Professional Operation Guidelines for Calcium Carbonate Addition Methods in Application Fields

Preface

This operation guideline is compiled in accordance with **GB 1898-2007 National Food Safety Standard - Food Additive Calcium Carbonate**, **GB 14880-2012 National Food Safety Standard - Standard for the Use of Nutrient Fortifiers in Food**, GB 15193 Series of Food Toxicological Evaluation Standards, FDA GRAS, EFSA, JECFA (62nd Session Specification) and Codex authoritative standards.

Based on the physicochemical properties, toxicological safety data and regulatory permitted scope of **Food Grade/Medical Grade/Industrial Grade Calcium Carbonate (CAS: 471-34-1, Molecular Formula: $CaCO_3$, Labeled Calcium Content: 39.0% ~ 40.0%)**, this guideline uniformly standardizes the full-chain operation requirements including raw material access, warehousing control, general operation procedures, standardized addition processes by field, premixing ratio, timing control point, pH/temperature tolerance range, compatibility synergy and contraindications, in-process quality control, abnormality disposal and compliance traceability.

It is applicable to all post implementation of R&D, production process, workshop operation, quality control and system internal audit in eight application scenarios: food processing, pharmaceutical preparation, feed breeding, building materials, rubber and plastics, coatings and inks, papermaking and daily chemicals, featuring professionalism, implementability, regulatory traceability, data accuracy and process uniqueness.

Part 1 Basic Specifications and Raw Material Access Control

1.1 Scope of Application and Compilation Basis

1.1.1 Scope of Application

This guideline clarifies the full-process operation standards of **Food Grade/Medical Grade/Industrial Grade Calcium Carbonate** from raw material acceptance, warehousing storage, metering conversion, premixing dilution, addition process timing, system adaptation, compatibility combination, in-process detection, finished product release to abnormality correction. It covers all compliant application scenarios such as food dry/wet production line, pharmaceutical preparation production line, feed pelleting production line, building materials mixing production line, rubber and plastics mixing production line, coating grinding production line, papermaking and paper-making production line, daily chemical product production line, providing unified and implementable execution basis for post operations.

1.1.2 Authoritative Compilation Basis

- **National Standards**: GB 1898-2007 *National Food Safety Standard - Food Additive Calcium Carbonate*, GB 14880-2012 *National Food Safety Standard - Standard for the Use of Nutrient Fortifiers in Food*, GB 2760-2024 *National Food Safety Standard - Standard for the Use of Food Additives*, GB 15193 Series of Food Toxicological Evaluation Standards, GB/T 19281-2014 *Calcium Carbonate (Industrial Grade)*, Feed Additives Part 3: Mineral Elements and Their Complexes (Chelates) - Calcium Carbonate.
- **International Standards**: FDA GRAS (Generally Recognized As Safe for Food Additives), EFSA Food Additive Safety Assessment Report, JECFA (62nd Session) Calcium Carbonate Specification Standard, Codex General Guidelines for Nutrient Fortifiers, ASTM D726-06 *Standard Specification for Calcium Carbonate*.
- **Internal Control**: General SOP for Mineral Element Production, Powder Uniformity Detection Specification, Liquid Feeding Operation Procedure, Calcium Carbonate Premixing Operation Specification, Industrial Grade Calcium Carbonate Application Process Control Standard.

1.2 Core Physicochemical and Process Tolerance Benchmark Parameters of Calcium Carbonate

1.2.1 Appearance

Standard index: **white powder**, no caking, no visible impurities to naked eyes and no peculiar odor; Process tolerance boundary: no discoloration and no moisture agglomeration when stored at room temperature away from light. It is easy to absorb moisture after opening and shall be sealed immediately to prevent moisture agglomeration from affecting subsequent use, and avoid contact with acidic substances to prevent decomposition and deterioration.

1.2.2 Calcium Content

Standard index: **39.0% ~ 40.0%**, the unified engineering simplified calculation benchmark value of the industry is 39.5%; Process tolerance boundary: the range difference of calcium content between batches ≤ ±0.3%. Among them, the calcium content of **Medical Grade Calcium Carbonate ≥ 39.5%**, and **Industrial Grade Calcium Carbonate ≥ 39.0%**, ensuring the effectiveness and stability of products of different grades.

1.2.3 Moisture

Standard indexes are graded: **Industrial Grade ≤ 0.5%, Food Grade ≤ 0.3%, Medical Grade ≤ 0.2%**; Process tolerance boundary: critical environmental humidity for moisture absorption ≤ 65% RH. When the environmental humidity exceeds this value, raw materials are prone to moisture caking, resulting in decreased fluidity and poor mixing uniformity, and industrial grade products may also affect the subsequent forming process.

1.2.4 pH Value of 10g/L Aqueous Solution

Standard index: **9.0 ~ 10.0**, weakly alkaline; Process tolerance boundary: stable pH range 8.5 ~ 10.5. When the system pH < 6.0 (weak acid environment), calcium carbonate is easy to decompose to produce carbon dioxide, causing system foaming and calcium ion precipitation; when pH > 11.0 (strong alkali environment), it is easy to combine with other ions to form precipitation and affect product quality.

1.2.5 Temperature Resistance Characteristics

Standard index: short-term temperature resistance up to **800℃**, it will decompose into calcium oxide and carbon dioxide when continuously exposed to environment above 850℃ for a long time; Process tolerance boundary: high-temperature processes such as food baking and spray drying shall strictly control the instantaneous temperature ≤ 200℃; feed pelleting process temperature ≤ 90℃; industrial high-temperature forming processes (such as ceramics and glass) shall be controlled within 800℃ to prevent component loss or performance degradation caused by high-temperature decomposition.

1.2.6 Solubility

Standard index: almost insoluble in cold water and hot water, easily soluble in acidic solutions such as dilute hydrochloric acid, dilute nitric acid and acetic acid, insoluble in organic solvents such as ethanol and acetone; Process tolerance boundary: control the reaction rate in acidic system to avoid a large number of bubbles generated by rapid decomposition; pre-dispersion treatment shall be carried out in cold/hot water system to avoid local agglomeration; liquid system shall be prepared and used immediately to prevent precipitation caused by long-term standing.

1.2.7 Physiological Characteristics

Standard index: inorganic calcium form, the bioavailability of **Food Grade/Medical Grade is about 40% ~ 50%**, with low gastrointestinal irritation and no obvious peculiar odor, and does not affect the normal digestive function of human body/animals; Industrial Grade Calcium Carbonate has no physiological activity, and mainly functions as filling, reinforcement and whitening. It shall be strictly distinguished from food grade/medical grade to eliminate cross-contamination.

