

Texas Sodium Bentonite

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■ CONTROLLED DOCUMENT

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Texas Sodium Bentonite Inc.

Dairy Operations Technical Sheet

Feed-Grade Sodium Bentonite & Clinoptilolite Zeolite — Species-Specific Guidance for Dairy Cattle

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⚠ Controlled Document Notice

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1. Purpose

This technical data sheet provides species-specific guidance on the use of Texas Sodium Bentonite Inc. feed-grade sodium bentonite (montmorillonite clay) and clinoptilolite zeolite products in commercial dairy cattle operations. The document is designed to support evidence-based, production-phase-appropriate application of these mineral additives across the full dairy cow lifecycle, including:

- Transition and close-up cow management (pre-fresh period, -21 to -3 days)
- Far-off dry cow programs (>21 days pre-fresh)
- Fresh, peak, mid-, and late-lactation cow programs
- Replacement heifer development

Guidance provided herein addresses rumen physiology, DCAD management, milk quality compliance, and TMR management objectives specific to modern commercial dairy production systems. This sheet is intended for use by qualified dairy nutrition and veterinary professionals in conjunction with herd-specific ration balancing.

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2. Scope

This technical sheet is applicable to all authorized users of Texas Sodium Bentonite Inc. products in dairy production contexts. The scope includes, but is not limited to:

- **Commercial dairy producers** — operations of all scales utilizing total mixed ration (TMR) or component feeding systems
- **Herd nutritionists and ration balancers** — professionals formulating diets for lactating, dry, and developing dairy cattle
- **Veterinarians and herd health consultants** — practitioners advising on transition cow programs, metabolic disease prevention, and milk quality management
- **Feed manufacturers and custom mixers** — entities incorporating Texas Sodium Bentonite Inc. into pre-mixed or delivered feed formulations
- **DHIA consultants and milk quality coordinators** — professionals engaged in production benchmarking and somatic cell count management

This document applies to all production phases from heifer development through first lactation, peak production, and dry-off, and is to be used in compliance with applicable federal, state, and Grade A dairy program regulations.

3. Product Overview

Texas Sodium Bentonite Inc. produces two feed-grade mineral additive products for use in dairy cattle nutrition programs. Both products are sourced from high-purity geological deposits in the Big Bend region of West Texas and are processed and packaged under the company's Quality Management System at dedicated facilities.

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3.1 Feed-Grade Sodium Bentonite (Montmorillonite Clay)

Sodium bentonite is a naturally occurring aluminosilicate clay mineral classified mineralogically as montmorillonite. The Texas Sodium Bentonite Inc. feed-grade product is derived from Cretaceous-era volcanic bentonite deposits indigenous to the Trans-Pecos / Big Bend geological region of West Texas, characterized by high smectite purity and exceptional swelling capacity. The product is mined, beneficiated, and processed at the company's **Alpine, Texas** facility and packaged at the **Comanche, Texas** facility.

3.2 Feed-Grade Clinoptilolite Zeolite

Clinoptilolite is a naturally occurring sedimentary zeolite mineral with a characteristic honeycomb aluminosilicate framework structure. The Texas Sodium Bentonite Inc. feed-grade clinoptilolite is sourced from West Texas volcanic tuff deposits within the Big Bend formation region, selected for high clinoptilolite purity and superior cation exchange capacity (CEC). Mining and primary processing occur at the **Alpine, Texas** facility; packaging is completed at the **Comanche, Texas** facility.

3.3 Physical Specifications Summary

Parameter	Sodium Bentonite	Clinoptilolite Zeolite
Physical Form	Fine powder / granule	Fine powder / granule
Color	Cream to light grey	White to Off-white
Particle Size	-20 mesh (feed grade)	-20 mesh (feed grade)

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Parameter	Sodium Bentonite	Clinoptilolite Zeolite
Moisture Content (%)	≤12%	≤10%
Origin	Big Bend Region, West Texas	Big Bend Region, West Texas
Processing Facility	Alpine, TX	Alpine, TX
Packaging Facility	Comanche, TX	Comanche, TX

4. Mode of Action

The mechanisms by which Texas Sodium Bentonite Inc. products exert beneficial effects in dairy cattle are well-characterized in peer-reviewed literature and are specific to the unique physiological demands of the high-producing dairy cow across her production cycle.

