

## **Use of BIONIT<sup>®</sup>-S as a Feed Additive**

### **1. Introduction**

The issue of "environmentally compatible agriculture" is of utmost importance in the discussion of agricultural policy.

On the one hand the introduction of agricultural substances into the atmosphere and the soil is of particular importance. Backed by the most recent prohibition within the EU as regards the use of antibiotics as performance enhancers, increasing significance is being given to "natural" additives to refine animal quality on the other hand.

In the context of these two major issues adsorbent feed additives on a clay mineral basis are growing in importance.

**BIONIT<sup>®</sup>-S** is a mineral feed additive which is designed to protect the health of working animals in a natural way, to have a positive effect on the digestive processes, to improve the air quality of the livestock pens and to prevent problems with the liquid manure. **BIONIT<sup>®</sup>-S** is a natural clay mineral (bentonite montmorillonite) with specific properties which has a regulatory effect on incorrect livestock techniques and hygiene, feed composition, the quality of the animal material and the liquid manure management. **BIONIT<sup>®</sup>-S** is not a conventional performance enhancer but a natural aid which permits the existing performance potential of the animals to be used to better effect. This means that it is a valuable instrument for crisis management today's intensive livestock rearing.

The bentonite montmorillonite product **BIONIT<sup>®</sup>-S**, which is specially treated for feed applications, is used not only for ruminants but also for pigs and chicken.

### **2. Physical Effects of Bentonite Montmorillonite for the Production of Mixed Fodder**

In the past bentonite montmorillonite was used in feed mixtures solely for technological reasons. Its excellent effects as a pelletising and flow agent are well known.

#### **2.1 Use for Pelletising**

The addition of bentonite montmorillonite improves the adhesion mechanisms and the binding forces in the pellets in the following manner:

- The feed particles do not normally have full contact with each other but only at certain points due to their irregular shape. The fine bentonite montmorillonite platelets fill the voids between the feed particles. They stick to the surfaces of the particles and thus increase the contact surfaces for stable solid body bridging.

- The specially treated bentonite montmorillonite product **BIONIT<sup>®</sup>-S** offers an extremely high water absorption capacity. Due to their large surface the montmorillonite platelets take up the condensed moisture more quickly and completely than the feed particles. The addition of **BIONIT<sup>®</sup>-S** thus ensures a higher moisture absorption during pelletising, something which increases the binding forces and thus the solidity of the pellets. At the same time the press rate is increased with the application of less energy as the pellets slide through the moulding channels more easily.

In addition this enhances the storage properties of the pellets.

### 2.2 Use as a Flow Agent

Farinaceous feed recipes contain a wide range of ingredients with extremely different physical characteristics and thus have a tendency towards segregation. Although the addition of molasses, oils etc. reduces this tendency, this has an adverse effect on flow behaviour. Bridging, impaired flow from silo compartments and adhesions are the undesirable consequences.

Due to its large surface and high water absorption capacity **BIONIT<sup>®</sup>-S** satisfies the requirements for a flow agent to a wide extent. The addition of **BIONIT<sup>®</sup>-S** to farinaceous feed mixtures containing molasses and fats results in a marked improvement in flow behaviour and mixing stability.

### **3. Physiological Effects of Bentonite Montmorillonite for Feeding**

Experience with the feeding of animals confirms that the use of bentonite montmorillonite not only offers technological advantages for the production of fodder but at the same time an improvement in animal performance.

The physiological effects can be described as follows:

Fodder with high concentrations of energy and protein and low fibre levels is not fully used by animals with a short digestive system. Undigested nutrients and feed constituents are converted in the digestive tract on a partly enzymatic and a partly microbial basis. The end-products of this conversion process are often so-called undesirable substances such as ammonia and various other nitrogenous compounds as well as microbial metabolites and substances of a toxic nature. Such catabolic products in the metabolic system are frequently the cause of digestive disorders and emissions of gas and odours harmful to the environment.

The physical, chemical and physiological effects of **BIONIT<sup>®</sup>-S** in animal feed are based on the properties of the valuable main mineral montmorillonite for water binding, swelling, cation exchange and bonding and binding, thus resulting in the inactivation of undesirable, in some cases toxic substances in the digestive tract.