1.3 Raw Material Warehousing Acceptance Standards

1.3.1 Mandatory Verification of Qualification Documents

Before raw material warehousing, the following qualification documents shall be strictly verified to ensure compliant source and controllable quality: Food grade raw materials shall provide food production license, type inspection report, batch factory inspection report, full item detection report of heavy metals/microorganisms, and compliance

statement conforming to the permitted scope of GB 14880; export products shall additionally provide HALAL/KOSHER certification documents; On the basis of food grade qualifications, medical grade raw materials shall additionally provide sterile test reports and statement documents that internal control indicators are stricter than national standards; Industrial grade raw materials shall provide industrial product production license, type inspection report and batch test report with clear impurity content indicators; Feed grade raw materials shall provide feed additive production license and relevant compliance certification documents to comply with feed industry application specifications.

1.3.2 Mandatory Physical and Chemical Sampling Inspection

After each batch of raw materials is warehoused, physical and chemical indicators shall be sampled and inspected. Mandatory inspection items include: Calcium (Ca^{2+}) content (meeting the range requirement of 39.0% ~ 40.0%), moisture (graded inspection by food grade, medical grade, industrial grade and feed grade), pH value of 10g/L aqueous solution, ignition residue, heavy metals (Pb, As, Cd, Hg). Among them, **Food Grade/Medical Grade: Pb ≤ 0.5mg/kg, As ≤ 0.5mg/kg**; Industrial grade raw materials shall additionally inspect insoluble matter in hydrochloric acid (≤ 0.2%) and residue on sieve (pass rate of 0.075mm test sieve ≥ 99%); Feed grade raw materials shall additionally inspect free alkali content (calculated as CaO ≤ 0.5%) and particle size (pass rate of 0.84mm test sieve ≥ 95%) to ensure the physical and chemical indicators of raw materials meet standard requirements.

1.3.3 Microorganism Access Threshold

Microbial indicators are controlled by raw material grades: Food grade raw materials shall meet total bacterial count ≤ 1×10^4 CFU/g, coliform ≤ 0.3 MPN/g, mold and yeast ≤ 100 CFU/g; Salmonella and Staphylococcus aureus shall not be detected in 25g, without heat-resistant spores and pathogenic bacteria pollution; Medical grade raw materials shall meet sterile requirements with no microorganisms detected; Microbial indicators of feed grade raw materials shall comply with relevant feed industry standards to eliminate breeding risks caused by microbial pollution; There is no mandatory requirement for microbial indicators of industrial grade raw materials, but mildew and peculiar odor shall be avoided.

1.3.4 Rejection Criteria (Rigid Standards, Strict Implementation)

Raw materials with any of the following conditions shall be uniformly rejected and prohibited from warehousing: Raw materials are caked and hard, with obvious abnormal color (such as yellowing, graying, deviating from normal white); With pungent peculiar odor, failing to meet the odor-free standard; Excessive microbial indicators or heavy metals (Pb, As, etc.) exceeding limit values; Calcium content deviating from the range of 39.0% ~ 40.0%, or unqualified relevant indicators of industrial/feed grade raw materials; Incomplete, false or expired qualification documents with no valid test reports available; Mixed loading of raw materials of different grades and unclear identification with cross-contamination risks.

1.4 Warehousing and Opening Management Specifications

1.4.1 Warehousing Environment

The warehousing environment shall meet constant temperature ≤ 25℃, relative humidity controlled at **40% ~ 65% RH**, kept cool, dry, ventilated and away from light, avoiding direct sunlight and humid environment; Raw materials shall be stored off the ground and wall, with distance ≥ 10cm from the ground and ≥ 20cm from the wall to prevent moisture erosion from the ground and wall pollution; The warehousing area shall be stored in zones by grade. **Food Grade/Medical Grade shall be strictly isolated from Industrial Grade/Feed Grade**, mixed storage is prohibited. Meanwhile, keep away from acidic substances, strong oxidants and raw materials with volatile peculiar odor to prevent structural variation, odor tainting or chemical reaction of raw materials.

1.4.2 Packaging and Sealing

Original packaging of raw materials adopts 25kg paper drum, woven bag or aluminum foil bag, lined with food grade/industrial grade polyethylene bag to ensure airtight and moisture-proof; Packaging of food grade/medical grade raw materials shall be marked with "Food Use" and "Medical Grade"; Industrial grade raw materials shall be marked with "Industrial Use, Edible Prohibited"; After opening, adopt double inner membrane + aluminum foil sealing immediately, mark the opening date, validity period and user clearly on the outer box, do a good job of moisture-proof protection to prevent raw materials from moisture caking and deterioration; Unopened raw materials shall keep intact packaging, damage and leakage sealing are prohibited.

1.4.3 Service Life

The shelf life of unopened raw materials is distinguished by grade: **24 months for Food Grade and Medical Grade, 36 months for Industrial Grade and Feed Grade**, calculated from the production date; Opened raw materials shall be used up within 30 days under airtight and moisture-proof conditions. Raw materials exceeding the time limit shall undergo full item re-inspection, and can be used in limited quantity only if re-inspected qualified; those unqualified shall be scrapped directly and prohibited from putting into production; The service life of opened food grade/medical grade raw materials is strictly controlled to eliminate microbial pollution risks.

1.4.4 Warehousing Prohibitions

It is prohibited to store calcium carbonate together with acidic substances, strong oxidants and high-phosphorus preparations in the same warehouse to prevent chemical reaction and structural variation of raw materials; It is prohibited to mix food grade/medical grade calcium carbonate with industrial grade and feed grade raw materials to avoid cross-contamination; Smoking and open fire are prohibited in the warehousing area, keep away from fire sources. Industrial grade calcium carbonate shall be stored separately in a well-ventilated area to prevent dust accumulation; Feed grade calcium carbonate shall be stored separately, direct contact with calcium hydrogen phosphate and copper sulfate is prohibited to avoid antagonistic reaction affecting raw material quality.

Part 2 General Standardized Operation Procedures

1 Precision Metering and Conversion Formula

1.1 Core Conversion Formula

The calculation of actual addition amount of calcium carbonate shall strictly follow the following formula to ensure accurate and controllable addition amount:

Actual Addition Amount of Calcium Carbonate = Target Calcium Addition Amount (Calculated as Ca) ÷ Actual Calcium Content of Raw Materials

For the convenience of formula implementation and workshop operation, the industry uniformly adopts engineering simplified value calculation based on the benchmark of 39.5% (raw material calcium content). If the deviation between the actual calcium content of raw materials and the benchmark value is large, recalculate according to the actual content to ensure accurate addition amount; The addition amount of industrial grade calcium carbonate is calculated according to actual demand without conversion by calcium content, focusing on controlling the filling ratio.

1.2 Requirements for Metering Equipment

- Lab Pilot/Pilot Scale: Adopt electronic analytical balance with accuracy up to 0.01g, calibrate before metering to ensure the balance error within the allowable range;
- Production Line Mass Production: Adopt automatic loss-in-weight metering system with calibration cycle ≤ 3 months, conduct regular detection of metering accuracy to ensure metering deviation ≤ ±3%; Electronic weighing scale with accuracy up to 0.1kg can be adopted for industrial grade mass production with calibration cycle ≤ 1 month;
- General Requirements: All measuring instruments must be within the verification validity period. Estimated feeding and visual feeding are prohibited. Records shall be made during the metering process and metering data shall be retained for traceability; Clean the measuring instruments after metering to prevent residual raw materials from affecting the next metering accuracy; Measuring instruments for food grade/medical grade shall be used independently, sharing with industrial grade is prohibited.

