Zeolites: A New Look at an Old Product

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Several years ago, as a professor at Colorado State University, a group claiming to have found the magic bullet for all of animal agriculture's problems came to campus. I was told that there was so much available that it would be cheap and easily incorporated into animal production. Further reading and research revealed that this product has literally been around for centuries. Zeolites are formed when molten volcanic rock reacts with water. If the molten rock reacts with seawater, then high levels of sodium will be locked into the mineral. Naturally occurring zeolites are rarely pure enough to provide the needed consistency for commercial application but are readily available throughout the world. Recently, an old zeolite mine was restored in West Texas.

Zeolites are known as molecular sieves because of the ability to sort molecules. The molecular structure of zeolites provides a channel matrix that traps some compounds while allowing others to pass through depending on size and charge of the passing molecule. The zeolite molecule is naturally negatively charged which facilitates binding to positively charged molecules. Zeolites act as a natural filter in solution with other compounds. Zeolites are inert, stable and non-toxic when ingested in solution or mixed with feed.

A quick Internet search is similar to my initial introduction to zeolites. There are websites that claim everything from a miraculous cancer cure to the best solution to reduce greenhouse gases. Many of these claims are not substantiated or even addressed by peer-reviewed research. It seems that this old product is experiencing resurgence in popularity with many new applications.

Zeolites are being manufactured on a large scale currently primarily in the United States. Zeolite A is the most common example. The primary raw materials to make Zeolite A are alumina and silica that are both in abundant supply around the world. The world's annual production of zeolite is estimated to be over 3 million tons. The binding properties of the zeolite are what provide the commercial application. Zeolites are used extensively in water filters to bind contaminants that can then be removed by the filtering of the zeolites. Another use in the U.S. is in cat litter. The zeolites bind water as well as odor, which provide a no odor litter box for the home. The largest use of zeolites is in the global detergent market. Zeolites are used in most laundry detergents to trap contaminants and then be rinsed out into wastewater.

Zeolites also have biological uses. The primary zeolite used for biological application is clinoptilolite. Clinoptilolite is a naturally occurring zeolite, which is found in abundant supply. Each site containing clinoptilolite has varying degrees of purity with the most pure being the most effective. There is significant research that addresses the effectiveness and uses of clinoptilolite in animal production. Much of the research is old by research standards and likely needs updating with better lab analysis available today. The research has been conducted in many different environments around the world. For this article I will only discuss the applications to the dairy industry.

The primary mode of action of clinoptilolite in a rumen environment is to provide a reservoir for nitrogen. The clinoptilolite will bind ammonia and then as the rumen microbes consume the available nitrogen the clinoptilolite will release more ammonia for use by the microbes. The clinoptilolite willhelp facilitate a steady nitrogen supply in the rumen versus a surge immediately following a meal event. This process allows or more efficient use of the available nitrogen from the ration. This change in efficiency resulted in increased body condition score, increased blood glucose concentration and decreased ketone bodies in lactating cows.

Clinoptilolite supplemented cows also had improved reproductive performance and increased milk production. There were four studies that revealed the same results at a feed rate of 200g/d. I also found research that indicated that Clinoptilolite has a similar function with calcium. In two studies, cows were supplemented with clinoptilolite for 4 weeks prepartum. At calving, the clinoptilolite supplemented cows had greater serum calcium concentrations than the control cows. There could be some real application for clinoptilolite addition in dairy cow diets especially in organic operations because the clinoptilolite is naturally occurring.

Clinoptilolite has been widely used as a trap for micotoxins that originate from feed. The micotoxin will become trapped in the zeolite matrix and because the zeolite is not absorbed, the micotoxin moves through the digestive system and is excreted with the zeolite. Clinoptilolite has been shown in numerous studies to be an effective tool to prevent micotoxin absorption in dairy cows.

Another use for clinoptilolite in animal feeding is as a binder for urinary ammonia, which is the primary contributor to environmental nitrogen release from animals. The clinoptilolite may be applied directly to animal pens as a top dress or as a soil mixture in animal bedding. Improvements in air quality in animal barns and calf hutches could be achieved. The clinoptilolite can then be applied directly to areas for crop production and in an area of low nitrogen concentration; the clinoptilolite will release the nitrogen back to the soil providing a natural nitrogen fertilizer. I did not find good research data to substantiate this claim. The fact that clinoptilolite will bind the urinary nitrogen and prevent it from volatizing into the atmosphere would be substantial in reducing these emissions from dairy farms.

Zeolites are not any different from any other feed ingredient that comes to the market. Each must be evaluated on effectiveness and economic impacts to the farm. It might not hurt to take a new look at an old product.