### 3.1 *Feed Effects*

- **Intensification of digestive process**

A high nutrient density and high level of digestibility result in a drastic reduction in the dry substance volume of the intestinal contents. The intestinal motor system for intensive mixing of the nutritional slurry greatly depends on the dilation impulses exercised by the contents of the intestines on the intestinal wall. This particularly applies to livestock rearing methods which do not include intensive activity levels for the animals. As a mineral bulk material **BIONIT<sup>®</sup>-S** provides for an effective increase in the volume of the intestinal contents exceeding its own volume several times over due to water adsorption. The increased dwell time of the nutritional slurry in the alimentary canal brings about an improvement in the enzymatic digestive processes and thus enhances the digestibility of the nutrients.

- **Loosening and dilution of nutritional slurry**

The action of the digestive enzymes is improved and energy and the nutrient retention levels increased through the interaction between the loosening and dilution of the nutritional slurry on the one hand and the increased passage time on the other.

- **Stimulation of endogenous micro-organisms**

Due to its mineralogical structure **BIONIT<sup>®</sup>-S** is ideal for the colonisation of micro-organisms. The main importance of colonic fermentation by means of bacterial conversion lies in the removal of the endogenous nitrogen and thus relieving the burden on the liver. An optimum pH value and a balanced ratio between endogenous nitrogen and fermentable energy encourages the activity of utilising bacteria (formation of bacterial protein) and suppresses the development e.g. of coliform organisms.

- **Regulation of acid-base balance in the rumen of ruminants**

As a prophylactic **BIONIT<sup>®</sup>-S** prevents acidotic metabolic conditions. Due to its high affinity with hydrogen ions bentonite montmorillonite reduces acid resorption and subsequently the regulatory effort of the organism for maintenance of the acid-base balance. The use of bentonite as a prophylactic at an early stage is particularly indicated in the weak-structure feed ration types with a high level of easily digestible carbohydrates which may primarily cause acidotic metabolic conditions with impairment of performance and metabolic disorders.

**BIONIT<sup>®</sup>-S** is not a rumen buffer in the narrower sense but a regulator of the protonic concentration in the rumen. This takes place according to the principle of the reversible exchange of ions, i.e. the buffer capacity of the bentonite montmorillonite is not exhausted. It has a continuous balancing effect due to an increased protonic exchange with a falling pH-value and adsorption of other cations ( $\text{Ca}^{2+}$ ,  $\text{Na}^{+}$ ) with a rising pH-value.

- **Adsorption of harmful substances**

**BIONIT<sup>®</sup>-S** has an active inner and outer surface of 400-600 m<sup>2</sup>/g. Harmful substances such as ammonium and sulphur compounds as well as toxins and radionucleotides contained in the feed

or produced during the digestive process then bind to this surface. In particular the adsorption of ammonium reduces the formation of ammonia and thus corrects any imbalance in the ratio between nitrogen and fermentable energy.

The adsorption and resulting deactivation of mycotoxins, in particular aflatoxin B1, by **BIONIT®-S** considerably relieves the burden on the liver and prevents any impairment of animal performance due to mycotoxins.

Stress is caused by both the active and non-active intestinal contents. **BIONIT®-S** can reduce the intestinal stress levels and the chemical burden to which the animal is subjected originating from the intestinal canal.

- **Prophylactic for diarrhoea**

The extended passage time causes a sharp increase in the acid levels of the feed slurry in the stomach due to naturally occurring stomach acids. The pH value experiences a greater fall and only rises again slowly in the course of the digestive process. In the rear section of the digestive tract (colon) the development of coliform organisms is effectively prevented. In addition the binding of the bacterial toxins to the surface of the bentonite and the water absorption between the lamellar layers reduces symptoms of diarrhoea and improves the state of health. This antilaxative effect is particularly significant in the rearing of piglets.