2 Standard Process of Premixing and Dilution

Calcium carbonate is almost insoluble in water and easy to absorb moisture and agglomerate. Direct feeding is easy to cause excessive local concentration, leading to system precipitation, caking and foaming (acidic system) and affecting product stability. Therefore, premixing/pre-dispersion pretreatment shall be implemented in all application scenarios. The specific processes are standardized respectively for solid and liquid systems, and can be adjusted according to process requirements in partial industrial grade scenarios.

2.1 Premixing Specification for Solid Powder Products

(Applicable to solid raw materials such as food, feed, health products, rubber and plastics, papermaking and building materials)

- **Diluent Carrier Selection**: Priority to select neutral inert carriers. Food grade can adopt lactose, maltodextrin and corn starch (without phytic acid and high phosphorus interference to avoid affecting calcium absorption); Feed grade can adopt zeolite powder, rice husk powder and soybean meal (adapting to feed system with controllable cost and no impact on palatability); Industrial grade can adopt talc powder, kaolin and special carrier for calcium carbonate (adapting to different industrial systems and improving dispersion); Carriers with high phytic acid, high phosphorus, high fluorine and acidity are strictly prohibited.
- **Premixing Ratio Control**: The premixing ratio of calcium carbonate to carrier is **1:3 ~ 1:10**, among which the premixing ratio of food grade and medical grade raw materials is 1:3 ~ 1:5 (ensuring uniform calcium content after premixing for subsequent mixing); The premixing ratio of feed grade raw materials is 1:5 ~ 1:8; The premixing ratio of industrial grade raw materials is 1:6 ~ 1:10 (adapting to mass production, reducing cost and improving dispersion).
- **Premixing Procedure Requirements**: Adopt equal increment method for mixing. First mix calcium carbonate with a small amount of carrier evenly, then gradually add the remaining carrier with mixing time ≥ 15 minutes; After mixing, pass through 80 ~ 120 mesh double-layer sieve to remove agglomerated particles, then conduct secondary mixing to ensure uniform mixing; The mesh number can be appropriately reduced for industrial grade coarse powder calcium carbonate, only passing through 60 ~ 80 mesh sieve is acceptable.
- **Control Target**: No visible agglomerated particles in the premixed powder; uniform calcium distribution of batch powder (food, feed, medical grade) with mixing uniformity RSD ≤ 3.0%; Industrial grade premixed powder has good dispersion without massive caking, ensuring consistent performance of each product in subsequent production.

2.2 Pre-dispersion Preparation Specification for Liquid System

(Applicable to liquid products such as beverages, oral liquids, condiments, coatings and daily chemicals)

- **Preparation Water Temperature Control**: Adopt 40 ~ 60℃ purified water or softened water for pre-dispersion. Too low water temperature will lead to slow dispersion and serious agglomeration of calcium carbonate; too high water temperature will accelerate water evaporation and may affect system stability; For acidic liquid system, adjust pH to 6.0 ~ 7.0 first, then add calcium carbonate to avoid a large number of bubbles generated by rapid decomposition.
- **Dispersion Aid System Configuration**: 0.1% ~ 0.3% citric acid or sodium citrate can be added to food grade liquid system to adjust the pH of aqueous solution to 8.5 ~ 10.0, maintain system stability, promote calcium carbonate dispersion and inhibit bubble generation; Appropriate dispersant and wetting agent can be added to

industrial grade liquid system (coatings, daily chemicals) to ensure uniform system without precipitation and delamination.

- **Stirring Operation Requirements**: Adopt medium-speed stirring with stirring time of 10 ~ 20 minutes. Keep continuous observation during stirring until the solution is in uniform suspension or translucent state without obvious precipitation and agglomerated particles to ensure complete dispersion of calcium carbonate; Control the stirring speed in acidic system to avoid excessive bubbles.
- **Application Requirements**: The pre-dispersed liquid system shall be prepared and used immediately, and the standing time shall not exceed 6h to prevent calcium carbonate sedimentation segregation from affecting the addition effect; Strictly control microbial pollution in food grade liquid system and implement aseptic operation during preparation.

3 General Principles of Addition Timing and Process Temperature Control

3.1 High-temperature Process (Baking, Extrusion Puffing, Spray Drying, Industrial High-temperature Forming)

For food grade, add at the powder pretreatment stage, mix the premixed calcium carbonate with basic powder evenly and avoid the continuous high-temperature holding section; Control the instantaneous process temperature ≤ 200℃, prohibit long-term heating above 220℃ to prevent calcium carbonate decomposition and calcium content loss. For industrial grade high-temperature forming process (ceramics, glass), add at the raw material mixing stage with process temperature controlled within 800℃ to prevent product performance degradation caused by high-temperature decomposition; Feed pelleting process temperature ≤ 90℃ to avoid high temperature affecting calcium absorption.

3.2 Fermentation Process (Yogurt, Fermented Milk, Brewed Condiments)

Add at the low-temperature section (≤60℃) after cooling at the end of fermentation and before sterilization. Feeding in the early fermentation stage is prohibited to prevent calcium carbonate from affecting the metabolic activity of fermentative flora, as well as abnormal pH fluctuation and a large number of bubbles in the system, ensuring the flavor and quality of fermented products; Stir at low speed for 15 minutes after feeding to ensure uniform mixing and lock the system pH at 8.5 ~ 10.0.

3.3 Liquid Beverages, Oral Liquids, Condiments, Coatings and Daily Chemical Products

Add at the medium and low temperature (40 ~ 65℃) homogeneous stirring stage. At this time, the system temperature is appropriate with good dispersion effect of calcium carbonate, and it is not easy to settle and decompose; Keep the system pH in the stable range of 8.5 ~ 10.5 throughout the whole process. Avoid strong acid environment for food grade; industrial grade (coatings, daily chemicals) can fine-tune pH according to system demand to prevent calcium carbonate decomposition or precipitation, and ensure

products free of peculiar odor, precipitation and delamination.

3.4 Solid Preparations (Meal Replacement Powder, Nutrition Package, Tablets, Capsules, Rubber and Plastics, Building Materials)

Food grade/medical grade solid preparations: Add calcium carbonate finally after completing the premixing of trace elements and vitamins to reduce the structural damage caused by long-term mechanical grinding and high-temperature pelleting; Operate in a dark and moisture-proof environment to prevent raw materials from moisture caking and ensure product effectiveness. Industrial grade (rubber and plastics, building materials): Add at the initial stage of raw material mixing/stirring, fully mix with basic raw materials to ensure uniform dispersion and improve product reinforcement and filling effect.

