosphorous. This problem can be solved by increasing the nitrogen, by the addition of phytase to the feed to solublize the phosphate in the bird.
- 6) Egg wash water can be recycled after filtration in a zeolite bed to remove suspended solids and bacteria

Using Zeolite in Chicken Operations



Using zeolite found that Léghorn chickens required less food and water and still gained as much weight in a 2-week trial as birds receiving a control diet. Feed efficiency values (FEV) were markedly higher at all levels of zeolite substitution. Feedstuffs containing zeolite gave rise to efficiencies more than 20 percent greater than those of normal rations (Table 1). The droppings of groups receiving zeolite diets contained up to 25 percent less moisture than those of control groups.

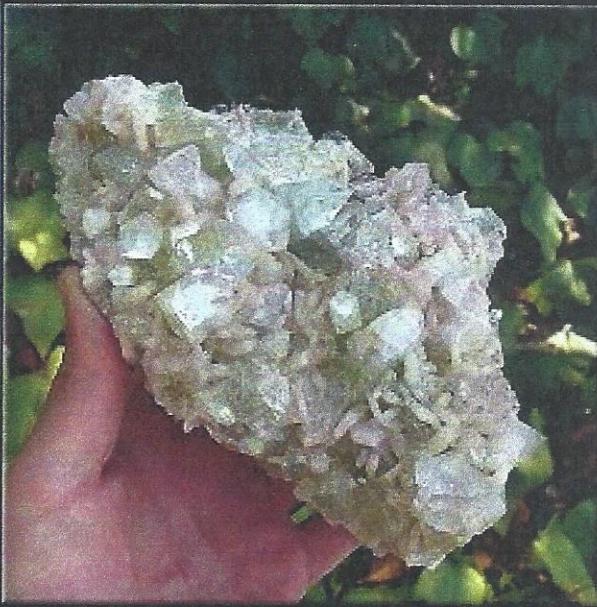
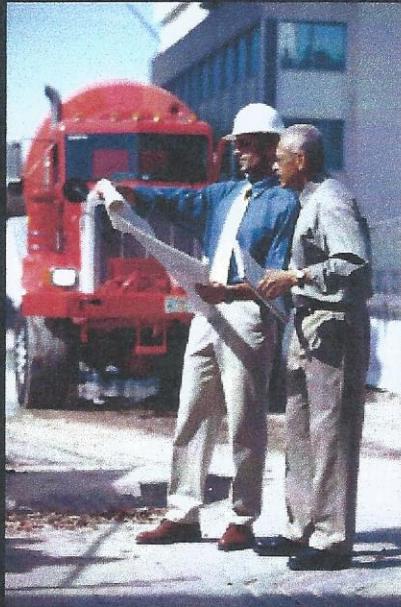
In addition to a feed-efficiency increase, the presence of zeolite in the diet appears to have had a favorable effect on the mortality of the birds.

Table 1 - Caloric Efficiencies of Zeolite Supplements in Poultry Feed

Group	Percent Zeolite content in feed	Average starting wt. (g)	Average final wt. (g)	Average gain (g)	Average weight intake (g)	Average Feed efficiency ratio
1	10%	553.7	795.6	241.9	668	0.362
2	5%	540.7	778	237.3	697	0.340
3	3%	556.7	796	239.3	748	0.320
4	10%	532.3	757.3	225.0	634	0.355
5	5%	552.3	814.6	262.3	775	0.338
6	3%	534.5	791.3	256.8	769	0.334
7	Control	556.5	789.3	232.8	782	0.298

consisted of 16.5% crude Protein and 66% digestible nutrients. Aflatoxin Control in Poultry A research study reveals zeolite to be effective and more than offsets the detrimental effects of feeding aflatoxin contaminated feed. Broilers fed 20 pounds of zeolite per ton (1%) of finished feed containing 115 ppm of aflatoxin showed improved feed conversion by 5.8 points and the body weight by 5.3 points versus the 115 ppm afatoxin control feed. Broilers fed the zeolite rations containing 115 ppm afltoxin had a lower feed conversiTests were carried out on 48-day-old Leghorns over a 14-day period, 30 birds/group. Normal rations on by 1.1 points and higher body weight by 3.7 points than the broilers fed rations containing no zeolite and no aflatoxin.