**Result: Increased Vitality of Animals, Improved State of Health, Better Performance**

#### **4. Test Results**

**BIONIT®-S** is being used successfully in many European countries. In addition there is also an abundance of scientific results from throughout the world relating to the use of bentonite montmorillonite in animal feeds. When comparing the test results and applying them to agricultural practice the different breeds of animals and special rearing conditions must also be taken into consideration.

The numerous test results for the individual species of animal can be summarised as follows:

##### *4.1 Pigs*

The effects of **BIONIT®-S** vary depending on the breeding type of the pigs. Fleshy animals with a strong type resemblance and a limited feed intake capacity are more likely to show an improvement in the daily increases. Porkers from multiple crossbreeding and hybrid breeding programmes often respond with an improvement in the food utilisation, in particular in the case of ad libitum feeding.

- **greater daily increases**
- **improved food utilisation**
- **improvement in health parameters (morbidity, mortality), in particular reduction in diarrhoea**
- **reduction in metabolic burden through reduction of urea concentration in blood**
- **binding of mycotoxins, primarily aflatoxin B1**

##### *4.2 Ruminants*

The use of **BIONIT<sup>®</sup>-S** has a positive effect not only on various processes occurring in the rumen of ruminants but also in the rear sections of the intestine. The following effects can thus be expected, in particular in the case of ruminant feed high in concentrates and with a weak structure:

- **higher milk production levels**
- **higher milk fat content due to increase in acetate: proportionate ratio**
- **prophylactic to prevent performance impairment and metabolic disorders due to acidotic metabolic conditions**
- **greater daily increases, improved food utilisation**
- **positive effect on diarrhoea process occurring in calves**

### 4.3 Poultry

In the past investigations into the use of bentonite montmorillonite for poultry keeping used to focus on the reduction in the excrement moisture levels, improvement of the air in the hen-house and acceleration of the excrement drying process. At the same time it was possible to improve the resorption of nutrients and food utilisation in the case of fattening poultry (broilers, turkeys). Laying hens primarily responded with an increase in mean egg mass and improved vitality.

- **greater weight increases with improved food utilisation**
- **increase in numbers of eggs laid**
- **lower mortality rate**
- **significant reduction in excrement moisture levels due to high swelling and water absorption capacity of bentonite montmorillonite**

### 4.4 Environmental Effects

In addition to the physical effects on the animals the use of **BIONIT<sup>®</sup>-S** brings about a marked reduction in the emissions of harmful gases from livestock farms and the distribution of liquid manure, something which has a positive result for both the atmosphere and the soil.

### **5. Summary**

Bentonite montmorillonite has been used successfully in animal feeds throughout the world for many years.

However, it is necessary to use superior qualities to ensure a lasting positive effect. The bentonite quality depends on its content of the valuable main mineral montmorillonite. The three-layer clay mineral montmorillonite is characterised by the following:

1. high surface area (400-600 m<sup>2</sup>/g)
2. high cation exchange capacity
3. high water absorption and swelling capacity

The physical and physiological effects of **BIONIT<sup>®</sup>-S** in animal feeds can be summarised as follows:

Due to its high content of bentonite montmorillonite and the specific activation process **BIONIT<sup>®</sup>-S** enhances the technological properties of a mixed feed, both for pelletising and as a flow agent for farinaceous rations.

In addition its ability to bring about a marked improvement in performance has been demonstrated for pigs, ruminants and poultry. This includes stimulation of growth rates, reduction in feed costs and in particular, an increase in the vitality and health of the animals. The effects result in a major improvement in the economics of animal production.

**BIONIT<sup>®</sup>-S** presents no health hazard to humans or animals. Residue problems and the development of resistance are ruled out. **BIONIT<sup>®</sup>-S** passes through the digestive tract without any particular resorption processes, is completely eliminated in the faeces and thus forms part of the liquid manure. This results in a marked reduction in NH<sub>3</sub> emissions and a significant improvement in plant tolerance of the liquid manure.

**BIONIT<sup>®</sup>-S is an additive which has been licensed under the regulations governing feeds and offers a wide range of effects; in addition to an improvement in the operating results of farms it also makes an important contribution to environmental protection.**

*... for greater vitality of livestock and a more healthy environment*