A172 Full-Scenario Common Problem Troubleshooting Guide

Contents

HiSiaddi is a new foreign trade service provider driven by both technology transformation and foreign trade business. It has established a "1+2+3+4=1" service system and can supply A172 from multiple well-known original manufacturers. With more than ten years of deep cultivation in the A172 foreign trade market as an R&D-oriented new foreign trade service provider, HiSiaddi sorts out key points requiring attention during the entire A172 purchasing decision-making process from a professional perspective and shares them with you.

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I. Troubleshooting of Raw Material Source Problems

1.1 Defects of Basic Synthetic Raw Materials

Fault Manifestations

Severe attenuation of finished product interfacial adhesion, filler dispersion, wet mechanical strength and dielectric insulation performance; turbid liquid with color ranging from pale yellow to dark brown and flocculent siloxane precipitates after standing; obvious batch fluctuations of refractive index, purity, free ethylene glycol methyl ether and hydrolysis activity; interfacial delamination and sharp drop of tensile strength of glass fiber and rubber plastic composite materials; rapid fogging and gelation of hydrolyzed preparation liquid with complete failure within 24 hours; unqualified third-party test indicators including GC main content, free chlorine, residual ethylene glycol methyl ether, refractive index, water content, heavy metals and volatile matter.

Troubleshooting Key Points

Insufficient purity of vinyltrichlorosilane raw materials containing methyltrichlorosilane and polychlorosilane impurities destroys the molecular bifunctional structure; water and aldehyde impurities in ethylene glycol methyl ether raw materials lower alcohol exchange conversion rate with residual incompletely substituted chlorine groups; trace water in raw materials triggers pre-hydrolysis in advance to generate oligomeric siloxanes, making products prone to turbidity and gelation during storage; residual iron and heavy metal ions in raw materials catalyze continuous self-condensation of alkoxy groups with rapid loss of hydrolysis activity; long-term open storage of raw materials absorbs water vapor for spontaneous hydrolysis and attenuation of vinyl active groups, failing crosslinking with polyolefins.

Incoming Inspection Control

Quantitative detection of GC main components and impurities; low-temperature stability observation of refractive index, density and appearance clarity; quantitative screening of free ethylene glycol methyl ether, free chlorine and water content; heavy metal limit testing; retention sample re-inspection of hydrolyzed preparation liquid clarity and 24-hour stability; benchmark test of glass fiber filled composite material tensile strength and wet strength.

Control Scheme

Adopt high-purity vinyltrichlorosilane and anhydrous refined ethylene glycol methyl ether raw materials, strictly control water content, metal ions and hybrid silane by-products; precisely control alcohol exchange feeding molar ratio to raise complete trisubstitution conversion rate of tris(2-methoxyethoxy) groups; reject raw materials with turbidity, yellowing, excessive free alcohol residue and rapid hydrolysis gelation to guarantee uniform high purity, hydrolysis stability and interfacial coupling performance of products.

1.2 Defects of Alcohol Exchange, Neutralization and Deacidification Purification Auxiliaries

Fault Manifestations

Excessive residual metal ions and salt contents of alcohol exchange acid-binding agents and neutralization buffer auxiliaries lead to unqualified finished product ash content and chloride ions; incomplete removal of acid-binding agents leaves trace hydrochloric acid continuously catalyzing self-polymerization during storage with turbid and viscous liquid; unbalanced neutralization ratio leaves residual free acid/alkali in the system, causing out-of-control pH of hydrolyzed liquid and rapid gelation; recycled ethylene glycol methyl ether solvent accumulates unsubstituted chlorosilane intermediates to lower the proportion of effective coupling components; colored impurities carried by auxiliaries cause innate yellowing of stock solution, failing matching requirements of high-transparency glass fiber and insulating coatings.

Troubleshooting Key Points

Sodium and iron metal ions contained in alkaline acid-binding auxiliaries continuously catalyze hydrolysis and polycondensation of alkoxy groups; incomplete water washing and stratification entrap chloride salts inside stock solution; recycled alcohol solvents accumulate incompletely substituted chlorosilane intermediates to reduce the proportion of effective coupling components.