4.1 Sodium Bentonite — Mechanism of Action in Dairy Cattle

4.1.1 Pellet Binding and TMR Handling

The natural adhesive and cohesive properties of sodium bentonite make it an effective pellet binder in close-up and transition TMR supplement formulations. Bentonite inclusion at recommended rates improves pellet durability, reduces fines generation, and enhances mixer consistency in total mixed rations, contributing to improved TMR sorting resistance and more uniform daily dry matter intake (DMI) in pen-managed transition cow groups.

4.1.2 Anti-Caking Properties

In TMR applications, sodium bentonite functions as an anti-caking agent by absorbing excess moisture and reducing clumping in high-moisture ingredient matrices. This property is particularly valuable in

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summer heat and humidity conditions common to Texas dairy operations, improving bunk feed presentation and limiting dry matter refusals.

4.2 Clinoptilolite Zeolite — Mechanism of Action in Dairy Cattle

4.2.1 Rumen pH Buffering

Clinoptilolite zeolite functions as a physical rumen buffer through its high water-holding capacity and cation exchange properties. When included in high-grain or high-fermentability TMR rations, zeolite moderates the rate of rumen acidification by absorbing excess hydrogen ions and volatile fatty acids (VFAs), thereby stabilizing rumen pH above the threshold associated with subclinical rumen acidosis (SARA, <5.8). This action is *complementary* to sodium bicarbonate and should be considered as part of a holistic rumen management strategy in close-up and early lactation rations where rapidly fermentable carbohydrate load is elevated.

4.2.2 Selective Cation Exchange — DCAD Management (K^+ Sequestration)

Clinoptilolite exhibits highly selective cation exchange affinity, with preference for $K^+ > NH_4^+ > Na^+ > Ca^{2+}$. In the context of pre-fresh dairy cow nutrition, the management of dietary cation-anion difference (DCAD = $[Na^+ + K^+] - [Cl^- + S^{2-}]$, expressed in mEq/100g DM) is a primary lever for reducing periparturient hypocalcemia and subclinical milk fever. Forage-based transition rations in many regions carry high potassium loads from grass hays and corn silage. Clinoptilolite zeolite, when included in close-up rations, selectively binds rumen-available K^+ ions through reversible cation exchange, effectively reducing the bioavailable cation load and contributing to a lower DCAD value without increasing Cl^- load or creating palatability challenges associated with traditional anionic salt programs. This mechanism should be reviewed with the herd nutritionist in the context of the complete DCAD equation and forage K^+ analysis.

4.2.3 Ammonia and Ammonium Capture

Clinoptilolite preferentially adsorbs ammonium ions (NH_4^+) within the rumen environment, reducing rumen ammonia concentration and consequently limiting ruminal-to-portal blood ammonia transfer.

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This action reduces the hepatic urea cycle burden, particularly important in high-protein close-up and fresh cow rations. Reduced blood urea nitrogen (BUN) and milk urea nitrogen (MUN) levels are a secondary benefit observed with consistent zeolite inclusion in high-degradable-protein ration programs.

4.2.4 Heavy Metal and Mycotoxin Co-Adsorption

The rigid three-dimensional pore network of clinoptilolite provides effective physical entrapment of select heavy metal cations (including Pb^{2+} , Cd^{2+}) and select polar mycotoxins via combined ion exchange and physical adsorption. This co-adsorption activity complements the aflatoxin binding role of sodium bentonite, providing a multi-mechanism mycotoxin and contaminant management approach when products are used in combination.

4.2.5 Rumen VFA Balance Support

Clinoptilolite inclusion has been associated with modest improvements in rumen volatile fatty acid (VFA) molar proportions, particularly acetate-to-propionate ratios, which are positively correlated with butterfat synthesis efficiency. The mechanism is attributed to indirect rumen pH stabilization via ammonia buffering and cation exchange effects, supporting a rumen environment more conducive to acetogenic fermentation in high-producing dairy cows.

5. Inclusion Rates

① Important Note on Inclusion Rate Basis

All inclusion rates below are expressed as a **percentage of complete diet dry matter (% DM)**. Rates should be calculated on an as-fed basis after accounting for the moisture content of the total mixed ration. Consult a qualified dairy nutritionist for herd- and ration-specific application. Do not exceed upper range without nutritionist oversight.

