



Smartamine® M

ADISSEO
A Bluestar Company

Smartamine® M

USERS' GUIDE

Building a Better Future
for Animal Nutrition



Smartamine M Users' Guide



Smartamine[®] M

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INTRODUCTION

Smartamine M is the most effective source of encapsulated methionine for ruminants.

This guide describes procedures and recommendations for using Smartamine M products in modern premix facilities and feed plants.

It is designed as a practical tool to help manufacturers everywhere produce top-quality Smartamine M-enriched feeds that will reach the feed bunk with 100% of their nutritional value.

The recommended techniques are based on accurate physical and chemical results, gathered from extensive tests carried out both within Adisseo experimental facilities and under a wide range of field conditions. These techniques provided state-of-the-art recommendations for the use of Smartamine M throughout the production process. Material safety data are also presented in this guide.

For further details on procedures, equipment and safety measures, please contact your local Adisseo representative or the Director of Ruminant Business.

IMPORTANT CONTACT INFORMATION

CareChem24 International (Emergency/HAZMAT Services):

See the [Material Safety Data Sheet \(MSDS\)](#) for your country





1/ PRODUCT SPECIFICATIONS

Each beadlet of Smartamine M contains a core of methionine, protected by a unique coating that was developed by Adisseo.

This innovative, patented technology guarantees that the methionine in Smartamine M is characterized *in vitro* by:

- Rumen protection ($\geq 90\%$).
- Abomasal release ($\geq 90\%$), before being absorbed in the small intestine.
- Highly concentrated ($\geq 75\%$ methionine).

**BIOAVAILABLE
WHERE
IT COUNTS**

Smartamine M Specifications

Smartamine M	
Description	<p>Smartamine M is the Adisseo rumen-stable abomasum-dispersible methionine product.</p> <p>It is produced using an unique patented process.</p> <p>Smartamine M contains a core of concentrated methionine, protected by a pH-sensitive coating.</p>
Composition	<p>DL-methionine, technically pure:</p> <ul style="list-style-type: none"> • CAS no. [59 - 51 - 8] • $\text{CH}_3\text{-S-(CH}_2\text{)}_2\text{-CH(NH}_2\text{)-COOH}$ <p>Patented pH-sensitive coating, containing a specific copolymer: poly (2-vinylpyridine-co-styrene)</p>



	Smartamine M
<p>Specifications</p> <ul style="list-style-type: none"> • Appearance • Colour • Particle size distribution <ul style="list-style-type: none"> - above 2.5 mm - below 1.4mm • DL-methionine content • Copolymer: poly (2-vinylpyridine-co-styrene) • Protection (in buffered solution, pH6, 40°C, 24 hours) • Release (in buffered solution, pH2, 40°C, 2 hours) • Shelf life 	<p>beadlets</p> <p>white to grey</p> <p>maximum 5 % maximum 5 %</p> <p>minimum 75 %</p> <p>maximum 3 %</p> <p>minimum 90 %</p> <p>minimum 90 %</p> <p>24 months when stored in original packing, in cool, dry place</p>
<p>As a guidance (*)</p> <ul style="list-style-type: none"> • Average beadlet size • Moisture content • Beadlet numbers 	<p>2 mm Ø</p> <p>approximately 0.5 %</p> <p>approximately 150/gram</p>
<p>Packaging</p>	<p>55 lb (25 kg) internally sealed bags (2,205 lbs [1,000 kg]/pallet)</p>

(*) Representative of products tested. Data may vary from one sample to another and should not be considered as a guaranteed feature of a particular batch or as a general product specification.





2/ RECOMMENDATIONS FOR QUALITY FEED MANUFACTURING

Smartamine M can be incorporated in a wide variety of feeds, but **cannot be pelleted**. The best results have been achieved when the following recommendations have been closely adhered to.



The effectiveness of Smartamine M is due to its unique coating, provided it remains intact in the rumen.

Therefore, feed manufacture must be carried out carefully, in order to maintain the coating's integrity while incorporating Smartamine M and manufacturing the feeds. This in turn will provide your customers with a quality product, meeting their expectations.

Smartamine M's coating can be damaged by physical impact, cutting, abrasion, pressure, heat (above 104°F/40°C), and prolonged exposure to wet air or humid raw materials. **In particular, Smartamine M does not withstand pelleting.**

In order to deliver the best possible feeds to your customers, we recommend that both the feeds and the processes used be developed with these considerations in mind.