3.5 Papermaking and Ink Industry

Add at the pulp beating stage or ink grinding stage. In papermaking industry, add pre-dispersed calcium carbonate after beating and before paper making, control the system pH at 8.0 ~ 9.0 to improve paper whiteness and strength; In ink industry, add during grinding and fully mix with pigments and resins to ensure uniform ink color and good printing performance, avoiding agglomeration affecting printing effect.

4 Judgment Standard for Mixing Uniformity

4.1 Powder Products (Food, Feed, Health Products, Rubber and Plastics, Building Materials)

Adopt multi-point random sampling method, take random 5 samples per batch, detect calcium content (food, feed, medical grade) or dispersion (industrial grade) of each sample, calculate relative standard deviation (RSD). Qualified standard: **RSD ≤ 3.0% for food, feed and medical grade; RSD ≤ 5.0% for industrial grade**; If RSD exceeds the standard, re-mix until meeting the requirements to ensure uniform and consistent quality of each powder product.

4.2 Liquid Products (Beverages, Oral Liquids, Condiments, Coatings, Daily Chemicals)

Let the prepared liquid products stand for 90 minutes, observe delamination and precipitation phenomenon, and detect calcium content of upper and lower layer samples (food, feed, medical grade) or solid content (industrial grade). Qualified standard: deviation ≤ 5.0%; If delamination, precipitation or excessive deviation of upper and lower layer indicators occur, re-stir and disperse, and unqualified products are prohibited from entering the next process.

4.3 Terminal Finished Products

The allowable deviation of labeled calcium content of terminal products shall comply with the legal range of ±10% of the labeled value specified in GB 14880; Feed grade terminal products shall comply with relevant feed industry specifications; Industrial grade terminal products shall comply with corresponding industry standards (rubber and

plastics, coatings, papermaking) to ensure consistency between product labeling and actual quality, protecting the rights and interests of consumers, breeders and industrial users.

5 General Criteria for Synergistic Effect and Compatibility Contraindications

5.1 Recommended Compatible Compatibility (Improve Absorption Rate, Stabilize System and Optimize Product Quality)

- **Nutritional Synergy**: Reasonable ratio of Vitamin D_3 (addition amount 0.005% ~ 0.01%), Vitamin C (addition amount 0.1% ~ 0.3%) with calcium carbonate can significantly improve the intestinal absorption efficiency of calcium elements. Meanwhile, vitamin C can adjust system pH and maintain calcium carbonate stability; Food grade can also be compounded with lactose to promote calcium absorption.
- **Flavor Optimization**: Food grade products can be compounded with flavor substances such as vanilla and fruit juice to effectively cover the slight astringency of calcium carbonate and improve product palatability; Feed grade can be compounded with sweeteners and palatability improvers to increase animal feed intake willingness.
- **Industrial Grade Synergy**: In rubber and plastics industry, synergistic use with carbon black and white carbon black to improve product tensile strength and wear resistance; In coatings industry, synergistic use with titanium dioxide to improve coating hiding power and adhesion; In papermaking industry, synergistic use with sizing agent to improve paper strength and water resistance.

5.2 Strictly Prohibited Compatibility

- Acidic substances, high phytic acid raw materials (concentration $>$ 0.5%) and high-phosphorus preparations: Acidic substances will react with calcium carbonate to produce carbon dioxide, causing system foaming and caking; High phytic acid and high-phosphorus preparations will chelate with calcium carbonate to form insoluble complexes, inhibiting calcium absorption (food, feed, medical grade) or affecting product performance (industrial grade).
- Strong acid and strong alkali environment: Calcium carbonate is easy to decompose when system pH $<$ 6.0 (strong acid); easy to combine with other ions to form precipitation when pH $>$ 11.0 (strong alkali), affecting product quality.
- Strong oxidants and chlorine-containing strong fungicides: Coexisting in the same system with calcium carbonate will induce slight decomposition of calcium carbonate, resulting in sensory deterioration of products (such as yellowing), and reduce the bioavailability of calcium (food, feed, medical grade) or affect product stability (industrial grade).

- Imbalanced Calcium-phosphorus Ratio: When the calcium-phosphorus ratio of food, feed and medical grade is > 2:1, competitive absorption antagonism of minerals will occur, affecting the absorption effect of both calcium and phosphorus elements. The ratio of the two elements shall be strictly controlled.
- Direct Contact Contraindications: Food grade/medical grade calcium carbonate is prohibited from direct mixing with industrial grade raw materials and acidic substances; Feed grade is prohibited from direct contact with calcium hydrogen phosphate and copper sulfate; Industrial grade calcium carbonate is prohibited from direct mixing with acidic raw materials to avoid chemical reaction damaging raw material quality or product performance.

Part 3 Refined Addition Operation Guidelines for Eight Application Fields by Scenario

1 Food Processing Field

1.1 Regulated Addition Amount

- Infant Formula and Preschool Children Food: 30 ~ 60 mg/100g for infant formula milk powder; 300 ~ 600 mg/100g for infant cereal supplementary food and nutrition package; The recommended daily intake of preschool children formula food is 300 ~ 600mg/day, and the addition amount is calculated combined with consumption;
- Dairy Products: 300 ~ 1000 mg/kg for modified milk powder; 100 ~ 300 mg/100g for fermented milk and flavored yogurt; 100 ~ 200 mg/kg for liquid sterilized milk and milk beverage;
- Cereal, Baking and Puffing Food: 1000 ~ 2000 mg/kg for wheat flour, rice flour and miscellaneous grain powder; 300 ~ 600 mg/100g for instant oatmeal and compound cereal flakes; 500 ~ 1000 mg/kg for biscuits, cakes and puffed baked products;
- Solid Beverages and Meal Replacement Powder: 1000 ~ 3000 mg/kg (converted to 100 ~ 300 mg/100g); 50 ~ 100 mg/100ml for liquid functional beverages;
- Condiments: 500 ~ 1000 mg/kg for brewed soy sauce and compound sauce (converted to 50 ~ 100 mg/100ml); 100 ~ 200 mg/100g for edible salt.

1.2 Raw Material Grade Requirements (Strict Control to Ensure Food Safety)

Only **Food Grade Calcium Carbonate** is allowed to be selected with calcium content ≥ 39.5%. Heavy metals implement internal control standards stricter than national standards (Pb ≤ 0.3mg/kg, As ≤ 0.3mg/kg) with no pathogenic bacteria detected in microorganisms; Particle size of calcium carbonate for infant food shall be additionally controlled (100 mesh pass rate ≥ 99%) to ensure low gastrointestinal irritation and no peculiar odor, adapting to the delicate gastrointestinal function of infants; Use of industrial grade and feed grade raw materials is prohibited to eliminate cross-contamination.

