Troubleshooting Guide for Agricultural Silicone Surfactant Production Process

Contents

As a new foreign trade service provider driven by technological transformation and foreign trade services, HiSiaddi has established a "1+2+3+4=1" service system and can supply original factory materials of multiple well-known brands for Agricultural silicone surfactant. With R&D capabilities, HiSiaddi sorts out key points requiring attention for troubleshooting the production process of Agricultural silicone surfactant from a professional perspective and shares them with you.

If you need more professional and in-depth analysis regarding process troubleshooting or product consultation of Agricultural silicone surfactant, please contact HiSiaddi customer service or visit our official website www.hisiaddi.com

I. Basic Product Standards and Full Process Overview

1.1 Product Overview and Execution Standards

Polyether-modified heptamethyltrisiloxane (agricultural silicone surfactant, CAS: 27306-78-1) is synthesized via platinum-catalyzed hydrosilylation of heptamethyltrisiloxane (MDHM, containing active Si-H hydrogen) and allyl polyoxyethylene ether. It is a super spreading and penetrating auxiliary agent specially for agricultural use, featuring ultra-low surface tension, rapid leaf wetting, and enhanced pesticide systemic absorption. It is suitable for tank-mix addition of insecticides, fungicides, herbicides and foliar fertilizers. The product process is highly sensitive to moisture, oxygen, heavy metals and over-temperature, which can easily cause yellow discoloration, residual Si-H, deteriorated spreading performance, cloud point shift, storage stratification and hydrolysis failure. This guide is formulated in accordance with general internal control standards for agricultural silicone auxiliaries, covering fault tracing, defect troubleshooting and closed-loop rectification for all batch synthesis procedures including raw material drying, nitrogen-protected hydrosilylation, low-molecular stripping, filtration blending and airtight filling.

1.2 Internal Control Quality Indicators of Finished Products and Troubleshooting Thresholds for Abnormalities

Test Item	High-Grade Agricultural Premium Product	General Industrial Auxiliary Qualified Product	Abnormality Trigger Troubleshooting Threshold
Appearance & Properties	Colorless to pale transparent oily liquid, no turbidity, suspended solids, precipitates or pungent burnt odor	Pale amber transparent liquid without obvious solid impurities	Dark yellow/brown color, cloudy haze, white flocculent precipitates, pungent metallic burnt odor, two-phase stratification
Surface Tension of 0.1% Aqueous Solution (mN/m)	≤21.0	21.1～21.8	＞21.0, severely deteriorated spreading and penetration, reduced pesticide utilization rate
Active Substance Content (%)	≥99.0	97.0～98.9	＜97.0, insufficient stripping of low-molecular substances, unbalanced raw material ratio, heavy by-products diluting effective components
Residual Si-H (Active Hydrogen, ppm)	≤10	11～30	＞30, incomplete addition reaction, continuous hydrolysis and gas

Test Item	**High-Grade Agricultural Premium Product**	**General Industrial Auxiliary Qualified Product**	**Abnormality Trigger Troubleshooting Threshold**
			generation during storage, drum bulging
Cloud Point (℃)	5～10	3～12	＜3 prone to low-temperature stratification; ＞12 excessive side crosslinking of polyether segments, impaired wetting performance
pH (10% Isopropanol Solution)	6.0～8.0	5.5～8.5	＜5.5 acidic system accelerates hydrolysis; ＞8.5 siloxane chain scission under alkaline conditions
Viscosity (25℃, mm²/s)	18～28	15～32	Low value indicates excessive residual low-molecular substances; high value indicates excessive heavy crosslinking by-products
Platinum Metal Residue (ppm)	≤5	6～15	＞15, product yellowing, discoloration of pesticide formulations and leaf spot phytotoxicity
Moisture (ppm)	≤200	201～400	＞400, sharp increase of addition side reactions, dehydrogenation condensation to form gel impurities
Thermal Storage Stability (60℃/72h)	No color deepening, no stratification, surface tension rise ≤0.8mN/m	Slight yellowing, no massive precipitates	Obvious brown discoloration, separated precipitates, surface tension rise＞1.5mN/m,