The products described in this guide fall into the following two general categories:

- **Minerals or mineral mixes**

Products containing high levels of minerals, used mainly to provide most of the animals' daily requirements for calcium, phosphorus, magnesium, and for vitamins and trace-elements.

These are typically fed at a rate of 100 - 500 grams per animal per day.

- **Feeds and feed supplement products**

Products designed essentially to provide energy and/or protein with low mineral concentrations. They are generally composed of plant- or animal-origin feedstuffs such as soybean meal, corn, wheat, barley, etc., and their by-products (high protein or energy source, reinforced vitamin levels, additives, etc.) or specific carriers for Smartamine M.



Many pieces of equipment are common to both types of products (minerals and feeds). Many companies manufacture both types of products.

Therefore, this guide describes the equipment and processes used in most plants in a step-by-step fashion.

STEP-BY-STEP DOS AND DON'TS

Outlined below is a guide for successfully manufacturing feeds enriched with Smartamine M.

INCORPORATION

It is best to incorporate Smartamine M as close as possible to the mixer itself, for example directly above the mixer, as Smartamine M on its own can be damaged by abrasion or cutting due to machinery.

In particular, do not use pneumatic conveyors to transfer Smartamine M to a mixer. The coating on Smartamine M can be shattered when hitting corners particularly in a low-density, high-speed pneumatic conveyor.

MIXING

Smartamine M mixes quickly with most feeds, due to its size, shape and smoothness.

Some abrasion of Smartamine M can take place during mixing. We, therefore, recommend keeping the dwelling time of Smartamine M in mixers to a minimum.

Tests, both in Adisseo development facilities and in customer production plants, have shown **Smartamine M to be well mixed within 1 minute.**

Keeping dwelling time to a minimum can be achieved, for example, by incorporating Smartamine M after homogeneity of fine components (trace elements, vitamins...) has been reached (often 2-3 minutes or more) and then mixing for 30 seconds - 1 minute.



Flow bins

“Flow bins” or rotating containers such as those often used for premixes, have been shown to deliver high-quality feeds with excellent Smartamine M protection levels.

Flow Mixing

Flow mixing is generally a non-damaging process for Smartamine M, as mechanical interaction with the beads is minimized.

Outlined below is an example of the relatively simple and inexpensive flow-mixing installation, currently used with success in a number of plants.

This type of installation has been particularly useful for producing mineral mixes in plants with an aggressive process (e.g. high-speed mixers, long mixing times, blade molassors).

Flow bins do not damage the Smartamine M coating



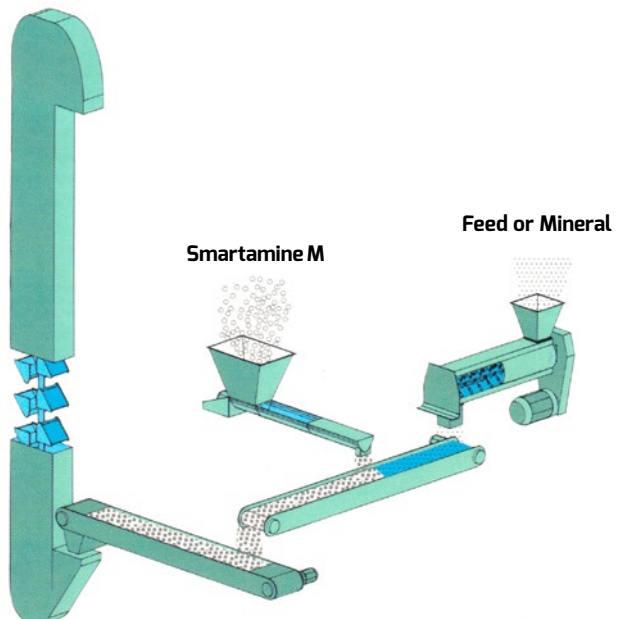
Premix containing 4% Smartamine M

Flow Mixing results in very minimal damage to the Smartamine M coating



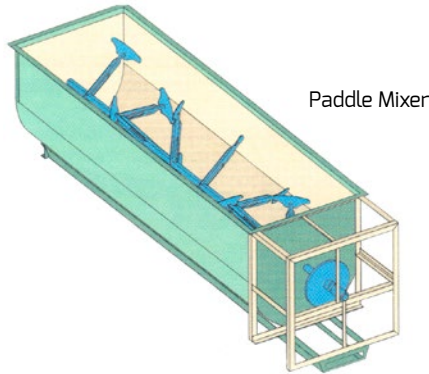
Premix containing 4% Smartamine M

Supplement



Paddle mixers and plough mixers

Paddle mixers and plough mixers are generally suitable for mixing Smartamine M with feeds (0% - 5% loss in protection). Best results are obtained when Smartamine M is introduced in the center of the mixer.