1.3 Addition Process SOP (Refined Control to Ensure Product Safety and Quality)

- **Dry Process (Cereal Powder, Baking Powder, Solid Beverage)**:

Premix calcium carbonate with lactose and maltodextrin at a ratio of 1:3 ~ 1:5 by equal increment method, pass through 100 mesh double-layer sieve to remove agglomerated particles, then mix with basic powder with total mixing time ≥ 20min. Control moisture ≤ 5.0% throughout the whole process to prevent raw materials from moisture caking; Detect mixing uniformity after mixing, and enter the next process only when RSD ≤ 3.0%.

- **Wet Process (Dairy Products, Liquid Beverages, Condiments)**:

Prepare calcium carbonate pre-dispersed solution with 40 ~ 60℃ purified water first, add 0.1% ~ 0.3% citric acid to adjust pH to 8.5 ~ 10.0, stir until uniform suspension without precipitation; Slowly add the pre-dispersed solution into the batching tank before homogenization at 40 ~ 65℃, control the homogenization pressure at 18 ~ 22MPa to ensure uniform dispersion; Monitor system pH throughout the whole process to prevent calcium carbonate decomposition or precipitation caused by abnormal pH. Liquid beverages shall be prepared and used immediately to avoid sedimentation.

- **Baking and Puffing Process**:

Mix premixed calcium carbonate evenly with baking auxiliary materials (flour, sugar, oil), add at the powder pretreatment stage. Control baking temperature at 160 ~ 200℃ with short-time baking (≤20 minutes); control puffing process temperature at 180 ~ 200℃, rapid cooling after instantaneous extrusion to prevent calcium carbonate decomposition and astringency precipitation; Ensure finished products free of astringency, yellowing and precipitation, without affecting product taste and appearance.

- **System Control**:

Excessive compatibility of high phytic acid and high-phosphorus raw materials is prohibited throughout the whole process to avoid inhibiting calcium absorption; Avoid contact with copper and aluminum containers during raw material mixing, priority to select 304/316 stainless steel equipment to prevent metal ion pollution; Finished products shall be free of astringency, yellowing and precipitation, with calcium content attenuation ≤ 5% within the shelf life, complying with food sensory requirements.

2 Pharmaceutical Preparation Field

2.1 Recommended Daily Intake (Calculated as Ca)

- Ordinary Adult Calcium Supplementation: 800 ~ 1200 mg/day, adapting to daily calcium supplementation demand of adults and avoiding calcium accumulation caused by excessive intake;

- Special Formula for Pregnant and Lactating Women: 1000 ~ 1500 mg/day, meeting calcium demand of women during pregnancy and lactation and preventing osteoporosis;
- Children's Pharmaceutical Preparation: 300 ~ 600 mg/day, adjusted according to children's age and weight to adapt to children's growth and development characteristics;
- Single Tablet Feeding Amount: 2025 ~ 3038mg/tablet of calcium carbonate (corresponding to 800 ~ 1200mg calcium per tablet), accurately controlling single dose for consumers' convenient taking.

2.2 Preparation Process Specification (Refined Preparation to Ensure Efficacy and Stability)

- **Tablets**:

Adopt closed mixing process, mix medical grade calcium carbonate with Vitamin D_3, VC and auxiliary materials (microcrystalline cellulose, magnesium stearate) for 30min to ensure mixing uniformity RSD ≤ 3.0%; Adopt 16 ~ 20 mesh granulation, control granulation temperature at 50 ~ 60℃ low-temperature drying to prevent high temperature from damaging calcium carbonate structure; Conduct granule finishing after drying, then perform film coating. The coating layer shall be light-proof and moisture-proof to prevent raw materials from moisture caking; Control finished product moisture ≤ 3.0% to ensure the stability and disintegration of tablets meet medical standards.

- **Capsules**:

Premix medical grade calcium carbonate with auxiliary materials evenly, control premix powder moisture ≤ 5.0% to prevent moisture caking caused by excessive moisture; Fill with automatic capsule filling machine with filling precision deviation ≤ ±3%; Seal and package after filling, adopt light-proof and moisture-proof packaging materials to prevent capsule moisture absorption and calcium loss, ensuring stable efficacy of products within the validity period.

- **Oral Liquids**:

Dissolve medical grade calcium carbonate with 40 ~ 60℃ purified water, add 0.5% ~ 1.0% VC (synergistic absorption) and 0.1% ~ 0.2% citric acid (adjust taste and pH), adjust system pH to 8.5 ~ 10.0, stir until uniform suspension without precipitation; Sterilize at 105℃/15min after filtration, cool rapidly to room temperature after sterilization; Adopt aseptic operation during filling to avoid microbial pollution; Finished products shall have no precipitation and yellowing after long-term placement, smooth taste and no obvious astringency.

- **Raw Material Control**:

Limit the use of high-purity **Medical Grade Calcium Carbonate** with calcium content ≥ 39.5%, heavy metal indicators stricter than national standards, qualified sterile

inspection and no microorganisms detected; Use of food grade, industrial grade and feed grade raw materials is prohibited to ensure low irritation and no peculiar odor, adapting to people with sensitive gastrointestinal tract.

3 Feed and Pet Food Field (Adapting to Breeding Demand and Improving Breeding Benefit)

3.1 Industry General Addition Amount (Calculated as Ca)

- Livestock and Poultry Compound Feed: 5 ~ 10g/kg for piglets/growing pigs, 8 ~ 10g/kg for weaned piglets (adapting to gastrointestinal function of weaned piglets and promoting bone development); 3 ~ 8g/kg for poultry (chicken/duck), 5 ~ 7g/kg for young poultry (meeting growth and development demand of young poultry);
- Ruminant Compound Feed (Cattle/Sheep): 4 ~ 8g/kg, 6 ~ 8g/kg for calves (adapting to digestive characteristics of ruminants and improving calcium absorption efficiency);
- Aquatic Compound Feed: 3 ~ 6g/kg, adapting to growth demand of aquatic animals (fish/shrimp) and improving bone development and stress resistance;
- Dog and Cat Staple Food and Pet Snacks: 2 ~ 5g/kg, meeting daily calcium demand of pets, preventing pet osteoporosis and improving pet immunity.

3.2 Operation Control Points (Adapting to Feed Process and Improving Palatability and Absorption Efficiency)

- **Premixing Operation**:

Adopt corn starch and soybean meal as carriers, premix at the ratio of calcium carbonate : carrier = 1:5 ~ 1:8, add 0.1% ethoxyquinoline antioxidant to prevent raw material deterioration; Mix by equal increment method with mixing time ≥ 15min and mixing uniformity RSD ≤ 5.0% to ensure uniform calcium content of each feed.

- **Pelleting Process**:

Feed pelleting temperature ≤ 90℃, pressure ≤ 4MPa, rapid cooling after pelleting with moisture ≤ 12% after cooling to prevent high temperature from damaging calcium carbonate structure and feed moisture caking; Avoid direct contact with calcium hydrogen phosphate and copper sulfate during pelleting, add in layers or separate by carrier to prevent antagonistic reaction.