Test Item	High-Grade Agricultural Premium Product	General Industrial Auxiliary Qualified Product	Abnormality Trigger Troubleshooting Threshold
			gas generation and bubbling

1.3 Core Segments of the Full Process (Mainstream Karstedt Platinum-Catalyzed Hydrosilylation Route)

1. Raw Material Drying Pretreatment Section: Vacuum drying of heptamethyltrisiloxane MDHM to remove water; vacuum dehydration and filtration of allyl polyether to remove polyether degradation impurities, strictly controlling moisture＜150ppm.
2. Nitrogen Replacement Protection Section: Multiple high-purity nitrogen replacements in the reactor to exhaust air inside the kettle, controlling oxygen content＜10ppm to isolate oxygen and prevent platinum catalyst oxidation and material yellowing.
3. Hydrosilylation Reaction Section: Constant temperature 95～110℃, uniform dropwise addition of MDHM into allyl polyether system, batch feeding of Karstedt platinum catalyst, closed-loop monitoring of Si-H conversion rate during heat preservation to inhibit dehydrogenation and crosslinking side reactions.
4. Constant Temperature Ripening Section: Extended heat preservation reaction to consume residual Si-H, reduce unreacted allyl polyether residues and improve main product purity.
5. Vacuum Low-Molecular Stripping Section: Low-temperature high vacuum stripping of unreacted MDHM, small-molecule olefins and isopropanol solvent to stabilize active substance content and cloud point indicators.
6. Precision Filtration Refining Section: Organic solvent-resistant filter elements to remove platinum colloids and trace heavy gel by-products, lowering metal ions and turbid impurities.
7. Blending Stabilization Section: Trace pH buffer regulators to neutralize trace acidic degradation products, compound antioxidant stabilizers to improve yellowing resistance during storage.

8. Light-Proof Airtight Filling & Warehousing Section: Stainless steel/HDPE light-proof storage tanks sealed with nitrogen, isolating water vapor and light to inhibit hydrolysis and oxidative degradation.

1.4 Access Control Standards for Raw and Auxiliary Materials

1. Heptamethyltrisiloxane MDHM: Industrial refined grade with standard Si-H content, colorless transparent appearance, moisture ≤100ppm and no sulfur-containing impurities to avoid catalyst poisoning and deactivation.
2. Allyl Polyoxyethylene Ether: Monoallyl terminated, free of double bond degradation impurities, stable hydroxyl value, moisture ≤120ppm and no free polyethylene glycol.
3. Karstedt Platinum Catalyst: Low-chroma platinum complex with stable platinum content, free of inorganic metal impurities and low tendency to precipitate colloids.
4. High-Purity Nitrogen: Oxygen content＜8ppm, free of moisture and impurities, isolating oxidative side reactions throughout the process.
5. pH Buffer Stabilizer: Weak organic alkanolamine type, does not affect surface tension and long-term inhibits siloxane hydrolysis and chain scission.
6. Equipment Materials: Reactors, pipelines and filtration equipment adopt 316L stainless steel/enamel glass; carbon steel and copper pipelines are prohibited from contacting materials to prevent metal ion-induced yellowing and siloxane decomposition.

II. Special Troubleshooting for Typical Quality Defects of Finished Products

2.1 Product Yellowing, Continuous Color Deepening During High-Temperature Storage and Amber Turbidity

2.1.1 Root Causes of Failure

Oxidative degradation of allyl polyether raw materials with inherent colored conjugated impurities; MDHM containing water and sulfur impurities leads to catalyst poisoning and formation of colored platinum colloids; insufficient nitrogen replacement leaves oxygen inside the kettle to undergo oxidation reactions with platinum and silicon hydrogen to generate chromogenic substances; reaction temperature exceeding 115℃ causes siloxane high-temperature chain scission and polyether oxidation to form unsaturated colored by-products; excessive catalyst feeding results in unfiltered platinum particles triggering chain oxidation continuously; excessive temperature during low-molecular stripping leads to long-term high-temperature aging of materials; light-transmitting storage tanks cause continuous photooxidation color deepening; excessive system moisture triggers dehydrogenation condensation to form gel impurities accompanied by yellowing.