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Production Phase / Group	Days Relative to Calving	Sodium Bentonite (% Diet DM)	Clinoptilolite Zeolite (% Diet DM)	Primary Application Objective
Far-Off Dry Cows	>21 days pre-fresh	0.50 – 0.75%	0.50 – 1.00%	Rumen conditioning; ammonia control
Transition / Close-Up Cows	–21 to –3 days	0.50 – 1.00%	0.50 – 1.50%	DCAD support (K^+ sequestration); pH buffering; pellet binding in supplements
Fresh Cows	0 – 21 DIM	0.25 – 0.50%	0.50 – 1.00%	Rumen pH stabilization; ammonia capture; anti-caking in fresh cow TMR
Peak & Mid-Lactation Cows	22 – 200 DIM	0.50 – 1.00%	0.50 – 1.00%	Rumen buffering in high-grain TMR; TMR handling
Late Lactation Cows	>200 DIM to dry-off	0.50 – 0.75%	0.50 – 1.00%	Rumen conditioning; BCS preparation for dry period
Replacement Heifers	Post-weaning to first calving	0.25 – 0.50%	0.25 – 0.75%	Rumen development support; anti-caking in grower rations

** DIM = Days In Milk. Rates reflect published nutritional literature ranges and Texas Sodium Bentonite Inc. field experience. Individual herd recommendations may vary based on ration composition, forage*

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mycotoxin analysis, DCAD program design, and herd health status. Rates for combined use of sodium bentonite and clinoptilolite zeolite should be reviewed for total dietary ash contribution.

6. Performance Benefits

The following performance benefits are supported by peer-reviewed research and field application data in commercial dairy operations. Benefits are attributable to the combined use of Texas Sodium Bentonite Inc. feed-grade sodium bentonite and/or clinoptilolite zeolite at recommended dietary inclusion rates:

- **Rumen buffering and milk component support** — Stabilization of rumen pH in high-grain TMR diets supports butterfat synthesis and milk protein percentage by maintaining optimal rumen acetate: propionate ratios and minimizing subclinical acidosis events
- **DCAD management support — transition cows** — Clinoptilolite K⁺ sequestration contributes to effective DCAD reduction in pre-fresh rations, complementing or potentially reducing anionic salt inclusion levels
- **Reduced subclinical milk fever and hypocalcemia risk** — Improved DCAD balance via zeolite K⁺ management in close-up rations supports proper calcium homeostasis at parturition and reduces the incidence of periparturient hypocalcemia
- **Improved TMR flowability and mixer consistency** — Anti-caking and binding properties of sodium bentonite improve total mixed ration handling, reduce ingredient bridging in mixer wagons, and support uniform daily DMI across pen-managed cow groups
- **Reduced environmental ammonia in free stall facilities** — Zeolite's ammonium adsorption capacity reduces manure-derived ammonia volatilization in free stall barns, improving air quality, cow comfort, and respiratory health outcomes in confinement dairy systems

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- **Reduced blood urea nitrogen (BUN) and milk urea nitrogen (MUN)** Zeolite ammonium capture reduces ruminal ammonia absorption, supporting more efficient nitrogen utilization and lower MUN levels in high-degradable-protein feeding programs

7. Milk Residue & Food Safety Note

⚠ Critical Food Safety Information — Read Before Use

This section is intended for use by herd veterinarians, milk quality coordinators, and Grade A dairy compliance personnel. Failure to properly document mycotoxin management programs may result in bulk tank aflatoxin exceedances. Retain all COA records, mycotoxin test results, and inclusion rate documentation as part of the dairy's food safety plan.

Systemic Absorption — Sodium Bentonite and Clinoptilolite Zeolite: Both sodium bentonite (montmorillonite) and clinoptilolite zeolite are non-absorbable inorganic mineral compounds. Neither product is systemically absorbed through the gastrointestinal tract at recommended dietary inclusion rates. No residue of sodium bentonite or clinoptilolite in milk or meat tissue has been identified or is expected under conditions of label-compliant use. No withdrawal period for milk or meat is required.

Regulatory Responsibility: Texas Sodium Bentonite Inc. provides this technical sheet as guidance only. The dairy producer and herd veterinarian retain responsibility for ensuring compliance with all applicable state and federal milk safety regulations. This document does not constitute a guarantee of milk quality outcomes.