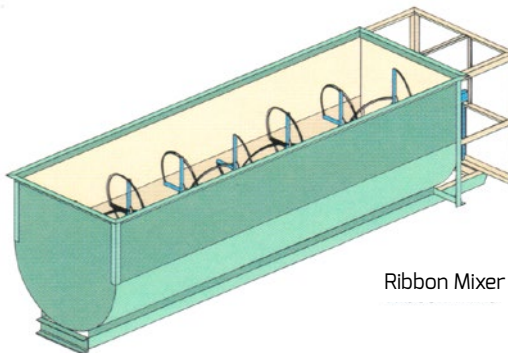


Ribbon mixers

Ribbon mixers have proven to be the most potentially damaging to Smartamine M, ranging from 0% to 30% loss in protection.

However, degradation in these cases has often been attributed more to surrounding equipment (lengthy incorporation circuit, baggers,...) than to the mixer itself.

Damage can occur from Smartamine M beads getting caught between a sharp ribbon and the sides of the mixer.



A recent study confirmed earlier studies on mixing and provided some additional information.

Smartamine M was added to three types of feed:

- A mineral feed, sometimes also called a base mix or a premix. It contained 7% P, 21% Ca, 5% Mg, trace elements and vitamins, for a recommended feeding rate of 150-250 g/cow/day.
- A compound feed in meal form made of barley, beet pulp, soybean meal, urea, molasses.
- A TMR, containing corn silage and a compound feed.

Smartamine M was mixed into these feeds in 3 different types of mixers (using industrial laboratory-sized mixers):

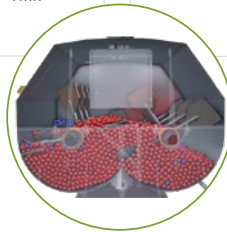
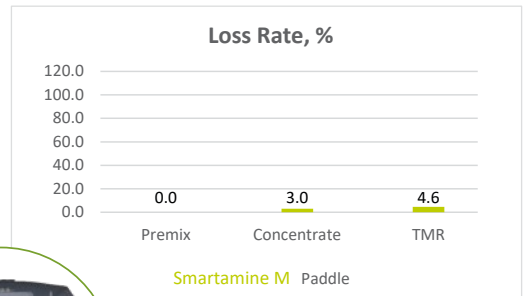
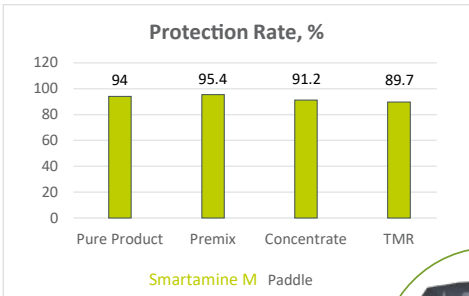
- A paddle mixer
- A plough mixer
- A ribbon mixer

An important point is that mixing was conducted at various speeds and for various lengths of time.

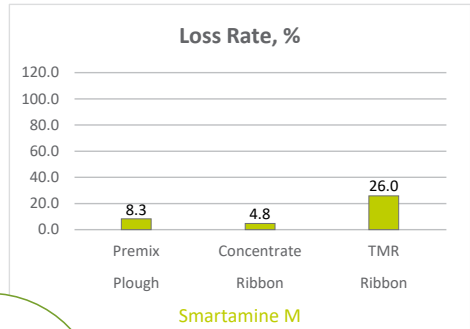
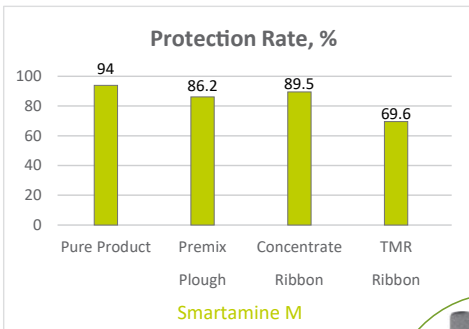
The main results were the following:

- Paddle mixer: Smartamine M protection was not affected by the paddle mixer for any of the feeds.
- Plough mixer and mineral feed: This mixer reduced Smartamine M's protection a little for the mineral feed, to 86%, due to abrasion and some shearing. It should be noted that the mixer was operated at 150 RPM, which is quite high for this type of mixer.
- Ribbon mixer and TMR: This mixer had no effect on Smartamine in the compound feed. It did, however, reduce Smartamine M protection to 70% in the TMR. It is worth pointing out that the ribbon mixer was operated at:
 - » High speed (70 RPM vs 7 RPM for the paddle mixer and vs 15-35 RPM for a typical on-farm mixing wagon),
 - » For a long time (10 minutes vs 3 minutes for the compound feed and 30 seconds for the mineral feed).
- The laboratory ribbon mixer does not fully represent practical on-farm TMR mixers, which typically have mixing augers and not ribbons, cover less of the forage and generally-speaking are gentler with the ingredients.

Forberg Mixer 'Paddle'



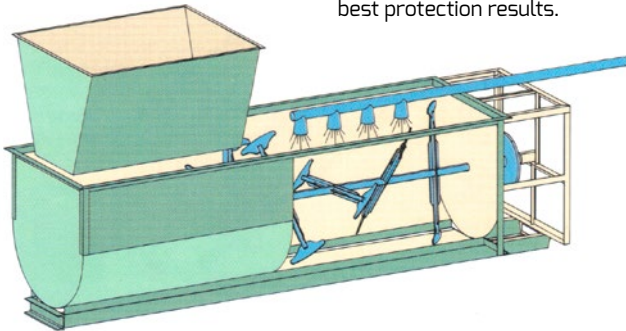
WAM Mixer 'Plough & Ribbon'



Molasses application

- Molasses in itself, incorporated in feeds, is not detrimental to Smartamine M.
- The best situation is when molasses sprayers are located directly in the mixer, as illustrated.

Spraying molasses in main mixer provides best protection results.



Molasses sprayers in mixers are less damaging to the Smartamine M coating than blade molassors



Premix containing 4% Smartamine M

- High-speed blade molasses incorporators should not be used, due to severe effect on Smartamine M protection.
- When using molasses sprayers in the mixer, we recommend the following procedure:
 - mix main ingredients and molasses until homogeneity of fine components (vitamins, trace elements ...) is reached.
 - then add Smartamine M and mix for required time (generally 1 minute)

PELLETING

Smartamine cannot be pelleted, as the pressure and abrasion incurred greatly degrade Smartamine M protection.



TRANSFERS

Bucket elevators and chain conveyors

These are generally not a major problem in manufacturing Smartamine M-enriched feeds (may induce a 0% - 5% loss in protection), once Smartamine M has been incorporated in a feed batch.

Pneumatic conveyors

These should not be used, particularly for pure Smartamine M transfers (e.g. at incorporation). Their use has been shown to crack Smartamine M coating, due to projection against bends in conveyor tubes.

Augers

These can damage Smartamine M, depending on type, length and feed composition, due to friction created within the auger or cutting between the screw and the inner side of the auger tube.

Wherever possible:

- use wide-diameter augers
- use augers with a screw diameter significantly smaller than the inner diameter of the auger tube
- do not use high speeds.

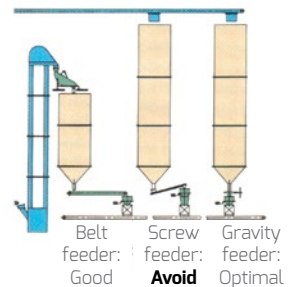
BAGGING

Gravity fillers and conveyors - belt baggers

These are generally not a problem and are currently used in a large number of plants with minimal breakage of Smartamine M coating.