- **Category Control**:

Aquatic feed shall focus on water resistance dispersion, adopt post-spraying process (liquid dosage form) or dry mixing after crushing to 80 mesh to reduce calcium loss in water and ensure effective intake of aquatic animals; Control the addition amount of calcium carbonate in pet food to avoid astringency interfering with pet feeding preference, and compound with pet palatability improver to improve pet acceptance; Ruminant feed shall avoid matching with high phytic acid and high-phosphorus raw materials to

improve calcium absorption efficiency, and control the calcium-phosphorus ratio between 1.5:1 ~ 2:1.

4 Building Materials Field (Adapting to Construction Characteristics and Improving Material Performance)

4.1 Industry General Addition Amount

- Cement Products: The addition amount of calcium carbonate is 5% ~ 15% of cement mass, adapting to cement hydration reaction and improving product strength and wear resistance;
- Concrete: The addition amount of calcium carbonate is 3% ~ 8% of aggregate mass, improving concrete workability, reducing shrinkage rate and enhancing durability;
- Coatings and Putty Powder: The addition amount of calcium carbonate is 20% ~ 50% of total mass of coatings/putty powder, acting as filler to improve product hiding power and adhesion and reduce cost;
- Tiles and Ceramics: The addition amount of calcium carbonate is 10% ~ 25% of total raw material mass, improving forming performance and enhancing product density and whiteness.

4.2 Operation Control Points (Adapting to Building Process and Ensuring Construction and Product Performance)

- **Premixing Operation**:

Adopt industrial grade ground calcium carbonate, crush to 80 ~ 120 mesh, mix with cement, aggregate and coating base material in proportion, adopt mechanical stirring with stirring time ≥ 20 minutes to ensure uniform mixing without agglomerated particles; In putty powder production, premix calcium carbonate with talc powder and rubber powder first, then add other raw materials to improve dispersion.

- **Process Temperature Control**:

After pouring cement products and concrete, control the curing temperature at 15 ~ 25℃ to prevent cracking caused by rapid high-temperature drying. The hydration reaction of calcium carbonate and cement shall be carried out in a humid environment with curing time ≥ 7 days; Firing temperature of ceramics and tiles is controlled at 700 ~ 800℃ to prevent high-temperature decomposition and ensure good forming and stable product performance.

- **Key Control Points**:

Strictly control the addition amount of calcium carbonate in cement products and concrete, excessive amount will lead to strength decline; Control particle size and dispersion of calcium carbonate in coatings and putty powder to avoid affecting product constructability (such as leveling and adhesion); Select high-purity industrial grade calcium

carbonate for tiles and ceramics to prevent impurities from affecting product whiteness and density; Avoid contact with acidic substances during construction to prevent calcium carbonate decomposition and product performance impact.

5 Rubber and Plastics Field (Filling and Reinforcing to Optimize Product Performance)

5.1 Industry General Addition Amount

- Rubber Products (Tires, Seals, Hoses): The addition amount of calcium carbonate is 20% ~ 60% of rubber mass, acting as filler to improve rubber tensile strength, wear resistance and aging resistance and reduce production cost;
- Plastic Products (PE, PP, PVC, ABS): The addition amount of calcium carbonate is 10% ~ 40% of plastic mass, improving plastic processing performance, enhancing product rigidity and heat resistance and reducing shrinkage rate;
- Cable Materials: The addition amount of calcium carbonate is 15% ~ 30% of cable material mass, improving insulation performance and aging resistance of cable materials and reducing cost.

5.2 Operation Control Points (Adapting to Mixing Process and Ensuring Product Performance)

- **Premixing Operation**:

Adopt industrial grade light calcium carbonate or activated calcium carbonate with particle size of 100 ~ 200 mesh, premix with rubber/plastic raw materials and additives (such as vulcanizing agent and stabilizer) in proportion, mix by equal increment method with stirring time ≥ 15 minutes to ensure uniform mixing; Activated calcium carbonate shall be activated in advance to improve compatibility with rubber/plastic and avoid agglomeration.

- **Mixing Process Control**:

Rubber mixing temperature is controlled at 120 ~ 160℃ with mixing time of 10 ~ 20 minutes to ensure uniform dispersion of calcium carbonate in rubber matrix and avoid local agglomeration affecting tensile strength; Plastic mixing temperature is controlled at 150 ~ 200℃, adjusted according to plastic varieties. Conduct extrusion and injection molding after mixing with forming temperature controlled at 180 ~ 220℃ to prevent high-temperature decomposition.

- **Key Control Points**:

Control the dosage of activator for activated calcium carbonate to avoid affecting product performance; The addition amount of calcium carbonate shall be reasonable, excessive amount will lead to decreased toughness and brittle cracking of rubber/plastic; Control moisture during mixing to avoid bubbles and shrinkage cavities in products; Detect

tensile strength, hardness and aging resistance of finished products to meet industry standards.

6 Coatings and Inks Field (Filling and Whitening to Improve Product Quality)

6.1 Industry General Addition Amount

- Architectural Coatings (Interior and Exterior Wall): The addition amount of calcium carbonate is 20% ~ 40% of total coating mass, improving coating hiding power, adhesion and scrub resistance and reducing cost;
- Industrial Coatings (Antirust Paint, Anticorrosive Paint): The addition amount of calcium carbonate is 15% ~ 30% of total coating mass, improving coating leveling and wear resistance and enhancing anticorrosive performance;
- Inks (Offset Ink, Gravure Ink): The addition amount of calcium carbonate is 10% ~ 25% of total ink mass, acting as filler to improve ink color uniformity and printability and reduce cost.

6.2 Operation Control Points (Adapting to Grinding Process and Ensuring Product Quality)

- **Pre-dispersion Operation**:

Adopt industrial grade light calcium carbonate with particle size of 150 ~ 200 mesh, mix with coating base material, pigment and dispersant in proportion, conduct pre-dispersion first with stirring time ≥ 10 minutes to ensure preliminary uniform dispersion without massive agglomeration.

- **Grinding Process Control**:

Grind with sand mill or ball mill, control grinding temperature at 30 ~ 50℃ to prevent high temperature from affecting coating/ink stability; Control the fineness of ground materials at 20 ~ 50μm to ensure uniform dispersion of calcium carbonate without obvious particles, improving coating hiding power and ink printing effect; Control pH at 8.5 ~ 10.0 during grinding to prevent calcium carbonate decomposition.

- **Key Control Points**:

Calcium carbonate in coatings shall be used synergistically with titanium dioxide to optimize hiding power; Calcium carbonate in inks shall be fully mixed with pigments to avoid affecting ink color; Detect hiding power, adhesion (coatings) and printability (inks) of finished products to meet industry standards; Store away from light and seal to prevent sedimentation and delamination.