Commercial

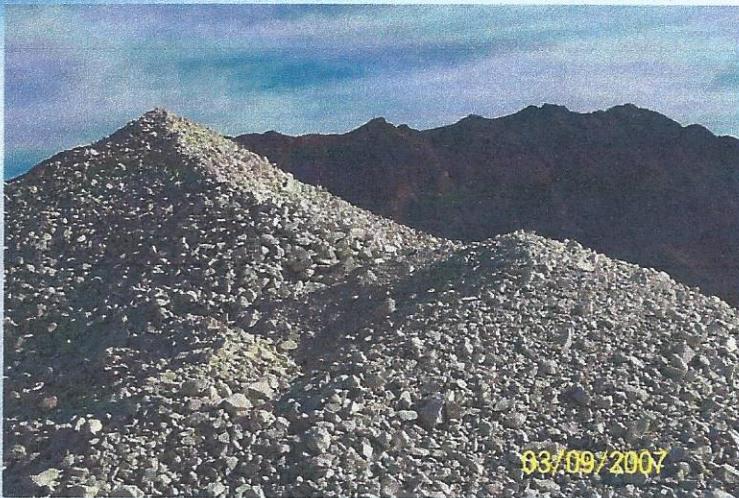


You may already be using zeolite and not realize it. Zeolite is often used in conjunction with other products in order to maximize their performance. Many manufacturers often try to gain a competitive advantage by using zeolite as an admixture to vastly improve their product or service.

Commercial zeolite products include:

- 1) Additive for Cements (Hardening agent, weight reduction)
- 2) Industrial/Environmental Spill Absorbent (Hydrocarbons, Paint, Glycol)
- 3) Cat Litter (Traditional and Clumping)
- 4) Soil Conditioner
- 5) Animal Nutrition (Improved Feed Conversion)
- 6) Odour Control (horse stalls, dog runs, litter box)
- 7) Traction for icy conditions.
- 8) Water Filtration & Pools (particulate removal, ammonia control)
- 9) Wastewater Treatment (metals removal)
- 10) Air Filtration Zeolites have been used for the separation of gases such as nitrogen, carbon dioxide, sulfur dioxide, and hydrogen sulfide.
- 11) Aquaculture (removal of ammonium and inhibits the growth of algae by removing nitrogen)
- 12) Flow Agent (Feed), Pellet Binder and Desiccant

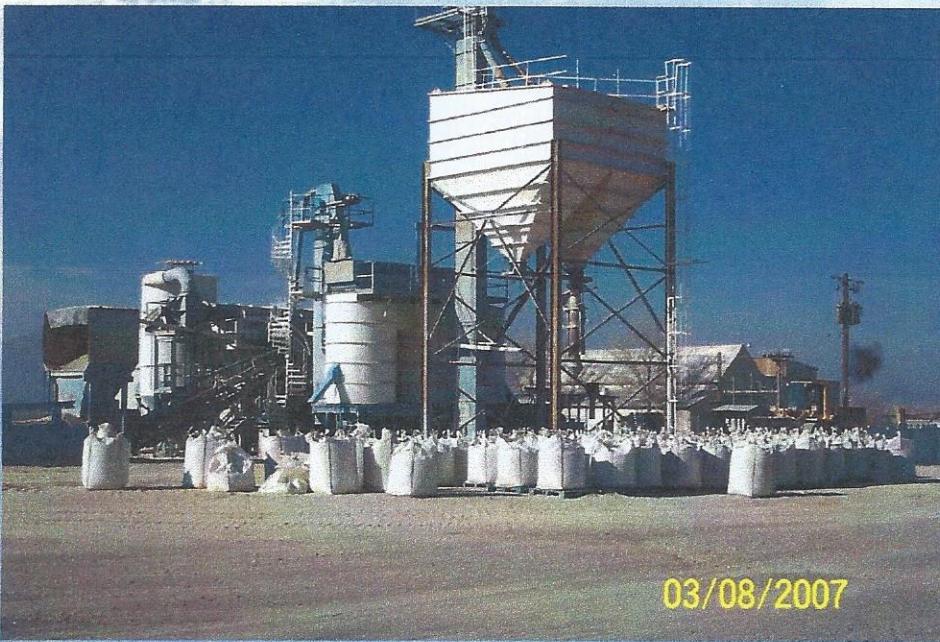
Image of Zeocan Zeolite



New products are always being developed using zeolite such as SurfactantModified Zeolite (SMZ) for control of anions (negatively charged particles). Zeocan Zeolite is commercially available in 10 kg bags, 1 tonne totes and bulk truckload. The Zeocan Zeolite deposit is less than 1 mile from a paved road, approximately 6 miles from a railroad - convenient for oversea shipments.

- 1) Zeocan Zeolite is light green when dry and dark green when wet. Also comes in white as well.
- 2) it holds up to 65% of its weight in water.
- 3) It has a high cation-exchange capacity (CEC) typically 160 to 180 meq/100 grams.
- 4) A low clay content makes Zeocan Zeolite non-clouding in water and provides for low dust.
- 5) It has a very large surface area (approximately 24.9 square meters per gram).
- 6) It is hard and resistant to attrition.

