Biuret

Reliable NPN source for ruminants

For greater formulation flexibility in rations

Biuret was a hot topic of livestock research in the 1960s and 70s and almost 50 research articles have been published about biuret since in 1959. Biuret is a feed ingredient that offers many benefits over the use of traditional urea. Below is the history of the development of feed-grade biuret.

Benefits

Biuret attracts little water, even in humid conditions, which allows for ease of manufacturing, feed ingredient stability, and good product flowabilty.

Biuret is extremely safe. It has been fed at levels 20 times greater than the toxic dose of urea without causing death.

Biuret's unique chemistry makeup controls the release of ammonia which provides a large margin of safety and contributes to production in various unique conditions.

Biuret has virtually no handling restrictions, which allows for a predictable process that does not affect the extended ammonia-release characteristics.

History

1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010

1958 First patent for manufacture and use in animal feed (Dow Chemical).

1975 Dow Chemical launches first commercial manufacturing.

1976 Approved by the FDA for the use in feeds of non-lactating ruminants.

1982 First successful commercialization of feed-grade biuret by Moorman Manufacturing (now ADM).

2003 Approved by the FDA for use in feeds of lactating dairy cattle.

ADM makes buiret avilable for purchase as a stand-alone ingredient. **2010**

The Basics...

Figure 1

Urea Vs. Biuret — Urea gained 45% water vs. biuret that gained 9% water, after 48 hours in a humidity chamber.

Feed definition of feed-grade biuret.

Biuret is a non-protein nitrogen (NPN) source for ruminants that is defined by the Code of Federal Regulations in CFR 573.220 and in AAFCO as definition 66.2.

Composition and physical characteristics.

Biuret typically contains 253% crude protein (38.5% minimum nitrogen guarantee) with no more than 15% urea. Biuret is composed of small to medium granules and is white to gray in color (see Figure 1).

Biuret is chemically and physically different than urea.

(See Figure 2) Biuret is made by heat-polymerizing urea. Chemically, feed-grade biuret contains 58% biuret and a combined 27% of triuret in both straight and ring forms. In the rumen, these compounds solubilize and break down to ammonia very slowly. Although there is a small amount of urea in feed-grade biuret, it is tightly imbedded in the biuret crystals.

Biuret does not attract water.

It is not like urea, which is very hygroscopic and readily attracts water from air and the feed matrix. As such, special precautions must be taken in formulation and handling to limit the caking and flowability problems caused by urea in almost all classes of feed products. In contrast, biuret attracts little water, even in extremely humid conditions (see Figure 1). There are very few ruminant formulations or feed processing conditions under which biuret would be expected to cause problems with manufacturing, feed ingredient stability, or product flowability.

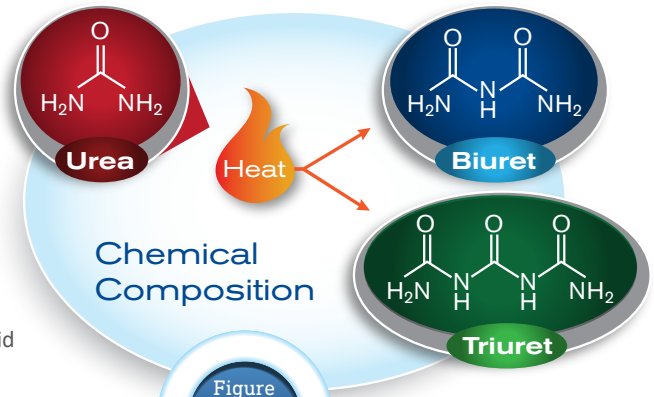


Figure 2

Biuret is extremely safe.

Urea must be used very carefully in ruminant applications, due to the risk of ammonia toxicity and death because of its extremely rapid conversion to ammonia (see Figure 3). In contrast, biuret has been fed at levels 20 times greater than the toxic dose of urea without causing death. Although biuret is classified and regulated as an NPN source, there are few practical upper limits for its use in dry or liquid feed applications.

Biuret's unique chemistry controls the release of ammonia.

Biuret is not urea and does not require special coatings to achieve controlled release of ammonia into the rumen. Unlike coated (encapsulated) ureas that are very fragile, biuret has virtually no handling restrictions. By its chemical nature, biuret dissolves slowly and is degraded by unique rumen enzymes to ammonia. The predictability of this process means that ration ingredients and other dietary conditions do not affect the ammonia-release characteristics of biuret. Biuret's ammonia-release pattern (see Figure 3) is close to that of vegetable proteins; however, biuret sustains ammonia release for many more hours than vegetable proteins or coated-ureas. This means biuret is still contributing to rumen ammonia even more than a day after its consumption.

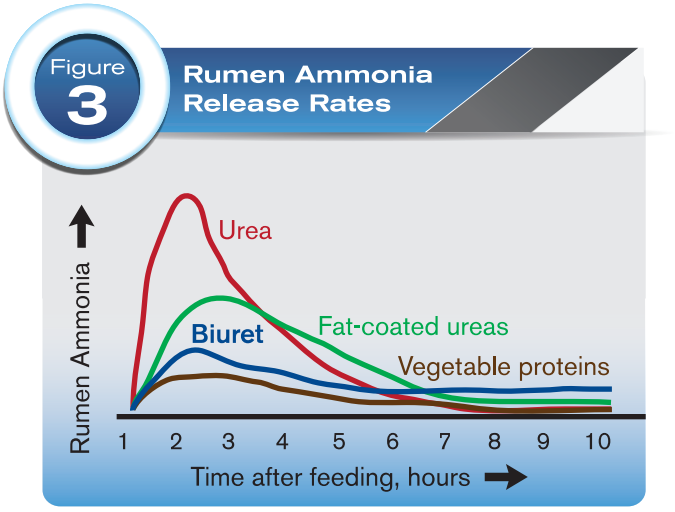
The unique chemistry means that biuret is still contributing to rumen ammonia even more than a day after its consumption.

