The Use of Vermiculite as a Technological Additive in Animal Feedstuffs (Binder, Anti-Caking Agent and Coagulant)

Background

Vermiculite has been safely used as an ingredient in animal feed in both North America and in Europe for many decades. Vermiculite in its expanded or exfoliated form is used in animal feedstuffs as a support and carrying medium for a range of feed additives, such as vitamin preparations, antioxidant’s, antibiotic’s, and mold inhibitors, as well as nutrients such as fat concentrates and molasses because of its absorbent, soft, sterile and free flowing nature. Vermiculite can act as a slow release medium for the active ingredients being carried, and will also provide additional non-nutritive roughage.

Vermiculite is on the EC list of permitted additives in animal feeding stuffs under “Binders, anti-caking agents and coagulants; E 561; Vermiculite”, and is listed in the latest edition of European Union Register of Feed Additives pursuant to Regulation (EC) No 1831/2003 Appendices 3b and 4. Annex: List of additives.

The Early Years

The first general use of vermiculite in animal feedstuffs came from pioneering research in the in the early to mid-1950s in the USA demonstrating the safety and effectiveness, of vermiculite as an effective technological additive in animal feedstuffs.

Vermiculite in a highly purified form under the original trade name in the USA of Verxite™ was approved by the Food and Drug Administration (FDA) in 1976 for use in animal feed as a non-nutritive carrier, or to provide bulk density, at levels not exceeding 5% of the total weight of the finished diet.

(Note: Verxite™ being a trade name in the USA for a purified form of vermiculite, but the US FDA no longer considers Verxite as a trade name, or trade mark, and it is therefore considered a synonym or generic name for purified feed grade vermiculite.)


Under the general stipulations of the U.S. Food and Drug Administration CFR - Code of Federal Regulations Title 21, the food additive Verxite/Vermiculite may be used in animal feed.

The initial usage was in compounding a product known as Santoquin 66, which was a blend of Ethoxyquin and vermiculite where the Ethoxyquin provides effective protection from oxidation of the valuable vitamins contained in the animal and especially poultry feed. The Ethoxyquin being a viscous liquid needed at between 0.01% and 0.02% of the final compounded feed, and without the vermiculite it would be exceedingly difficult to effectively distribute this small quantity of active ingredient uniformly through the entire batch of dry feedstuff. The use of vermiculite as a carrier for other micro-ingredients in animal feedstuffs then began to grow.

Examples of use of vermiculite in feedstuffs

Propionic acid is an active ingredient used as a fungicide and bactericide on stored animal feeds such as grain, hay and silage. Propionic acid is applied either as a solution or pre-applied onto an absorbent such as vermiculite. The following link shows the approval for propionic acid by the United States Department of Agriculture for mold growth prevention on grains for use as animal feed when absorbed on vermiculite.

The abstract of US Patent 41990606 A, titled: Fungicides for animal feeds, describes the use of vermiculite as a carrier of propionic acid:

Propionic acid absorbed on a particulate carrier material, including vermiculite and perlite, which will catalyze or effect the formation of monomeric propionic acid in the propionic acid vapors which evaporate therefrom is disclosed as a preservative for various agricultural crop products and derivative and by-products thereof, including animal feeds and cereals.

It has long been known that propionic acid either alone, or on a carrier material, may be used as a preservative for foodstuffs. The use of propionic acid on a carrier material will generally give better results because of the better distribution of the propionic acid that may be obtained.

- **Bloat Guard**

Bloat Guard is used for the prevention of legume (alfalfa, clover) and wheat pasture bloat in cattle. The ingredients of this being:

a) Active Ingredient: Poloxalene (approximately 53%) Equivalent to approximately 529 grams per kg of feed.
b) Inert Ingredients:
   (i) Ethoxyquin (a preservative), 0.064%;
   (ii) butylated hydroxy-toluene (a preservative), 0.20%;
   (iii) Feed-grade purified vermiculite (non-nutritive), approximately 47%.

- **Effects of vermiculite in poultry egg production and feed utilization**


Overview of the article: Effect of vermiculite on productive performance of White Leghorn hens in a controlled feeding system, S. N. Khokrin and M. J. Khan: Vermiculite was fed to chickens at the rates of 4 and 6 percent of the feed, and compared to control groups fed a standard diet or the standard diet - 5% of the amount. The group receiving 4% vermiculite showed the best egg production and feed utilization. Again, this study is mentioned not to construe any zoo-technological advantage of vermiculite in the feed at this time, but rather to illustrate the concentration parameters and safety within such parameters.

**Some of the properties and advantages of vermiculite useful in animal feedstuffs:**

- Sterility (when first exfoliated)
- Simplifies effective mixing of otherwise difficult to handle micro-nutrients
- High liquid adsorption
- Low bulk density
- Low dioxin and furan content
- Soft, and free flowing material
- Ability to carry fine powders
- Effective drying aid
- Incombustible
- Anti-caking agent
- Bulking agent (non-nutritive)
- Pelletizing aid
- Long shelf life
- Near neutral pH range
- Excellent dispersant
- Low bioavailable fluorine content
- No residuals or metabolites will be imparted into food derived from animals given feed containing vermiculite
Micro-ingredient Pre-mixing with Vermiculite

Vermiculite is especially useful for pre-mixing micro-ingredients for incorporation during the compounding process into animal feedstuffs. By pre-mixing micro-ingredients, the batching efficiency is increased and the errors in batching are reduced. The use of pre-mixing helps optimize the dispersion and therefore the effectiveness of the micro-ingredient throughout the final mix. Micro-ingredients typically include: vitamins, choline chloride, amino acids, flavours, mold inhibitors, antioxidants, trace minerals and pigments. An ideal premixing carrier such as vermiculite has to have the ability to absorb liquids of differing viscosity effectively, accept and retain fine powders without segregation or settlement over time. The low bulk density and very high specific surface area of exfoliated vermiculite make it highly suitable for this purpose. As a carrier and diluent, vermiculite is useful when pharmaceutical products such as antibiotics, cocidiostats, mold inhibitors, enzymes, flavours pigments and antioxidants are being compounded into the feedstuff. The low moisture content of vermiculite is also advantageous as excessive moisture in a feedstuff causes degradation of many of the pharmaceutical additives by reduction-oxidation reactions. The activity of all biochemical substances are critically influenced by the pH of the carrier media and extremes of pH should be avoided. The near neutral pH of most vermiculite sources ensures the stability of additives such as vitamins, propionic acid and Ethoxyquin.

Suitable mixing equipment for the incorporation of animal feedstuffs using vermiculite as a functional additive are usually of the ribbon blade or paddle blade varieties. Severe mechanical attrition should be avoided, as this destroys much of the capillary pore space of the vermiculite, and hence reduces its ability to effectively absorb the additives being incorporated during the compounding phase. Drum mixers are normally more suited for the compounding of the denser mineral premixes than incorporating liquids onto vermiculite. When adding liquids on to the carrier during the mixing phase, it is normally best to spray apply these over the maximum possible surface area of the carrier to promote most efficient distribution. The mixed feedstuff may appear to be wetter looking when first mixed than after a few hours standing when the full absorption by capillary action has occurred.

Examples of other biochemical and feed additives incorporated into animal feedstuffs using vermiculite:

- Propylene glycol
- Xanthophyll
- Stabilized vitamin A preparations
- Choline chloride
- Vitamin E (d-Alpha tocopherol)
- Ferric choline citrate
- Essential amino acids
- Fatty acids
- Animal fats such as tallow
- Dairy by-products