Screw fillers

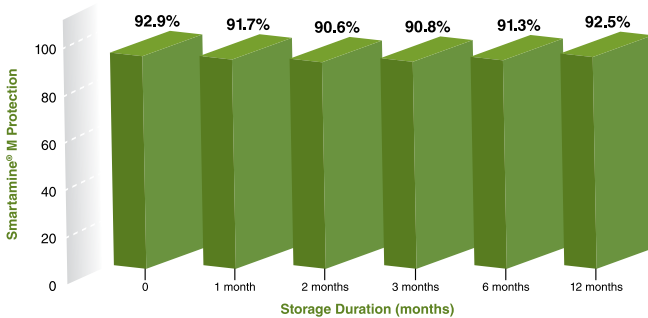
These baggers can inflict damage to Smartamine M (5% - 30% loss in protection) depending on size and speed of screws, and feed composition.



STABILITY DURING STORAGE AND USE

When incorporated into feeds, Smartamine M has been shown to be stable over long periods of time. This is advantageous for the storage and distribution of feeds enriched with Smartamine M. The following examples, typical to the industry, illustrate this.

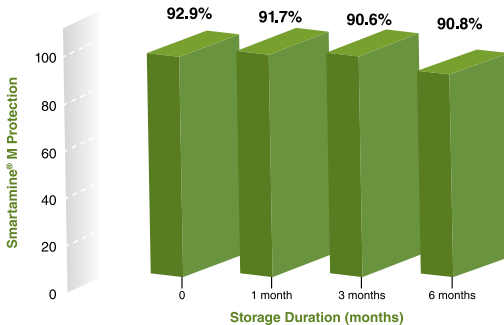
Smartamine M: Stable 12 months in industrially manufactured customer mineral mix



Minerals

- Mineral mix containing 4% Smartamine M (fed at 300g/cow/day);
- Manufactured using direct incorporation above mixer. Mixer was a paddle mixer. Molasses was sprayed in mixer.

Smartamine M: Stable up to 6 months in customer feed supplement



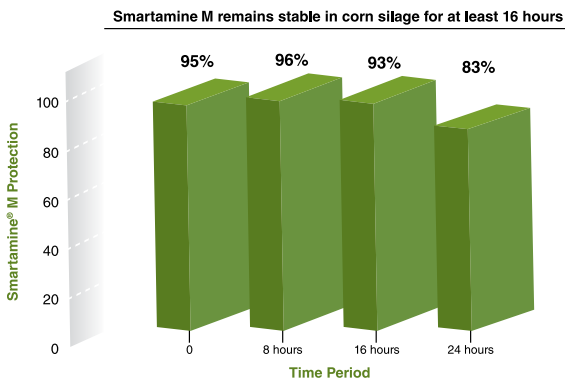
Feeds

Feed supplement was a crumble mix containing 1.5 % Smartamine M (fed at 1 kg/cow/day).

Silages

Minerals or feed supplements enriched with Smartamine M often are top dressed on silage or mixed in with the silage.

The following test showed Smartamine M to remain well protected in silage for up to 16 hours.



In practice, this means that Smartamine M fed with silage in the morning is good for consumption during the same day.

The protocol for this test was:

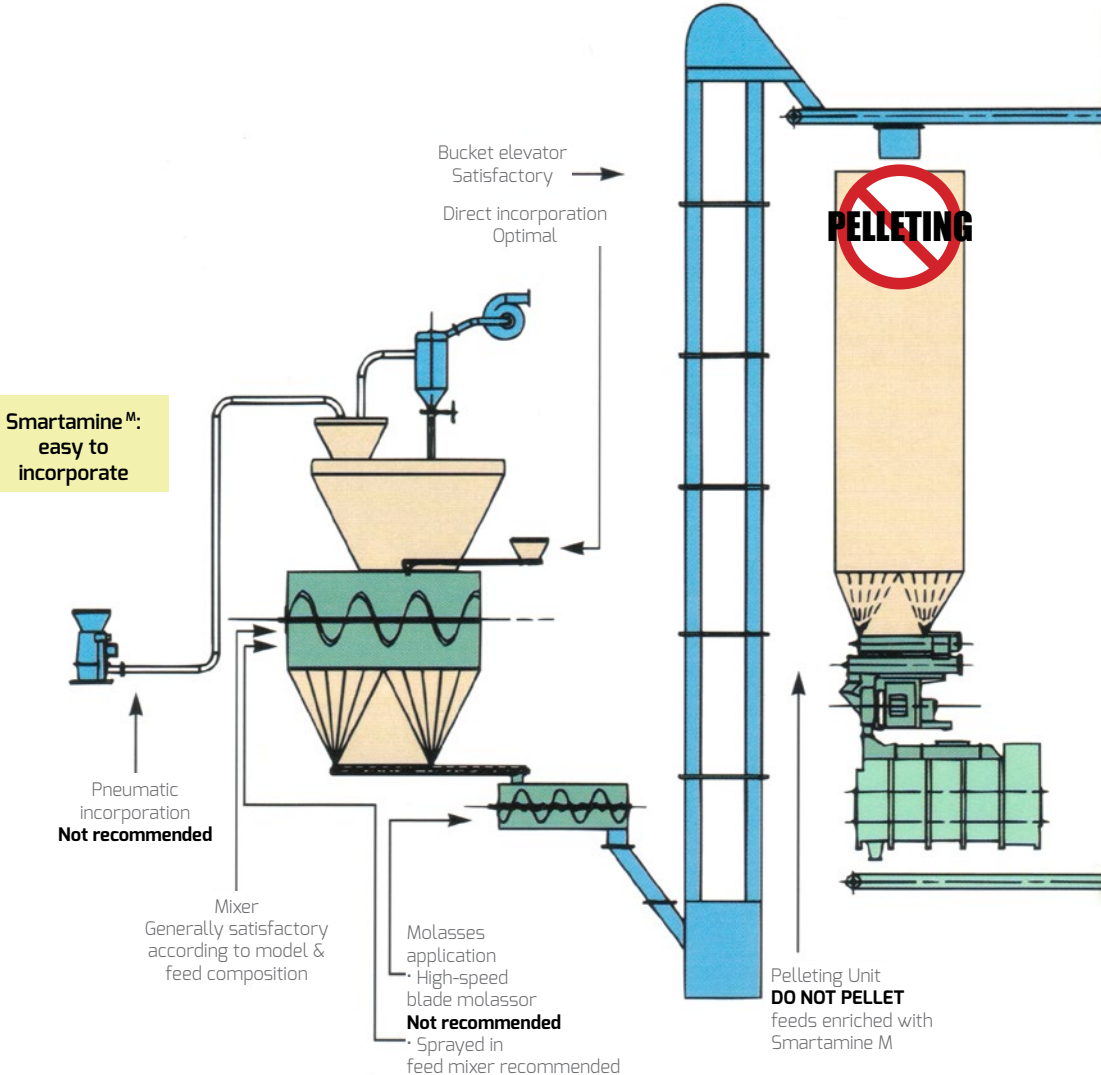
- 6g Smartamine M mixed with 100 g corn silage, placed in a polythene bag.
- Residual Smartamine M was measured at 0, 8, 16 and 24 hours after mixing.
- Corn silage used in this test has the following characteristics:
 - pH 3.8
 - dry matter content: 28 to 32 %

Note: The pH of a total mixed ration (TMR) will not be low enough to cause a concern regarding the Smartamine M coating.

