Maximising whole-farm productivity, Minimising environmental impacts...

with dietary natural zeolite

words by Ken Crawford

Abstract

Over half of the nutrients fed to pigs are excreted. This is a problem for the pork industry in Australia and overseas as it is a waste of nutrients and can have serious environmental impact. Nitrogen, phosphorus, potassium, copper and zinc being of greatest concern. There is an opportunity to meet this challenge by using dietary natural zeolite to treat the piggery effluent enabling safe storage and spreading as a fertiliser.

Applications of natural zeolite vary from handling radio-active waste to horticulture and agriculture. This innovative research work deals with the use of dietary clinoptilolite (a type of volcanogenic natural zeolite). Natural zeolite is an absorber and carrier of nutrients and in this case reduces the amount of nutrients excreted, retains those nutrients in the effluent stream and releases those plant nutrients when applied to the soil. In this manner less nutrients are wasted and the fertiliser value of the manure is enhanced.

There are many nutrient loss pathways in storing and spreading piggery effluent slurry. Dietary natural zeolite technology aids in maximising whole-farm productivity and minimising environmental impacts. This work may be viewed as part of a system of environmental nutrition. In other words environmentally friendly pig feed.

This research work and demonstration shows that formulating pig rations with natural zeolite powder is a safe, convenient and effective way of recycling waste nutrients in piggery effluent and reducing nitrogen losses in particular. Gowrie EcoFarm is a practical demonstration of this whole-farm approach over a decade of experimentation. This work is a farm case study. The following maximum inclusion rates of natural zeolite powder (by weight) in pig diets are as follows: weaners 5%, growers 2.5% and breeders 1%.

There is potential for widespread adoption in the Australian pork industry. Dietary natural zeolite technology applied in a whole-farm system, promotes agricultural productivity while protecting and enhancing our natural resource base.

Maximising productivity: whole-farm concept

The pig is not to be thought of as merely a producer of meat but an integral part of sustainable agriculture. As well meat production, the pig produces valuable fertiliser that should not be wasted. In fact, most farms produce approximately four tons of manure for every one ton of pork. This research and innovation takes the holistic approach to integrated nutrient management by using dietary means to reduce the amount of nutrients excreted, to retain the waste nutrients in the effluent stream and to release those nutrients to plants as they need them. A slurry tanker is used to spread the treated effluent for sustainable cropping systems. The ultimate goal is a closed-loop farm ecosystem where all natural resources are used to their potential. In this manner the farm fits nicely into the wider catchment ecosystem with many beneficial social and economic implications for the whole valley. One outcome is a feeling of well-being and happiness for the farmer.

Pigs fed natural zeolite are healthier and more content as it is thought the extra growth rate is achieved by boosting the immune system of the animal itself. In this sense it is not a chemical growth promotant but a natural way of improving animal health. This leads to higher growth rates and lower mortality.

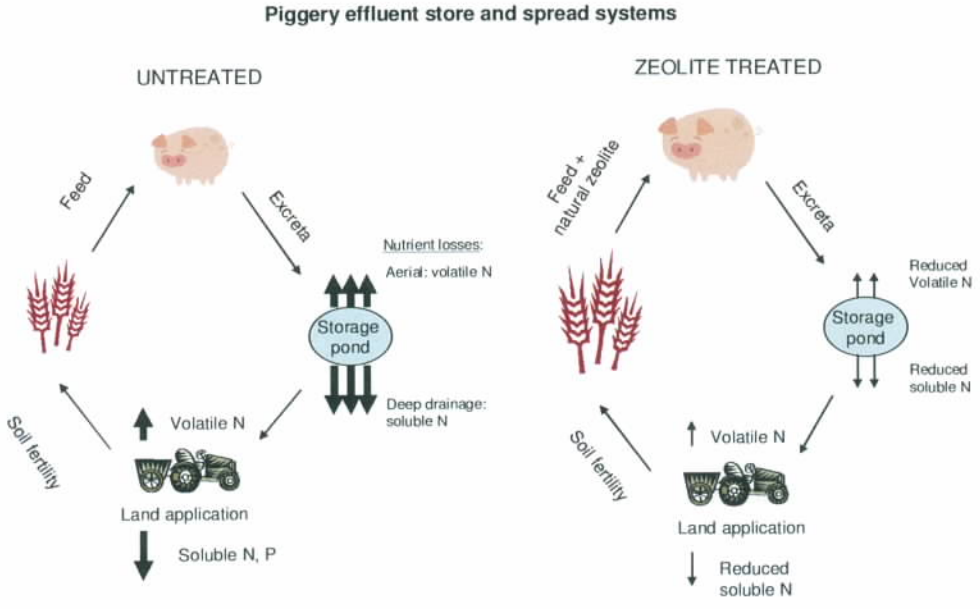

Figure 1a: No zeolite addition to feed: Nutrient losses of up to 30%, includes lower growth rates pigs and crops. Volatilisation and leaching processes unimpeded.