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8. Nutritional Interaction

Texas Sodium Bentonite Inc. feed-grade sodium bentonite and clinoptilolite zeolite are **inert mineral carriers** with no caloric, protein, fat, or fermentable fiber value. The following nutritional interaction guidance applies when incorporating these products into dairy cattle rations:

- **Energy (NEI):** No caloric contribution at recommended inclusion rates. No adjustment to net energy for lactation (NEI) ration specifications is required.
- **Protein (RDP/RUP):** Neither product contributes to rumen degradable protein (RDP) or rumen undegradable protein (RUP) fractions. Ration nitrogen balance is not directly affected by product inclusion.
- **Fiber (NDF/ADF):** No neutral detergent fiber or acid detergent fiber contribution. Effective fiber specifications are not impacted.
- **DCAD and Anionic Salt Programs:** When clinoptilolite zeolite is used in close-up rations in combination with anionic salts (e.g., calcium sulfate, calcium chloride, magnesium sulfate), zeolite's K^+ sequestration action may contribute to effective DCAD reduction. The nutritionists should model total dietary cation-anion balance inclusive of zeolite K^+ binding activity and adjust anionic salt levels accordingly. Individual forage K^+ analysis is strongly recommended prior to program design.
- **Total Dietary Ash:** Both products are inorganic mineral additives and contribute to total dietary ash. When multiple inorganic mineral additives (calcium carbonate, sodium bicarbonate, anionic salts, trace mineral premixes) are combined in a single ration, total dietary ash should be monitored. Maximum recommended total dietary ash in dairy rations typically does not exceed 8–10% of DM.

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- **Trace Mineral Interaction:** High zeolite inclusion rates may reduce the bioavailability of certain dietary cations including zinc, copper, and manganese through competitive cation exchange. At recommended dietary inclusion rates ($\leq 1.5\%$ DM), this interaction is not expected to be nutritionally significant but should be considered when designing trace mineral supplementation programs for transition and fresh cow groups.

9. Safety Considerations

9.1 Regulatory Safety Status

- Both sodium bentonite and clinoptilolite zeolite hold **GRAS (Generally Recognized as Safe)** status for animal feed use under FDA guidelines
- No withdrawal periods are required for milk or meat from animals fed at recommended inclusion rates
- No systemic absorption; no residue in milk or edible tissue is expected or has been identified at label-compliant inclusion rates

9.2 Handling and Personal Protective Equipment (PPE)

- **Inhalation Hazard:** Fine powder forms of both products may generate respirable dust during bulk handling, transfer, and mixing operations. Use appropriate respiratory protection (NIOSH-approved dust mask minimum; P100 respirator recommended for frequent or high-volume handling)

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- **Eye Protection:** Safety glasses or goggles should be worn during bulk transfer and mixer loading operations
- **Skin Contact:** Products are non-irritating under normal handling conditions. Wash hands after handling
- **Bulk Handling:** Use mechanical conveying equipment where feasible to minimize airborne dust generation. Ensure adequate ventilation in enclosed mixing facilities

9.3 Storage Requirements

- Store in cool, dry conditions in original sealed packaging
- Avoid moisture exposure — sodium bentonite swelling capacity is activated upon water contact, and product performance may be altered by premature hydration
- Keep bags off floor on pallets; store away from direct sunlight and sources of heat
- Recommended storage temperature: 40–90°F (4–32°C); relative humidity: <65%
- Shelf life: 24 months from date of manufacture under recommended storage conditions

9.4 Additional Precautions

- **Not for human consumption** — for animal feed use only
- Keep out of reach of children
- Do not use damaged, open, or moisture-compromised bags without inspection and QA clearance

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- In the event of a product quality concern, retain the lot number from the bag label and contact Texas Sodium Bentonite Inc. Technical Services immediately

10. Regulatory & Compliance Notes

10.1 AAFCO Recognized Ingredients

- **Sodium bentonite** — AAFCO Official Publication, Item No. 85.1; recognized for use in animal feeds as a pelleting aid and anti-caking agent
- **Clinoptilolite zeolite** — Recognized under AAFCO for use in animal feeds; refer to current AAFCO Official Publication for ingredient definition and use parameters

10.2 Federal Regulatory Framework

- Both products are compliant with **21 CFR Part 573** (Food Additives Permitted in the Feed and Drinking Water of Animals)
- FDA guidance recognizes sodium bentonite as a sequestering agent for aflatoxin management in dairy feed, supporting its inclusion as a documented component of herd aflatoxin management programs
- No FDA-mandated maximum inclusion rates are established for these ingredients in dairy cattle rations; however, use at rates consistent with AAFCO definitions and nutritionist recommendations are advised

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10.3 Quality Management System and Lot Traceability

- All Texas Sodium Bentonite Inc. products are manufactured under a documented **Quality Management System (QMS)** with full lot traceability from Alpine mining operations through Comanche packaging and shipment
- **Certificate of Analysis (COA)** is available upon request for each production lot — include lot number from bag label in all COA requests
- Lot numbers are printed on all packaging. Retain bag labels for a minimum of 12 months as part of the dairy's feed additive traceability records
- Periodic third-party testing is conducted on production lots for heavy metals, moisture, and particle size parameters