2.1.2 Troubleshooting Points

Test data of moisture, chroma and impurities of two main raw materials; real-time monitoring of oxygen content after nitrogen replacement before feeding; peak temperature during addition and low-molecular stripping processes; platinum catalyst feeding ratio and platinum residue content after filtration; vacuum degree and material residence time during vacuum stripping of low-molecular substances; light-proof sealing of storage tanks and warehouse temperature conditions.

2.1.3 Rectification Measures

Mandatory vacuum drying and filtration of MDHM and allyl polyether incoming materials to remove water and oxidized impurities; reject yellowed and deteriorated raw materials directly; three nitrogen replacements per kettle and temperature rise with catalyst feeding only after oxygen content inside kettle reaches standard; set fixed red lines for peak temperature of addition and low-molecular stripping processes to shorten high-temperature residence time; accurately meter platinum catalyst feeding amount to avoid excess; upgrade two-stage high-precision organic phase filtration to completely remove platinum colloidal particles; full-line light-proof airtight nitrogen storage tanks with constant warehouse temperature ≤35℃; secondary low-temperature stripping and re-filtration with stabilizer refining for yellowed and turbid batches.

2.2 High Surface Tension, Poor Spreading & Penetration and Reduced Pesticide Efficacy

2.2.1 Root Causes of Failure

Unbalanced molar feeding ratio of MDHM and allyl polyether with excess/insufficient polyether disrupting hydrophilic-hydrophobic molecular structure; incomplete hydrosilylation conversion with abundant unreacted MDHM and free polyether destroying interfacial activity; low reaction temperature and insufficient ripening time leading to incomplete double bond addition and increased heavy crosslinking by-products; excessive moisture triggering dehydrogenation condensation to form high-molecular gel impurities occupying interface sites; insufficient vacuum during low-molecular stripping leaving residual low-molecular siloxanes interfering with spreading performance; excessive platinum metal residues disrupting the interfacial film of pesticide liquid.

2.2.2 Troubleshooting Points

Monthly calibration records of raw material metering pumps and feeding molar ratio; real-time Si-H conversion rate central control data during addition reaction; constant reaction temperature and ripening holding time; system moisture content; vacuum negative pressure and end-point judgment of low-molecular stripping; finished product platinum ion content testing.

2.2.3 Rectification Plan

Mandatory monthly calibration of all raw material metering delivery pumps to lock the standard addition molar ratio; stabilize the constant temperature range of 95～110℃ for addition and extend ripening holding time to improve Si-H conversion rate; strictly control moisture of raw materials throughout the process ≤200ppm; overhaul vacuum units to increase negative pressure for full stripping of low-molecular siloxanes; multi-stage filtration to reduce platinum residues; re-addition and secondary low-molecular stripping purification for materials with unqualified performance.

2.3 Excessive Residual Si-H Active Hydrogen, Gas Generation & Drum Bulging During Storage

Core Root Causes: Excessively fast MDHM dropwise addition leading to local silicon hydrogen enrichment failing to fully contact polyether double bonds; insufficient ripening holding time leaving unconsumed residual Si-H; insufficient or low-activity platinum catalyst leading to incomplete addition reaction; excessive system moisture consuming catalyst and inhibiting hydrosilylation; low reaction temperature sharply reducing addition reaction rate; low-molecular stripping procedure unable to remove unreacted hydrogen-containing siloxanes.

Rectification Measures: Segmented slow and uniform dropwise addition of MDHM to ensure uniform material contact in the system; standardized ripening holding time with discharge only after central control Si-H reaches standard; accurate matching of platinum catalyst feeding amount to guarantee catalytic activity; in-depth pre-drying of raw materials to strictly control moisture throughout the process; stabilize the minimum temperature lower limit of addition to improve reaction conversion rate; reheat and ripen materials with excessive Si-H to consume active hydrogen.