Figure 1b: Dietary natural zeolite treatment of feed: increased growth rates (Giles et al. 2005), reduced nutrient losses, increased fertiliser value (Gowrie EcoFarm case study).

Sustainable cropping systems

Gowrie EcoFarm is a working demonstration showing that not only do the pigs do better but the crops also produce higher yields of quality, highly nutritious grain. This grain is then milled on farm and fed to the pigs with natural zeolite as a feed additive to the rations depending on the physiological class of the animal. This sets up a virtuous cycle of continuous improvement in overall farm productivity.

Soybeans fields slurry tanker spread in the fallow Photo: Ken Crawford 2010

High energy barley and beans on Gowrie EcoFarm

One observation over the years of cropping using zeolite treated manure without any artificial fertiliser is that energy values of the grain are consistently high. The energy value of wheat used in the EMAI trial was 14.8 MJ of DE/kg. The zeolite in feed appears to allow the animal to utilisise this energy better. This also applies to feed oils and tallow.

A possible explanation is that the zeolite prevents scours particularly in weaners.

Weaners on dietary natural zeolite (2.5% RRB) Photo: Ken Crawford 2013

Minimising environmental impact

The pork industry internationally has high levels of untreated pig manure. This is a major concern for the environment, in terms of volatilization of gases to the atmosphere and leaching of minerals deep into the soil and groundwater. The challenge is reduce this wastage and put these minerals to a beneficial use.

Dietary natural zeolite may play a key role in the future by blocking nutrient loss pathways. Natural zeolites are crystalline silicate minerals found in some volcanic rock formations. This research work involved natural zeolite powder from the Castle Mountain deposit at Quirindi in NSW, Australia.

Natural zeolite used as a feed additive in animal diets has the following environmental benefits: reduces the amount of nutrients excreted
retains waste nutrients in the effluent stream
releases plant nutrients after slurry spreading

Red Roc Booster (RRB) is a product developed for Castle Mountain Zeolites and is the powder form of clinoptilolite, a natural zeolite. APVMA permit and BFA approval for use have been obtained.

Castle Mountain Zeolites RRB in 25kg bags Photo: Ken Crawford 2013

How zeolite works in sustainable agriculture

The zeolite crystal has a negative electrical charge. In an attempt to balance this in the effluent stream or soil or even the gut of the pig, it attracts positive ions. Fortunately, most of the plant nutrients are positively charged ions. Nitrogen in the form of the ammonium ion, phosphorus, potassium, copper and zinc are attracted to the zeolite crystal, which by the way, is micro-porous so some ions can be accommodated internally. Other positive ions are loosely bound to the surface of the crystals. This type of bonding is different to chemical bonding when inorganic compounds are precipitated and may no longer be available to the plant. Likewise, once the ammonium ion is accommodated by the zeolite crystal, soluble nitrates cannot form. This is evidenced by the many treated effluent samples from Gowrie EcoFarm that all have extremely low levels of nitrate and high levels of available nitrogen for plant fertiliser.

The value of nutrients saved by using dietary zeolite technology is as follows; for every 100 sows the value of nutrients excreted annually(and potentially able to be saved) in an average piggery amounts to around $32,000, including $14,000 of nitrogen. Many piggeries waste all the nutrients. This is not sustainable.

Recycling waste nutrients in piggery effluent using dietary natural zeolite
Photo: Ken Crawford

Ongoing innovative research

The author is currently developing surfactant modified technology to mimic organic matter properties. By experimenting with organic detergents the zeolite crystal may be coated with organic compounds and attract negative as well as positive ions in the manner that organic matter does. This technology has great promise in the field of carbon sequestration and binding greenhouse gases by way of the soil building process.

For more information contact Castle Mountain Zeolites on 02 67463555
Ken is the author of ***Recycling waste nutrients in piggery effluent using dietary natural zeolite*** which can be downloaded at www.cmzeolites.com.au for $37 Aus plus GST
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