Control Scheme

Adopt low-heavy-metal refined acid-binding and neutralization auxiliaries, precisely adjust finished product stable neutral range; multi-stage pure water washing to remove chloride salts, residual hydrochloric acid and unreacted alcohol impurities, stabilize bifunctional molecular skeleton of A172 and reduce risks of hydrolysis, gelation and discoloration during storage.

1.3 Defects of Decolorization, Filtration and Vacuum Rectification Purification

Fault Manifestations

Incomplete activated carbon decolorization leads to obvious liquid yellowing and severe fogging of high-transparency glass fiber products and insulating varnish; insufficient precision of filter elements leaves macromolecular polysiloxane and salt micro-particle residues, generating white spot pits on product surfaces after filler modification; offset vacuum rectification cutting interval leaves mono/disubstituted intermediates with sharp decline of coupling efficiency; calcium and magnesium ions contained in water for water washing purification cause out-of-control silane hydrolysis rate and easy flocculation of preparation liquid.

Troubleshooting Key Points

Saturated adsorption of decolorization fillers fails to remove colored oxidized impurities; aging and damaged filter elements incompletely intercept oligomeric siloxane impurities; improper control of rectification vacuum degree and temperature prevents effective separation of target components and intermediates; insufficient standing stratification duration of oil and water entraps trace water into finished products for advance pre-hydrolysis.

1.4 Defects of Sealed Oxygen-Isolated Drying Protection

Fault Manifestations

A172 features ether-type alkoxy groups with prominent water and temperature sensitivity. Under high temperature, open and high-humidity environments, alkoxy groups hydrolyze to generate silanol and undergo rapid intermolecular condensation; continuous deepening of liquid chroma, slow viscosity rise and cliff-like drop of hydrolysis activity; open storage absorbs water vapor from air to precipitate flocculent siloxane after standing; huge batch fluctuations of filler dispersion and interfacial adhesion strength with obvious volatility of composite material mechanical properties.

II. Troubleshooting of Alcohol Exchange Synthesis, Neutralization Rectification and Filtration Filling Process Faults

2.1 Out-of-Control Alcohol Exchange Substitution and Deacidification Rectification Procedures

Fault Manifestations

Unbalanced reaction temperature, ethylene glycol methyl ether feeding volume and reaction duration lead to insufficient trisubstitution conversion rate with massive residual mono/disubstituted chlorine intermediates and insufficient reaction sites between vinyl groups and inorganic interfaces; excessively high reaction temperature breaks siloxane bonds to generate macromolecular polysilanes, resulting in turbid liquid and rapid gelation of hydrolyzed preparation liquid; excessively low temperature leads to incomplete alcohol exchange with excessive free chlorine and free ethylene glycol methyl ether; uneven stirring flow rate generates massive salts from localized excessive acid-binding agent concentration; insufficient rectification vacuum fails to separate light and heavy components with inconsistent batch purity and hydrolysis stability.

Optimization Scheme

Segmented low-temperature closed temperature-controlled alcohol exchange process, precisely control ethylene glycol methyl ether feeding ratio to maximize the proportion of complete trisubstituted target products; low temperature suppresses thermal polymerization side reactions and strictly controls generation of oligomeric siloxanes; gradient vacuum rectification removes intermediates, free alcohols and chloride salts with full-process nitrogen oxygen isolation protection to lock stable hydrolysis activity, high coupling efficiency and low gelation characteristics.

2.2 Defects of Water Washing Neutralization, Decolorization Decontamination and Vacuum Desolventization Procedures

1. Failure of water washing neutralization: Incomplete removal of free hydrochloric acid, acid-binding salts and unreacted ethylene glycol methyl ether leads to excessive finished product chloride ions and free alcohols, continuous hydrolysis and gelation during storage and sharp drop of composite material wet strength; residual trace water accelerates pre-hydrolysis and deterioration of stock solution.
2. Incomplete decolorization decontamination: Residual colored oxidized impurities and oligomeric siloxanes cause yellowing and turbidity of liquid with fogging white spots in transparent insulation and glass fiber systems; residual mono/disubstituted intermediates weaken bridging capacity of coupling agents.
3. Out-of-control desolventization: Incomplete removal of ethylene glycol methyl ether leaves strong pungent solvent odor in finished products, interferes crosslinking reactions and fails safety indicators.