2.4 Cloud Point Shift, Low-Temperature Two-Phase Stratification and Floating Precipitates in Tank-Mixed Pesticides

Core Root Causes: Batch fluctuation of EO segments of allyl polyether raw materials changing hydrophilic group proportion; unbalanced feeding ratio leading to higher cloud point with excess polyether and lower cloud point with insufficient polyether; high-temperature low-molecular stripping causing slight polyether degradation and damaged molecular hydrophilic structure; excessive heavy crosslinking by-products with poor compatibility with main products at low temperature; finished product pH deviating from 6.0～8.0 range triggering siloxane molecular chain scission; long-term storage environment below 5℃ causing precipitation and stratification of polyether segments at low temperature.

Rectification Measures: Fix single-specification allyl polyether and test EO polymerization degree of incoming raw materials; accurately lock the silicon-ether feeding molar ratio to eliminate ratio drift; lower low-molecular stripping kettle temperature to reduce thermal degradation of polyether; optimize addition process to inhibit heavy crosslinking by-products; neutralization section with trace buffer regulators to stabilize finished product pH; constant warehouse temperature ≥10℃ for finished products to avoid low-temperature storage; heat homogenize stratified materials and filter after blending buffer agents.

2.5 Excessive Moisture and Generation of Gel Flocculent Precipitates in the System

Core Root Causes: Insufficient vacuum negative pressure during pre-drying of MDHM and allyl polyether leading to excessive inherent moisture in raw materials; water-containing nitrogen for kettle replacement bringing water vapor; open operation during feeding and transfer absorbing air moisture; system moisture＞400ppm triggering dehydrogenation condensation between Si-H and water to form organosilicon gel; low-molecular stripping procedure unable to remove trace bound water; damaged storage tank seals accumulating moisture via long-term moisture absorption.

Rectification Measures: Two-stage gradient vacuum drying of raw materials with feeding only after central control moisture reaches standard; adopt dry high-purity nitrogen replacement to eliminate water vapor introduction; full-process closed negative pressure delivery prohibiting open transfer; strictly control upper limit of system moisture and re-dry raw materials with excessive moisture; improve vacuum and temperature of low-molecular stripping to remove trace bound water; regularly replace storage tank sealing gaskets and seal with positive nitrogen pressure; heat and dissolve water-containing gel materials, filter to remove gel then re-dehydrate for refining.

2.6 Excessive Platinum Metal Ions, Discoloration of Pesticide Formulations and Leaf Phytotoxic Spots

Core Root Causes: Excessive feeding of Karstedt platinum catalyst; excessively high reaction temperature decomposing platinum complexes to precipitate inorganic platinum particles; insufficient precision or damaged filter elements allowing platinum colloids to penetrate finished products; high-temperature residence time during low-molecular stripping accelerating precipitation of platinum compounds; repeated recycling of recovered mother liquor leading to continuous enrichment of platinum metals; iron ions dissolved from corroded carbon steel equipment co-developing color with platinum.

Rectification Measures: Accurately meter the minimum effective feeding amount of catalyst to avoid excess; fix upper limit of addition temperature to prevent thermal decomposition of platinum catalyst; replace high-precision organic phase filter elements and monitor filtration pressure difference per shift; reduce high-temperature residence time during low-molecular stripping; thoroughly replace recovered mother liquor regularly to remove accumulated metal impurities; passivate and anti-corrode all equipment regularly to isolate iron ion dissolution; multi-stage sedimentation and filtration of materials with excessive metal ions to remove platinum particles.

2.7 Abnormal Viscosity Fluctuation, Excessive Heavy By-Products and Uneven Liquid Spreading

Core Root Causes: Excessively high addition temperature triggering intermolecular crosslinking of siloxanes to form high-molecular heavy substances; excessive moisture inducing dehydrogenation condensation and increased macromolecular gel; self-polymerization of double bond impurities in allyl polyether raising system viscosity; unbalanced raw material ratio enriching double-molecule addition by-products; uneven stirring during ripening causing local excessive crosslinking.

Rectification Measures: Strictly control addition temperature not exceeding 110℃ to inhibit crosslinking side reactions; in-depth full-process dewatering to eliminate inducements of dehydrogenation condensation; pre-filter polyether raw materials to remove double bond degradation impurities; stabilize silicon-ether feeding molar ratio to reduce double-molecule addition; optimize stirring speed to eliminate reaction dead zones inside the kettle; secondary vacuum stripping of low-molecular heavy by-products for batches with abnormal viscosity.

