Sulfur (S) is one of seven generally recognized macro minerals needed in the diets of dairy cattle and other animals. Sulfur is a mineral that is found in the amino acids methionine, cysteine (cystine), homocysteine and in taurine. It is also in the B-vitamins, thiamin and biotin. It is an important component of healthy cartilage. As a part of the specified amino acids, it is key to the structure of proteins. Heating protein supplements can rearrange the structures of proteins, due to the sulfur-containing amino acids, which can determine whether these nutrients are soluble and rumen degradable or if they will resist rumen degradation in cattle. Heating also affects the essential amino acid, lysine, when carbohydrates are present in a supplement. An example of this change by heating can be observed when an egg is boiled.

Animals have a need for essential sulfur-containing nutrients, such as methionine and cysteine. However, the microbes in the rumens of cattle and other ruminants can use mineral sources of sulfur to produce some of these important nutrients for dairy and beef cattle. Thus, it is important to feed sulfur at recommended dietary levels to meet the needs of the microbes, as well as the animals. In dairy cattle, it is needed in the diet at the level of 0.20%. For beef cattle, the recommended concentration is a minimum of 0.15% of dietary dry matter (DM). Since about 0.15% of the body weight is sulfur, commercial concentrations in typical beef cattle rations range from 0.18 to 0.24%. Sulfur is essential when a nonprotein nitrogen source, such as urea, is fed. The total Nitrogen:Sulfur (N:S) ratio in a diet should range from 10:1 to 12:1, and the rumen soluble N:S ratio should be 4.0:1 to 5.5:1.

Common sources of sulfur for livestock include:
- potassium sulfate
- magnesium sulfate
- sodium sulfate
- ammonium sulfate
- calcium sulfate
- corn gluten feed, distillers grains and other corn co-products.

Sulfate forms of macro and trace minerals are among the most digestible and easily absorbed forms in the digestive tract. Elemental sulfur in water and feed is not a readily available source for animals.

A deficiency of sulfur in the diets of animals can have detrimental effects on their performance. Marginal deficiency symptoms include:
- reduced microbial synthesis
- reduced fiber digestion due to slow microbial growth in ruminants
- slow growth
- reduced milk production
- reduced feed efficiency

**Sulfur is an important element in the pH balance of the blood of animals.**
• reduced intakes
  Severe deficiencies can cause the following symptoms:
• unwillingness to eat
• weight loss
• dullness and slow movement
• excessive salivation
• death

For ruminants, the maximum tolerable level of sulfur in diets is .40% of their dry matter intakes. Excess sulfur will interfere with the digestion and absorption of other minerals, particularly the trace minerals, copper and selenium. Even though these minerals may be adequate in the diet, secondary deficiency symptoms can be observed, simply because the trace minerals were made unavailable, due to too much sulfur in the feed.

Other toxicity symptoms or problems that can occur from high levels of sulfur include:
• reduced intakes
• overloading the urinary system, leading to kidney failure
• interference with nerve impulses, including blindness, coma, muscle twitches and intestinal inflammation or bleeding
• The breath of cattle may smell like “rotten eggs,” due to the toxic form of sulfur, hydrogen sulfide.
• polioencephalomalacia (PEM)

With recent increased usage of distillers grains in dairy and feedlot diets, the association between sulfur and PEM has been noted and documented. One of the causes of PEM in ruminants is the interference by sulfur with the B-vitamin, thiamin. Supplementation with thiamin may help to alleviate PEM. This is one reason why thiamin is included in Agri-King base mineral products. The symptoms of PEM include:
• excessive salivation
• nervousness and twitching (hypersensitivity)
• poor muscle coordination and dullness
• tilting the head to the side and walking in circles (star gazing)
• head pressing
• blindness
• death

Sulfur is an important element in the pH balance of the blood of animals. Sulfates are some of the anionic salts that are used to adjust PCI (Pre-Fresh Cow Index) that affects calcium utilization in cows prior to calving. This can be a key factor in the prevention of milk fevers and retained placenta in fresh cows.

In summary, sulfur is needed in dairy rations at a minimum level of .20% of dry matter for a TMR. It is a key macro mineral in maintaining life and production in animals, and it is an essential component of some amino acids, vitamins and other nutrients needed by all animals. Like all required nutrients, too much S can become toxic. The maximum level of sulfur is .40% of the dry matter intake for cattle.

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