Zeolite Tote bags ready for shipment





ZEOLITE IS A UNIQUE GROUP OF MINERALS WITH AN IMPORTANT BASIC PROPERTY – IT'S THE WORLD'S ONLY MINERAL WITH A NATURALLY OCCURRING' NEGATIVE CHARGE. THEREFORE, ZEOLITES PRESENTLY HAVE IMPRESSIVE INDUSTRIAL BENEFITS WITH A HUGE UPSIDE IN MARKET POTENTIAL. ZEOLITES POSSESS TWO INTRIGUING PRIMARY PHYSICAL AND CHEMICAL PROPERTIES THAT ARE INVALUABLE TO INDUSTRY (TECHNOLOGICAL & ECONOMIC). THESE PROPERTIES INCLUDE CATION EXCHANGE AND ABSORPTION. ZEOLITES SIMPLY LOCK & HOLD MANY POSITIVE IONS AND ABSORB A MULTITUDE OF ENVIRONMENTAL CONTAMINANTS. THESE WILL BENEFIT VARIOUS INDUSTRIES INCLUDING HYDROCARBON, MINING, RADIATION, MUNICIPAL, COMMERCIAL AND AGRICULTURE INDUSTRIES. IN SUMMARY, ZEOCAN IS A BACKGROUND PLAYER THAT THRIVES FOR THE CREATION OF INNOVATIVE THINKING AND DESIGN. ZEOCAN ZEOLITE FOR NORTH AMERICA AND THE WORLD HAS A COMMITMENT TO PROVIDING THE MOST SOUND AND CREATIVE TECHNOLOGY THAT WILL BRING YOUR PRODUCT AND PROCESS TO THE LEADING EDGE...NOT ONLY FOR YOU TO GAIN A COMPETITIVE ADVANTAGE BUT...FOR THE BETTERMENT OF OUR EARTH.

LA ROCA MAGICA: USES OF NATURAL ZEOLITES IN AGRICULTURE AND INDUSTRY.

"FOR NEARLY 200 YEARS SINCE THEIR DISCOVERY IN 1756, GEOLOGISTS CONSIDERED THE ZEOLITE MINERALS TO OCCUR AS FAIRLY LARGE CRYSTALS IN THE VUGS AND CAVITIES OF BASALTS AND OTHER TRAPROCK FORMATIONS. HERE, THEY WERE PRIZED BY MINERAL COLLECTORS, BUT THEIR SMALL ABUNDANCE AND POLYMINERALIC NATURE DEFIED COMMERCIAL EXPLOITATION. AS THE SYNTHETIC ZEOLITE (MOLECULAR SIEVE) BUSINESS BEGAN TO TAKE HOLD IN THE LATE 1950S, HUGE BEDS OF ZEOLITE-RICH SEDIMENTS, FORMED BY THE ALTERATION OF VOLCANIC ASH (GLASS) IN LAKE AND MARINE WATERS, WERE DISCOVERED IN THE WESTERN UNITED STATES AND ELSEWHERE IN THE WORLD. THESE BEDS WERE FOUND TO CONTAIN AS MUCH AS 95% OF A SINGLE ZEOLITE; THEY WERE GENERALLY FLAT-LYING AND EASILY MINED BY SURFACE METHODS. THE PROPERTIES OF THESE LOW-COST NATURAL MATERIALS MIMICKED THOSE OF MANY OF THEIR SYNTHETIC COUNTERPARTS, AND CONSIDERABLE EFFORT HAS MADE SINCE THAT TIME TO DEVELOP APPLICATIONS FOR THEM BASED ON THEIR UNIQUE ADSORPTION, CATION-EXCHANGE, DEHYDRATION-REHYDRATION, AND CATALYTIC PROPERTIES. NATURAL ZEOLITES (I.E., THOSE FOUND IN VOLCANOGENIC SEDIMENTARY ROCKS) HAVE BEEN AND ARE BEING USED AS BUILDING STONE, AS LIGHTWEIGHT AGGREGATE AND POZZOLANS IN CEMENTS AND CONCRETES, AS FILLER IN PAPER, IN THE TAKE-UP OF CS AND SR FROM NUCLEAR WASTE AND FALLOUT, AS SOIL AMENDMENTS IN AGRONOMY AND HORTICULTURE, IN THE REMOVAL OF AMMONIA FROM MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL WASTE AND DRINKING WATERS, AS ENERGY EXCHANGERS IN SOLAR REFRIGERATORS, AS DIETARY SUPPLEMENTS IN ANIMAL DIETS, AS CONSUMER DEODORIZERS, IN PET LITTERS, IN TAKING UP AMMONIA FROM ANIMAL MANURES, AND AS AMMONIA FILTERS IN KIDNEY-DIALYSIS UNITS. FROM THEIR USE IN CONSTRUCTION DURING ROMAN TIMES, TO THEIR ROLE AS HYDROPONIC (ZEOPONIC) SUBSTRATE FOR GROWING PLANTS ON SPACE MISSIONS, TO THEIR RECENT SUCCESS IN THE HEALING OF CUTS AND WOUNDS, NATURAL ZEOLITES ARE NOW CONSIDERED TO BE FULL-FLEDGED MINERAL COMMODITIES, THE USE OF WHICH PROMISE TO EXPAND EVEN MORE IN THE FUTURE."

MUMPTON FA(DR MUMPTON IS CONSIDERED THE FATHER OF THE ZEOLITE INDUSTRY IN NORTH AMERICA)