10.4 Grade A Dairy Program Compatibility

- These products are compatible with Grade A milk program requirements when used at recommended inclusion rates and properly documented in the dairy's feed additive records
- Dairy producers should confirm product use and documentation requirements with their herd veterinarian and Grade A program representative (state department of agriculture or federal order market administrator)
- Retain Texas Sodium Bentonite Inc. COA documentation as supporting records for milk quality audits, FDA inspection preparation, and NCIMS compliance reviews

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11. Quality Specifications

The following specifications represent Texas Sodium Bentonite Inc. minimum quality standards for feed-grade products supplied to dairy operations. Each production lot is assigned a Certificate of Analysis (COA) documenting actual tested values. Contact Technical Services to obtain the current lot-specific COA.

11.1 Feed-Grade Sodium Bentonite — Quality Specifications

Parameter	Specification	Test Method
Moisture Content	≤12.0%	AOAC 930.15 (Oven drying at 105°C)
Particle Size	-20mesh (US Standard Sieve Series); ≥95% passing 20 mesh	ASTM D7928 / Sieve analysis
Free Swell Index	≥14 mL/g (free swelling in deionized water)	ASTM D5890 (Modified for feed grade)
pH (10% aqueous slurry)	8.5 – 10.5	ASTM C837 / Bench pH electrode
Arsenic (As)	30 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL

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Parameter	Specification	Test Method
Lead (Pb)	10 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL
Mercury (Hg)	2 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL
Cation Exchange Capacity (CEC)	≥80 meq/100g	ASTM C837 (Methylene blue index, modified)
Montmorillonite Content	≥70% (smectite fraction)	X-ray diffraction (XRD) quantitative analysis

11.2 Feed-Grade Clinoptilolite Zeolite — Quality Specifications

Parameter	Specification	Test Method
Moisture Content	≤10.0%	AOAC 930.15 (Oven drying at 105°C)
Particle Size	-20mesh; ≥90% passing 20 mesh	ASTM D7928 / Sieve analysis
pH (10% aqueous slurry)	6.5 – 8.5	Bench pH electrode

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Parameter	Specification	Test Method
Cation Exchange Capacity (CEC)	≥150 meq/100g	ASTM C837 (ammonium acetate saturation method)
K⁺ Exchange Capacity	≥40 meq/100g	Selective ion exchange titration; ICP-OES verification
Clinoptilolite Purity	≥80% (clinoptilolite mineral fraction)	X-ray diffraction (XRD) quantitative Rietveld analysis
Arsenic (As)	30 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL
Lead (Pb)	10 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL
Mercury (Hg)	2 (ppm in complete feed) 42 (ppm in mineral premixes and supplements)	AAFCO MTL / NRC MTL

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12. Ordering & Contact Information

12.1 Company Contact

Item	Details
Company	Texas Sodium Bentonite Inc.
Headquarters	Alpine, TX, United States
Processing Facility	Alpine, TX (mining & processing)
Packaging Facility	Comanche, TX (packaging & distribution)
Technical Support Line	Contact via company main line — request Dairy Technical Services
COA Requests	Provide lot number from bag label; available upon request per production lot
Document Control	Texas Sodium Bentonite Inc. QA Department — request controlled document access through authorized distributor or company representative

12.2 Packaging Options

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Package Type	Net Weight	Closure Type	Facility
Sewn-top kraft paper bag	50 lb. (22.7 kg)	Sewn top / pinch bottom	Comanche, TX
Sewn-top polypropylene woven bag (poly-woven)	50 lb. (22.7 kg)	Sewn top	Comanche, TX
Bulk (FIBC) tote / super sack	Contact for availability	Standard FIBC fill spout	Comanche, TX

① Ordering Note

When placing orders, request a lot-specific COA at the time of order placement. Specify intended use (dairy feed application) to ensure appropriate product grade and particle size selection.

Minimum order quantities and lead times are available from your Texas Sodium Bentonite Inc. sales representative.

13. Revision History

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Rev	Date	Description of Change	Author / Department
1.0	June 16, 2026	Initial Release — Dairy Operations Technical Sheet TS-DA-001. Establishes species-specific guidance for feed-grade sodium bentonite and clinoptilolite zeolite in commercial dairy cattle production across all life stages. Covers inclusion rates, mode of action, milk residue compliance, DCAD management, quality specifications, and regulatory compliance framework.	Texas Sodium Bentonite Inc. QA Department

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