Nutritional application of biuret

Biuret's primary value is its highly controlled conversion to ammonia in the rumen. This provides both a large margin of safety relative to ammonia toxicity and contributes to performance under conditions in which ammonia availability may limit forage intake or rumen function.

Cattle on range and lower-quality pasture:

Because ammonia is a critical nutrient for fiber-digesting bacteria, insufficient rumen ammonia dramatically limits fiber digestion which reduces both forage energy value and feed intake. Because of this, crude protein (nitrogen) is typically the most critical factor limiting the performance of cattle consuming either winter pastures or low-protein hays or roughages. Whereas urea or vegetable proteins provide adequate ammonia to the rumen for only a few hours (see Figure 3), biuret is capable of releasing ammonia into the rumen for greatly extended amounts of time. This is particularly important when cattle may consume free-choice or hand-fed protein supplements only once a day or even less frequently. Under these circumstances, extensive research shows that beef cows and stockers consuming biuret maintained body condition better than controls.



Feedlot cattle:

Although biuret is an effective NPN source for feedlot rations, it is not cost competitive with urea when directly included as an ingredient in blends of complete feedlot rations. However, for pre-blended or manufactured feedlot minerals, biuret may help reduce mineral handling problems when substituted for urea.

Dairy rations:

Biuret can be included in rations for lactating cows at 0.1 to 0.2 lb per head daily. Best results are attained if urea is also included, typically at a 1:1 ratio with biuret. The formulation strategy for using biuret will be similar to that when using fat-encapsulated, slow-release urea products. There is no scientific agreement on a "best" ammonia release pattern for these products and ration formulation programs generally cannot model the effects of slow-release NPN sources.

Sheep and goats:

Biuret is approved for sheep and goats. In general, sheep and goats fed biuret will perform similarly to cattle when on low-protein forage.

Formulation guidelines and recommendations

There are three primary reasons to use biuret in ruminant formulas:

1) as a highly safe alternative to urea

2) as a sustained or slow-release NPN source

3) as a non-hygroscopic NPN source.

Following are some guidelines and suggestions for using biuret across the most common ruminant ration and product applications. Table 1 provides a quick reference to these recommendations.

Free-choice beef minerals:

The hygroscopic nature of urea greatly reduces its usefulness for this application. Biuret inclusion in this application could reach up to 30% of the formula. Higher levels of biuret may become impractical for balancing mineral consumption relative to animal requirements.

Pelleted protein supplements:

Biuret can substitute for some urea in high protein pellets. This can help reduce some of the bridging problems caused by usage of high levels of urea. Biuret has no impact on the pelleting characteristics of typical protein supplements.

Range cubes:

Biuret can be used in cubes or cakes for its safety and ammonia-release characteristics. With up to 25% of the NPN as urea, range cubes with as much as 40% crude protein can be safely formulated using biuret.

Table 1
Suggested guidelines for including biuret in forms of manufactured ruminant feeds.

Forms of manufactured ruminant feeds	Upper limit in formula		Co-usage of urea with biuret (total NPN)[1]
	Urea	Biuret	
Free-choice beef minerals	—	30%	No urea
Pelleted protein supplements	2-3%	5%	up to ⅓ as urea
Range cubes	3-4%	8%	up to ¼ as urea
Mineral-protein lick blocks	5-8%	15%	up to ½ as urea
Tubs (cooked or pressed)	3-5%	10%	up to ⅓ as urea
Liquid feed	3-6%	10%	up to ¾ as urea
Vegetable protein replacers	1-2%	5%	up to ¼ as urea

[1] At the maximum level of formulated protein or level of ration inclusion.

Mineral-protein lick blocks:

Depending on target consumption (block hardness), biuret can be used at up to 15% of high-protein blocks. Biuret will have little impact on block hardness.

Tubs (cooked or pressed):

Considering target intake for most tub products, biuret inclusion will rarely need to exceed 10% of the formula. At the highest protein levels, urea can comprise up to one third of the NPN. However, during drought or any conditions where forage availability is limited, it is recommended that the urea level be reduced in these higher protein products due to the possible risk of over-consumption.

Liquid feeds:

Generally, biuret can be included in these applications only when very high protein levels are desired or with very extensive range conditions where production benefits compared with urea may be observed. Grinding of biuret will likely be necessary to optimize its suspension characteristics.

Vegetable protein replacers:

Up to 5% biuret can be used make “protein replacers” that are sold as low-cost alternatives to soybean meal. Because these products may be presumed to be equally as safe as soybean meal, it is recommended that no more than 1 to 2% additional urea be included with biuret in these formulations.

Biuret Guaranteed Analysis

Nitrogen, min. 38.5%

Equivalent crude protein from non-protein nitrogaen, min./max. 240.0-255.0%

Key References

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