2.8 pH Deviating from Standard Range and Rapid Hydrolysis Failure During Storage

Core Root Causes: Trace organic acids generated by oxidative degradation of polyether raw materials without pre-neutralization; trace acidic degradation products produced at high addition temperature; insufficient feeding of buffer stabilizer and uneven stirring leading to local neutralization component deficiency; enrichment of trace acidic low-molecular substances during low-molecular stripping; long-term oxygen absorption of storage tanks continuously generating carboxylic acids to lower pH.

Rectification Measures: Pre-neutralize allyl polyether raw materials to remove organic acids; add sufficient buffer stabilizers at low temperature after addition and extend homogenization stirring time; secondary fine-tuning of pH after low-molecular stripping; full-process nitrogen light-proof sealed storage of finished products to slow acid generation via oxidation; low-temperature precise neutralization and homogenization blending for batches with abnormal pH.

III. In-Depth Process Fault Troubleshooting by Section

3.1 Raw Material Drying Pretreatment Section

Hidden Troubles: Insufficient vacuum negative pressure during vacuum drying of MDHM and allyl polyether bringing excessive moisture into the reaction system; oxidized and yellowed polyether raw materials containing double bond degradation impurities triggering sharp increase of addition by-products; insufficient precision of raw material filtration allowing solid dust impurities to enter the kettle; open storage of raw material tanks leading to moisture absorption and degraded oxidized components; uncalibrated metering pumps causing inherent imbalance of silicon-ether ratio.

Process Red Lines: Two main raw materials must undergo vacuum drying, precision filtration and pass moisture & chroma testing before feeding; reject water-containing and yellowed oxidized raw materials directly.

3.2 Nitrogen Protection & Hydrosilylation Section (Core Control of Surface Tension, Si-H and Chroma)

Hidden Troubles: Insufficient nitrogen replacement leaving residual oxygen inside the kettle oxidizing platinum catalyst and yellowing materials; out-of-control MDHM dropwise addition rate leading to local silicon hydrogen enrichment and incomplete conversion; excessive/insufficient platinum catalyst feeding increasing side reactions or incomplete addition; over-limit reaction temperature triggering simultaneous crosslinking, oxidation and platinum decomposition; stirring dead zones causing uneven local material reaction and enrichment of heavy impurities; excessive system moisture triggering dehydrogenation condensation to form gel flocs.

3.3 Constant Temperature Ripening Section (Key Control of Residual Si-H and Main Product Purity)

Hidden Troubles: Low ripening temperature and insufficient holding time leaving unconsumed residual Si-H; air leakage of ripening kettle allowing air entry and oxidative discoloration; no central control Si-H testing at ripening end point leading to huge batch conversion rate differences; failure to rapidly cool materials after ripening resulting in continuous high-temperature crosslinking to form heavy substances.

3.4 Vacuum Low-Molecular Stripping Section (Control of Active Substances, Cloud Point and Low-Molecular Residues)

Hidden Troubles: Insufficient negative pressure of vacuum units failing to strip unreacted MDHM and small-molecule olefins; excessively high low-molecular stripping kettle temperature triggering polyether degradation, platinum catalyst precipitation and material yellowing; delayed judgment of low-molecular stripping end point leading to excessive low-molecular residues; air leakage of low-molecular stripping system allowing air entry to oxidize materials.

3.5 Precision Filtration & Neutralization Blending Section (Control of Platinum Ions, Turbidity and pH)

Hidden Troubles: Damaged or insufficient precision of organic phase filter elements allowing penetration of platinum colloids and gel impurities; low filtration temperature precipitating heavy by-products and blocking filter media; metering deviation of buffer stabilizers leading to finished product pH deviating from standard range; insufficient stirring during neutralization causing uneven local acid-base and partial hydrolysis stratification during storage.