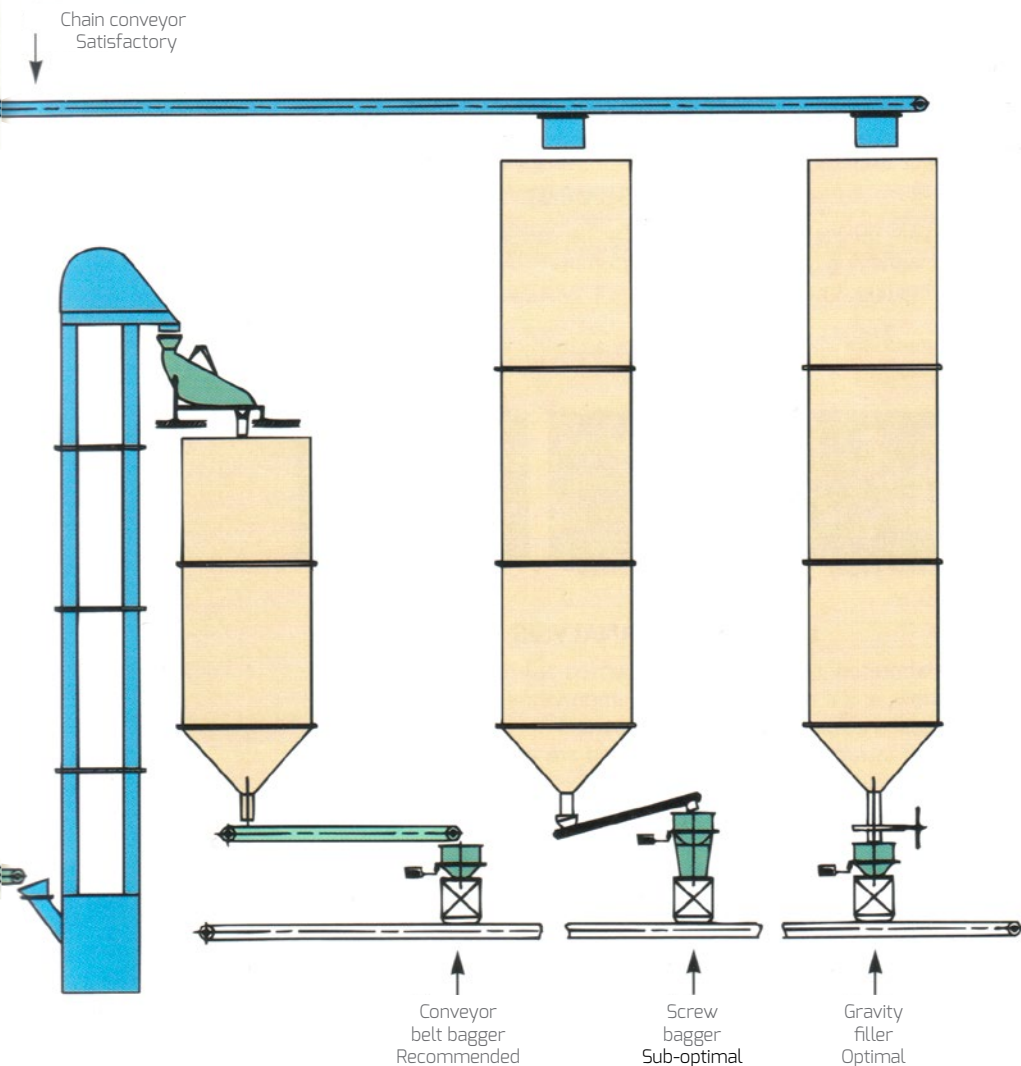


OVERVIEW OF TYPICAL MANUFACTURING EQUIPMENT

The process diagram below provides an overall view of a typical production line found in many feed plants. It identifies process stages which are harmless to Smartamine M and those which are damaging.



These stages have a standard recommendation. Means to maintain Smartamine M protection throughout the production process are described in the previous pages (“Dos and Don’ts” - Page 5).





3/ QUALITY ASSURANCE PROGRAM

Checking Smartamine M protection in your feed is important.

Smartamine M effectiveness for animal performance, and hence your customers' satisfaction, is dependent on how well the methionine stays protected. This is particularly important during the introduction period on your market.

We therefore strongly recommend:

- Developing your manufacturing process to make feeds enriched with Smartamine M well ahead of market introduction.
- Analyzing Smartamine M protection in the feeds:
 - during the development period and
 - regularly and systematically during full production period.

VISUAL ASSESSMENT

An immediate qualitative assessment can be carried out using a microscope or magnifying glass. If more than 10% Smartamine M beadlets show broken or damaged coating, the mixing process should be reviewed. If corrective action does not result in less than 10% visual damage, **MetaSmart®** is recommended to be used instead.



Intact Smartamine M beadlets





Damaged coating on Smartamine M beadlets



Cut/broken Smartamine M beadlets



LABORATORY ANALYSIS

Periodically, a laboratory control should be carried out to check product quality accurately and, if necessary, identify improvements needed. The analytical method is outlined as follows. More details including full analysis method are available upon request.

SAMPLE SIZES

Two samples are requested:

- A sample sent for analysis should be of 2.2 lbs (1 kg) for organic feeds and 1.1 lbs (500g) for mineral feeds. It should contain at least 2% of Smartamine M.
- A control sample of the same size of the same feed without Smartamine M, along with its label, is requested as well in order to identify and investigate any possible interference of the feed itself with the test.

CONTROL ASSAYS

***In vitro* rumen protection measurement**

Degree of protection is measured as the difference between the total methionine content of Smartamine M (assayed in Step 2) and the fraction of methionine released after 24 hours at pH 6, i.e. rumen simulation (assayed in Step 1).