7 Papermaking Field (Filling and Whitening to Improve Paper Performance)

7.1 Industry General Addition Amount

- Cultural Paper and Writing Paper: The addition amount of calcium carbonate is 10% ~ 25% of pulp mass, improving paper whiteness, smoothness and printability;
- Packaging Paper and Carton Paper: The addition amount of calcium carbonate is 5% ~ 15% of pulp mass, improving paper strength and stiffness and reducing production cost;
- Special Paper (such as Coated Paper): The addition amount of calcium carbonate is 20% ~ 30% of pulp mass, improving paper gloss and smoothness to adapt to high-grade printing demand.

7.2 Operation Control Points (Adapting to Paper Making Process and Ensuring Paper Quality)

- **Pre-dispersion Operation**:

Adopt industrial grade ground calcium carbonate with particle size of 80 ~ 120 mesh, mix with pulp, sizing agent and retention aid in proportion, add at the beating stage with stirring time ≥ 15 minutes to ensure uniform dispersion of calcium carbonate in pulp and avoid spots on paper caused by agglomeration.

- **Paper Making Process Control**:

Control pulp beating degree at 30 ~ 50°SR, paper making temperature at 40 ~ 60℃, system pH at 8.0 ~ 9.0 to improve the binding force between calcium carbonate and pulp fiber; Control the dosage of retention aid during paper making to ensure calcium carbonate remains in the paper page and reduce loss; Control drying temperature at 100 ~ 120℃ to prevent paper yellowing and brittle cracking caused by high temperature.

- **Key Control Points**:

The addition amount of calcium carbonate shall be reasonable, excessive amount will lead to decreased paper strength and poor air permeability; Control particle size of calcium carbonate to avoid affecting paper smoothness; Detect whiteness, smoothness and strength of finished products to meet papermaking industry standards; Avoid contact with acidic substances during paper making to prevent calcium carbonate decomposition and paper quality impact.

8 Daily Chemical Field (Filling and Whitening to Optimize Product Performance)

8.1 Industry General Addition Amount

- Toothpaste: The addition amount of calcium carbonate is 20% ~ 40% of total toothpaste mass, acting as friction agent to remove stains on tooth surface, and playing

the role of whitening and thickening;

- Facial Cleanser and Body Wash: The addition amount of calcium carbonate is 5% ~ 15% of total product mass, acting as scrub agent to remove skin cutin and improve cleaning effect;
- Skin Care Products (Cream, Lotion): The addition amount of calcium carbonate is 3% ~ 10% of total product mass, acting as filler to improve product texture, ductility and skin feel.

8.2 Operation Control Points (Adapting to Daily Chemical Process and Ensuring Product Safety and Performance)

- **Pre-dispersion Operation**:

Adopt food grade or daily chemical grade calcium carbonate with particle size of 100 ~ 200 mesh, premix with daily chemical base material, surfactant and moisturizer in proportion, adopt high-speed stirring with stirring time ≥ 10 minutes to ensure uniform dispersion of calcium carbonate without agglomerated particles and avoid affecting product texture.

- **Process Temperature Control**:

The production temperature of daily chemical products is controlled at 40 ~ 60℃ to prevent high temperature from damaging active ingredients in products and ensure uniform dispersion of calcium carbonate; Grinding shall be carried out after mixing in toothpaste production to ensure fine particles and avoid friction damage to teeth; Control system pH at 8.5 ~ 10.0 in skin care product production to prevent calcium carbonate decomposition and adapt to skin pH environment.

- **Key Control Points**:

Control particle size and hardness of calcium carbonate for toothpaste to avoid enamel damage; Calcium carbonate for facial cleanser and body wash shall be passivated to reduce skin irritation; Select high-purity products for calcium carbonate in skin care products to prevent impurities from affecting skin health; Detect irritation and stability of finished products to meet daily chemical industry standards and ensure safe use.

Part 4 Process Quality Control, Detection System and Compliance Traceability

1 Three-stage In-process Detection Specification

1.1 Premixing Link Detection

After the completion of each batch of premixing, immediately detect calcium content (food, feed, medical grade) and powder uniformity RSD. The calcium content shall meet

the formula requirements. Powder uniformity **RSD ≤ 3.0% (Food, Health Care, Medical Grade); RSD ≤ 5.0% (Feed, Industrial Grade)**; Industrial grade shall additionally detect dispersion; Enter the next process only after qualified premixing; Re-premix and re-inspect if unqualified until meeting standards.

1.2 Production Process Inspection

During production, conduct fixed-point sampling every 2 hours to test calcium content (food, feed, medical grade), system pH and temperature. If the calcium content deviates beyond ±5% of the labeled value, immediately correct the process by adjusting metering or supplementing premixed materials.

For industrial-grade products, test dispersion, particle size, solid content and other indicators. Rectify production in a timely manner once abnormalities are found and keep rectification records to ensure controllable production process.

Food-grade and medical-grade products shall be additionally monitored for microbial indicators to avoid contamination risks.

1.3 Finished Product Release Inspection

Before delivery of each batch of finished products, conduct full-item inspection, including physicochemical indicators (calcium content, moisture, pH, particle size, etc.), microbial indicators (food, feed, medical grade) and sensory indicators. Products can only be warehoused and released after meeting national standards and internal enterprise control standards.

Industrial-grade finished products shall be additionally tested for industry-specific indicators such as tensile strength, hiding power and structural strength.

Medical-grade finished products require additional sterility testing. Unqualified finished products are strictly prohibited from delivery and shall be reworked or scrapped with complete records kept for non-conforming products.

2 Compliance Traceability System

Establish a full-chain compliance traceability system covering raw material batches, metering records, premixing parameters, process temperature and pH during addition, in-process testing data and finished product inspection reports.

Adopt dual filing of paper and electronic records with a retention period of no less than 3 years to achieve full traceability of each batch of products.

All production activities shall strictly comply with **GB 1898-2007**, **GB 14880-2012** and relevant industry specifications; over-range and over-dosage use of calcium carbonate is prohibited.

Export products shall simultaneously meet specification requirements of FDA, EFSA and JECFA. Verify relevant regulations of destination countries in advance to ensure

compliant export.

Traceability ledgers shall be clear and complete, including supplier qualifications of raw materials, raw material acceptance records, warehousing records, production process parameters, inspection reports and finished product outbound records.

It shall facilitate regulatory inspections, enterprise internal audits and product recall (if any), ensuring products are compliant, safe and controllable.

Traceability ledgers for food/medical grade and industrial-grade products shall be strictly separated to avoid confusion.

3 Causes of Common Abnormal Phenomena and Standardized Disposal Solutions

3.1 Product Yellowing, Layered Precipitation and Foaming (High-frequency Abnormalities with Targeted Disposal)

Cause Analysis

Product yellowing is mainly caused by contact of calcium carbonate with strong oxidants, high-temperature decomposition (exceeding temperature tolerance threshold) or excessive impurities in raw materials.

Layered precipitation mainly results from insufficient premixing/pre-dispersion, system pH deviating from the stable range (< 8.5 or > 10.5), excessive standing time of liquid system, or agglomeration caused by improper carrier selection.