3.6 Light-Proof Airtight Filling & Warehousing Section

Hidden Troubles: Storage tanks without positive nitrogen pressure sealing undergoing long-term oxygen absorption and yellowing; high humidity in filling workshop causing finished products to rapidly absorb moisture and contain water; light-transmitting packaging barrels and aged leaking sealing gaskets accelerating photooxidation under light; large temperature difference between day and night in warehouse aggravating precipitation and stratification via repeated temperature rise and fall; mixed tank storage of different reaction batches causing overall indicator fluctuation due to component differences.

IV. Systematic Troubleshooting of Utilities and Equipment

4.1 Nitrogen, Vacuum and Heating Drying Systems

Key Troubleshooting Points: Excessive oxygen and moisture in nitrogen failing to isolate oxidation and water vapor; leakage of nitrogen pipelines continuously introducing air into the kettle; vacuum unit negative pressure leakage and insufficient negative pressure disabling drying and low-molecular stripping procedures; scaling of heating coils causing local over-temperature triggering material crosslinking and yellowing; unstable temperature of raw material drying vacuum units failing to reach dewatering standard.

4.2 Temperature Control, Pressure and Metering Systems

Key Troubleshooting Points: Drift of temperature measuring instruments for addition, ripening and low-molecular stripping triggering over-temperature crosslinking or low-temperature insufficient conversion; faulty pressure transmitters leading to unstable nitrogen and vacuum pressure; failed calibration of MDHM, allyl polyether and catalyst metering pumps causing unbalanced ratio; out-of-control heating gradient program disrupting dropwise addition reaction rhythm.

4.3 Reaction, Filtration, Low-Molecular Stripping and Storage Tank Equipment Systems

Key Troubleshooting Points: Insufficient stirring speed of reactors and accumulated crosslinked gel materials at bottom dead zones; peeling of passivation layer on inner wall of 316L stainless steel dissolving iron ions to co-develop color with platinum ions; aging, damaged or blocked multi-stage organic phase filter elements allowing penetration of platinum colloids and gel; coking on inner wall of low-molecular stripping tower causing cross-contamination of colored heavy impurities; deposition of platinum salts and gel by-products at storage tank bottom leading to excessive impurity content of mixed batches; accumulated aged crosslinked materials at dead zones of pipeline elbows.

4.4 Closed Light-Proof Clean System

Key Troubleshooting Points: Failed sealing of equipment flanges and manholes allowing air and water vapor intrusion for oxidative degradation; no light-proof protection in filling workshop accelerating photooxidation yellowing; high environmental humidity in workshop causing finished products to absorb moisture and generate gel; dust and foreign metal impurities mixed into filled finished products; no constant temperature and light-proof protection in warehouse triggering dual degradation of materials via light and low temperature.

V. Safety and Environmental Risk Troubleshooting

5.1 Process Safety Risks

Heptamethyltrisiloxane is a low-boiling flammable liquid prone to fire upon leakage encountering high temperature and static electricity; high-temperature organic vapor of allyl polyether carries VOC explosion hazards; hydrosilylation releases intense heat, and failed temperature control may cause kettle overflow and material spraying; improper closed space replacement with high-purity nitrogen leads to suffocation risks; organic platinum catalyst easily releases heat via oxidation at high temperature exposed to air; finished organic liquids are flammable with fire hazards during leakage storage and transportation.

5.2 Three-Waste Environmental Risks

Process cleaning waste liquid containing low-molecular siloxanes, trace platinum metals and organic polyethers features high COD and trace heavy metals, requiring flocculation and precipitation pretreatment to reach discharge standards; waste organic filter elements and gel heavy filter residues are hazardous solid wastes; organic waste gas from low-molecular stripping containing siloxanes and olefins needs condensation + activated carbon adsorption devices to strictly control VOC emissions; hazardous waste collection and separate disposal of unqualified platinum-containing organic waste liquid with direct discharge prohibited.

5.3 Batch Quality Scrap Risks

Failed raw material drying and dewatering, out-of-control addition ratio and temperature, insufficient ripening conversion, incomplete platinum removal via filtration, drifted low-molecular stripping parameters and lack of light-proof sealing storage control will directly trigger batch defects including excessive surface tension, yellow turbidity, gas generation from Si-H, low-temperature stratification and platinum ion phytotoxicity, resulting in failed pesticide spray wetting, leaf spot phytotoxicity on crops and mass scrap & rework of pesticide formulations downstream.