- **Step 1:** A weighed representative subsample of the feed enriched with Smartamine M is poured into a glass vessel containing 1,000 ml of a pH 6 - buffered solution. Content assayed realized in duplicate stirred, under standardized conditions, during 24 hours (rumen simulation). At the end of this period, a test portion of the liquid in the vessel is taken and assayed for methionine content.
- **Step 2:** Acidity is lowered to pH1 in the vessel by introducing hydrochloric acid.

Smartamine^M:
safe to use



Stirring is continued for 2 hours, at pH 1, in order to release all the methionine contained in the Smartamine beadlets.

At the end of this period, a test portion of the liquid in the vessel is taken and assayed for methionine content.

***In vitro* abomasal release measurement**

Degree of release is measured as the ratio between the quantity of methionine released after 2 hours at pH 2, i.e. abomasum simulation (assayed in Step 3), and the total methionine content of Smartamine M (assayed in Step 4).

• **Step 3:** A weighed representative subsample of the feed enriched with Smartamine M is poured into a glass vessel containing 1,000 ml of a pH 2 - buffered solution.

Content assay realized in duplicate stirred, under standardized conditions, during 2 hours (abomasum simulation).

At the end of this period, a test portion of the liquid in the vessel is taken and assayed for methionine content.

• **Step 4:** idem Step 2.

Determinations of degree of release do not have to be carried out as often as determinations of degree of protection: release is generally not affected by feed manufacturing.

Determination of Smartamine M content in the feed

Smartamine M content is assessed as the ratio between the total methionine content resulting of the mean value of Steps 1 and 4 (or directly obtained by stirring a representative subsample at pH 1 during 2 hours) and the theoretical concentration of methionine in Smartamine M. Determination of methionine content can be assayed by the potentiometric method.

Smartamine^M:
easy to control





4/ MAIN SAFETY DATA

Hazard Identification:

Not classified as a “hazardous preparation.”

In use, may form flammable/explosive dust-air mixture.

By precaution, if material is pneumatically transferred a proven bonding and grounding system should be utilized.

Keep away from strong oxidizing agents.

PPE

Recommended:



First aid measures:

As a general rule, in case of doubt or if symptoms persist, always call a doctor.

- Exposure by inhalation: If inhaled, move the patient into the fresh air and keep warm and at rest.
- Contact with eyes: wash thoroughly with soft, clean water for 15 minutes holding the eyelids open.
- Contact with skin: wash skin thoroughly with soap and water or a recognized cleaner.
- Swallowing: do not force vomiting. Seek medical attention, showing the label.

Packaging:

Always keep in packaging made of an identical material to the original.

Firefighting measures:

Non-flammable.

In the event of a fire, immediate and rapid evacuation is necessary.

Extinguishing media:

Suitable:

- sprayed water or water mist
- foam
- powder
- carbon dioxide (CO₂)

Not Suitable:

- Water jet



Special hazards arising from the substance or mixture:

Combustion may release toxic gases (carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxide, nitrogen dioxide).

Due to the toxicity of the gas emitted on thermal decomposition of the products, firefighting personnel are to be equipped with autonomous insulating breathing apparatus.

Accidental release measures:

Retrieve the product by mechanical means (sweeping/vacuuming): do not generate dust.

Recycle or dispose of waste in compliance with current legislation, preferably via a certified collector or company.

Environmental protection:

Do not pour into drains and waterways.

Insoluble in water.

Partially biodegradable.

This preparation does not present any particular risk to the environment.

For further information, please refer to the **Material Safety Data Sheets** (MSDS).

European MSDS available in the website QuickFDS.

Please find in this link guidelines to consult them:

<https://plm.adisseo.com/share/s/81qZVtlwTQ54GtFL9Usm5w>

If needed:

CareChem 24: 24 hours international emergency (phone number available in MSDS).

CareChem 24 will provide rapid access to information about the hazards of Smartamine® M in addition to expert advice on appropriate response actions to protect your employees, the public and the environment.





5/ IMPORTANT CONTACT INFORMATION

CareChem24 International (Emergency/HAZMAT Services):

See the Material Safety Data Sheet (MSDS) for your country



NOTES:





Smartamine[®] M

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