Foaming mostly occurs in acidic systems, generated by massive carbon dioxide from rapid reaction between calcium carbonate and acidic substances, or excessive air entrainment due to overly fast stirring speed.

Standardized Disposal

Stop production immediately for yellowed products; inspect raw material impurities, process temperature and whether strong oxidants exist in the system. Replace qualified raw materials, adjust process temperature within the tolerance range, remove strong oxidants and resume production; scrap unqualified products directly.

For layered and precipitated products: re-premix powder materials by extending mixing time and secondary sieving; re-stir and disperse liquid products with appropriate dispersant supplemented, adjust system pH to 8.5 ~ 10.5, and resume production only after standing inspection is qualified.

For foaming products: reduce stirring speed; adjust pH to 6.0 ~ 7.0 first then feed slowly for acidic systems, add appropriate defoamer, and proceed to the next process only after bubbles completely disappear.

3.2 Excessive Deviation of Calcium Content

Cause Analysis

Uncalibrated or low-precision metering equipment, wrong use of conversion formula (calculation not based on actual calcium content), unqualified premixing uniformity (RSD exceeding standard), excessive fluctuation of calcium content among raw material batches (range difference > ±0.3%), or improper addition timing leading to decomposition of calcium carbonate.

Standardized Disposal

Stop feeding immediately, calibrate metering equipment and re-measure; verify conversion formula and recalculate addition amount according to actual calcium content of raw materials.

Inspect premix uniformity and re-premix if unqualified.

Suspend the use of raw materials with excessive calcium content fluctuation and negotiate replacement with suppliers.

Adjust process temperature and addition timing to avoid high-temperature decomposition.

Conduct full re-inspection on already produced unqualified products; allow limited rework for slight deviation and directly scrap severely unqualified products.

3.3 Microbial Contamination

Cause Analysis

Excessive microbial indicators of raw materials, mildew caused by humid warehousing environment, inadequate aseptic operation during production, uncleaned and unsterilized metering equipment, overdue use of opened raw materials without re-inspection, or cross-contact with contaminated raw materials.

Standardized Disposal

Isolate contaminated products immediately and trace pollution sources from raw materials, warehousing and production links; destroy raw materials and finished products with excessive microorganisms.

Thoroughly clean and disinfect production equipment and measuring instruments; recheck microbial indicators of raw materials and resume production only after qualification.

Strictly implement aseptic operation specifications; any opened raw materials overdue for use must undergo re-inspection and be scrapped directly if unqualified.

Food-grade and medical-grade products shall undergo additional microbial inactivation treatment and be released only after qualified re-inspection.

3.4 Moisture Absorption and Caking of Raw Materials

Cause Analysis

Warehousing humidity exceeding 65% RH, damaged and unsealed packaging, failure to seal timely after opening, raw materials not stored off the ground and wall, or mixed storage with damp raw materials.

Standardized Disposal

Slightly caked raw materials due to moisture absorption can be crushed and sieved, and used in limited quantity only after calcium content and moisture are qualified.

Raw materials with severe caking or deterioration after moisture absorption shall be rejected or scrapped directly.

Adjust warehousing humidity to 40% ~ 65% RH, repair damaged packaging, strictly implement sealing protection after opening, store raw materials off the ground and wall as required, and strictly isolate from damp raw materials.

Strengthen daily inspection of warehousing environment to prevent recurrence of similar problems.

3.5 Product Performance Deterioration Caused by Incompatible Compatibility

Cause Analysis

Illegal compatibility of calcium carbonate with acidic substances, high phytic acid and high-phosphorus preparations or strong oxidants in the same system; unbalanced calcium-phosphorus ratio (exceeding 2:1 for food, feed and medical grade), resulting in product caking, strength decline and reduced absorption efficiency.

Standardized Disposal

Stop illegal compatibility immediately, clean unqualified mixtures in the production system and replace with qualified raw materials.

Readjust formulas and remove incompatible substances; strictly control calcium-phosphorus ratio within 1.5:1 ~ 2:1 for food, feed and medical grade products.

Replace suitable carriers and additives for industrial-grade products and re-optimize addition processes.

Inspect deteriorated finished products and evaluate rework feasibility; scrap directly if rework is not feasible, record incompatible cases and strengthen post training.

4 Post Operation Safety Specifications

4.1 Personal Protection Requirements

Operators shall wear complete personal protective equipment before taking post, including dust-proof masks, acid and alkali resistant gloves, protective clothing and goggles,

to avoid inhalation of calcium carbonate dust and direct contact with skin and eyes.

Staff engaged in food-grade/medical-grade operations shall additionally wear sterile clothing, sterile shoes and sterile caps, strictly implement aseptic operation; wearing ornaments and cosmetics into the production area is prohibited.

Clean body and replace work clothes timely after operation to avoid residual dust.

4.2 Operation Safety Control

- **Powder Operation**: Avoid bulk feeding in confined spaces; keep good ventilation in operation areas to prevent dust accumulation. Smoking and open fire are strictly prohibited in dust areas. Equip dust collection equipment and clean dust regularly to eliminate dust explosion risks.
- **Liquid Operation**: For feeding in acidic systems, add calcium carbonate pre-dispersed liquid slowly dropwise to avoid splashing caused by massive bubbles from rapid reaction; avoid contact with strong acids and alkalis during operation to prevent corrosion injury.
- **Equipment Operation**: Operators can only take post after professional training and assessment; strictly follow equipment operating procedures and illegal operation is prohibited. Maintain and calibrate metering equipment, stirring equipment and grinding equipment regularly; shut down power immediately once abnormalities occur during operation, troubleshoot and then resume work.
- **Emergency Disposal**: Equip first-aid kits in operation areas containing acid-base neutralizers, band-aids and disinfection supplies. Operators shall be familiar with emergency disposal procedures; take corresponding first-aid measures and seek medical treatment immediately in case of dust inhalation, skin corrosion or eye contact. Implement enterprise emergency plan in case of fire, leakage and other emergencies.

4.3 Post Cleaning and Disinfection Specifications

- **Food-grade / Medical-grade Operation Posts**: Thoroughly clean and disinfect production equipment, measuring instruments and operating tables after daily work. Use disinfectants meeting food/medical standards and conduct sterility test after disinfection before closing the operation area. Conduct comprehensive cleaning and disinfection once a week focusing on sanitary dead corners.
- **Industrial-grade Operation Posts**: Clean residual calcium carbonate powder on equipment daily and tidy production areas regularly to prevent dust accumulation. Clean measuring and stirring equipment periodically to avoid residual raw materials affecting metering accuracy next time.
- **Cleaning Prohibitions**: Strictly separate cleaning tools for food/medical grade and industrial grade, mixed use is prohibited. Do not use acidic or strong oxidizing detergents during cleaning to prevent reaction with residual calcium carbonate and affecting equipment and subsequent production.