VI. Standardized Five-Step Fault Troubleshooting Process

6.1 Full-Dimensional Abnormal Data Collection

Record finished product appearance chroma, surface tension, active substances, residual Si-H, cloud point, pH, viscosity, moisture, platinum ions and 60℃ thermal storage stability for 72h; collect full-process parameters including moisture of dried raw materials, addition temperature and pressure, catalyst feeding amount, ripening holding time, low-molecular stripping vacuum & temperature, filtration pressure difference and filling & warehousing conditions; check calibration records of metering equipment, filter element replacement records, equipment passivation records and nitrogen leakage inspection ledgers.

6.2 Segmented Sampling Traceability and Location

Sampling nodes: Dried silicon-ether raw materials → hydrosilylation intermediates → ripening crude products → low-molecular stripped semi-finished products → filtered and blended finished products. Test moisture, Si-

H, chroma and platinum ions section by section to accurately locate the procedure where faults occur.

6.3 Full Coverage Inspection of Utilities

Check purity and moisture of drying nitrogen, negative pressure of vacuum units, temperature control precision of heating system and calibration of metering equipment; inspect operating conditions of addition, ripening, low-molecular stripping and filtration equipment; check temperature & humidity, light-proof sealing of filling workshop and constant temperature light-proof environmental parameters of warehouse.

6.4 Classification and Judgment of Four Major Root Causes

1. Deviated process parameters: Addition temperature, silicon-ether feeding ratio, ripening duration, low-molecular stripping vacuum & temperature and raw material drying moisture exceeding standard ranges;
2. Failed equipment: Drifted metering pumps, damaged filter elements, vacuum leakage, drifted temperature measuring instruments and corroded stainless steel passivation layer dissolving iron;
3. Defective raw and auxiliary materials: Water-containing and oxidized silicon-ether raw materials, excessive platinum catalyst, water & oxygen containing nitrogen;
4. Material degradation side reactions: Moisture-induced dehydrogenation condensation gel, high-temperature crosslinking heavy by-products, platinum-catalyzed yellowing via oxygen absorption and siloxane hydrolysis chain scission due to acid-base imbalance.

6.5 Closed-Loop Verification of Rectification

Emergency isolation of abnormal batches, lock process red lines including anhydrous raw material pretreatment, low-temperature nitrogen addition, sufficient ripening, two-stage filtration, low-temperature stripping and light-proof sealed storage; short-term replacement of damaged consumables, calibration of metering instruments, equipment passivation & iron removal and optimization of addition temperature control & dropwise addition rate; long-term solidification of systems including full moisture inspection of incoming raw materials, monthly metering calibration, regular filter element replacement and quarterly equipment passivation; resume mass production only after three consecutive batches fully meet all indicators, no yellowing or stratification after 72h 60℃ thermal storage and stable surface tension.

VII. Quick Reference Table for Fault Troubleshooting

Abnormal Phenomenon	Core Root Cause	Priority Troubleshooting Section
Product yellowing and continuous color deepening during high-temperature storage	Water-containing oxidized raw materials, insufficient nitrogen replacement, over-temperature addition & low-molecular stripping, unfiltered excessive platinum catalyst, light-transmitting storage tanks	Raw material drying pretreatment, hydrosilylation, precision filtration, light-proof airtight warehousing
High surface tension and poor spreading & penetration	Unbalanced silicon-ether ratio, incomplete Si-H conversion, gel generated by moisture, excessive residual low-molecular substances, excessive platinum ions	Raw material metering, hydrosilylation & ripening, vacuum low-molecular stripping, multi-stage filtration
High residual Si-H and gas generation & drum bulging of finished products	Excessively fast MDHM dropwise addition, insufficient ripening time, insufficient catalyst dosage, moisture inhibiting addition reaction of raw materials	MDHM feeding control during hydrosilylation, constant temperature ripening section, raw material drying and dewatering
Abnormal cloud point and low-temperature separated precipitates	Fluctuated EO specification of polyether, unbalanced ratio, thermal degradation of polyether, pH deviating from standard range, low-temperature storage	Raw material control, addition ratio, low-molecular stripping temperature control, pH neutralization adjustment, constant temperature warehousing
Excessive moisture and generation of white gel flocs in system	Substandard raw material drying, water-containing nitrogen, moisture absorption via open transfer, leaking storage tank seals	Raw material vacuum drying, nitrogen protection, full-process closed delivery, nitrogen sealed storage tanks
Excessive platinum metal ions and pesticide	Excessive catalyst feeding, platinum decomposition at high addition temperature,	Catalyst metering control, addition temperature control, two-stage

Abnormal Phenomenon	Core Root Cause	Priority Troubleshooting Section
phytotoxic spots & discoloration	damaged filter elements, enriched platinum in recovered mother liquor	precision filtration, replacement of recovered mother liquor
High viscosity and excessive heavy crosslinking impurities	Over-temperature addition triggering crosslinking, dehydrogenation condensation due to moisture, self-polymerization of polyether double bonds, local excessive crosslinking at stirring dead zones	Hydrosilylation temperature control, in-depth raw material dewatering, pre-filtration of raw materials to remove impurities, stirring system inspection
pH deviating from 6.0～8.0 and rapid hydrolysis failure during storage	Organic acids generated by polyether oxidation, insufficient stabilizer feeding, acid generation via high-temperature degradation, continuous oxidation and acid generation under long-term oxygen absorption	Raw material pretreatment neutralization, blending buffer stabilizers, light-proof nitrogen storage

VIII. Periodic Preventive Troubleshooting Checklist

8.1 Per-Shift Inspection

Finished product clarity, no gel precipitation or stratification; preliminary screening of moisture of dried MDHM and allyl polyether; oxygen content after nitrogen replacement inside kettle; real-time addition temperature, MDHM dropwise addition rate and catalyst feeding status; ripening holding temperature and duration; operating parameters of low-molecular stripping vacuum and kettle temperature; filtration pressure difference and clarity of filtrate; nitrogen positive pressure of finished product storage tanks, workshop temperature & humidity and light-proof inspection.

8.2 Daily Inspection

Sampling inspection of operating parameters of drying nitrogen and vacuum units; rapid central control testing of finished product surface tension, moisture, pH and Si-H; simple recheck of addition conversion rate; observation of pressure difference of all levels of organic filter elements; real-time monitoring of viscosity and cloud point at low-molecular stripping end point; inspection of light-proof sealing and constant temperature status of finished product storage tanks.

8.3 Weekly Inspection

Full-line leakage inspection and calibration of nitrogen and vacuum negative pressure systems; cleaning of gel and platinum salt deposits at bottom of reactors and low-molecular stripping kettles; integrity inspection of all filter elements and replacement of blocked filter elements; simple passivation inspection of inner wall of stainless steel equipment; testing of platinum ions and gel impurity content of recovered mother liquor and replacement once upper limit is reached; discharge of water-containing impurities at bottom of raw material storage tanks.

8.4 Monthly In-Depth Testing

Full-line calibration of temperature control, pressure and metering pumps; full-indicator testing of raw materials and finished products with special re-inspection of platinum ions, residual Si-H and thermal stability; deep purification of drying nitrogen, vacuum and heating utilities; non-destructive testing of passivation layer on stainless steel of reaction, low-molecular stripping and storage equipment; verification of 60℃ accelerated thermal storage stability of finished products.

8.5 Quarterly Shutdown In-Depth Maintenance

Complete cleaning of gel, platinum salts and colored impurities for all raw material drying, addition, ripening, low-molecular stripping and filtration equipment; maintenance of stirring, vacuum, heat exchange and transmission components; complete replacement of all sealing gaskets and organic filter elements; comprehensive calibration of hydrosilylation explosion-proof, nitrogen oxygen isolation, vacuum negative pressure and light-proof clean systems; screening of inventory MDHM, allyl polyether and platinum catalysts to remove water-containing and oxidized deteriorated raw materials.

If you need more professional and in-depth analysis regarding process troubleshooting or product consultation of Agricultural silicone surfactant, please contact HiSiaddi customer service or visit our official website www.hisiaddi.com

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