2.3 Problems of Constant-Temperature Maturation, Precision Filtration and Closed Filling Procedures

Fault Manifestations

High-temperature and open storage of maturation tanks causes continuous hydrolysis and condensation of alkoxy groups with fogging and turbidity of liquid and loss of coupling activity; insufficient maturation duration fails to homogenize components with obvious batch fluctuations of refractive index, purity and hydrolysis stability; failure of terminal precision filtration leaves fine carbon powder and polysiloxane micro-particle residues, generating particle defects on product surfaces after filler modification; high-temperature high-humidity open operation in filling workshop causes secondary yellowing of stock solution via water absorption and pre-hydrolysis; aged polymeric stock solution accumulated in filling pipelines causes cross-contamination of batches and unstable interfacial performance.

III. Full-Link Troubleshooting of Packaging, Storage and Logistics

3.1 Defects of Packaging Sealing, Oxygen and Moisture Isolation

Fault Manifestations

Ordinary plastic barrels transmit water vapor and air continuously, inducing pre-hydrolysis of stock solution, polysiloxane precipitation and rapid gelation of hydrolyzed preparation liquid; packaging without light-proof lining accelerates oxidative degradation of vinyl groups under light with reduced crosslinking activity; ordinary rubber gaskets are swelled and precipitated by ether solvents, causing stratification and matting of compound coatings and rubber plastic systems; large barrels without nitrogen filling for oxygen isolation undergo preferential hydrolysis and deterioration of surface stock solution with inconsistent purity and activity indicators between barrel top and bottom.

Control Scheme

Adopt light-proof high-barrier ether-resistant sealed HDPE barrels for complete airtight filling; vacuum nitrogen filling storage for high-end specifications to isolate water vapor and oxygen, block pre-hydrolysis and self-polymerization paths and stabilize long-term purity, hydrolysis activity and interfacial coupling indicators.

3.2 Abnormal Control of Storage Environment

Standard storage conditions: Cool constant-temperature closed warehouse with temperature 10–30℃, relative environmental humidity ≤45%, ventilated, clean and dry storage room; prohibit storage above 35℃, freezing below 0℃ and open-air strong light stacking; prohibit mixed storage with strong acids,

strong alkalis, water, alcohols and metal catalytic materials, keep away from heat sources, steam pipelines and open flames.

Fault Manifestations

Storage temperature above 30℃ doubles A172 hydrolysis and condensation rate, causing liquid yellowing, increased free polysiloxanes and coupling failure; temperature below 0℃ brings no irreversible precipitation but elevated viscosity to hinder dilution and dispersion; high-humidity warehouse environment generates water condensation on barrel walls to exceed stock solution water content with fogging and flocculation of hydrolyzed preparation liquid within minutes; mixed storage with acid/alkali and water-containing solvents triggers violent rapid hydrolysis and gelation with direct material scrapping; large day-night temperature difference causes repeated water condensation on inner barrel walls with accumulated water aggravating pre-hydrolysis.

3.3 Logistics Transportation Damage

High-temperature exposure inside carriage accelerates hydrolysis of alkoxy groups of stock solution during transportation with loss of crosslinking and coupling activity; low-temperature transportation without heat preservation drastically elevates viscosity with uneven dilution and dispersion upon arrival; packaging extrusion damage and leakage cause secondary pre-hydrolysis and impurity contamination upon contact with water vapor and dust; loose barrel cover sealing during long-distance bumpy transportation allows air and water ingress with rapid fogging and gelation of liquid.

IV. Troubleshooting of Faults in Full-Industry Application Scenarios

4.1 Glass Fiber Reinforced Polyolefin and Wire & Cable Halogen-Free Flame Retardant Composite Material Scenario

Common Faults

Interfacial peeling between glass fiber and resin, sharp drop of material tensile and impact strength; agglomeration and poor dispersion of aluminum hydroxide/magnesium hydroxide fillers, melt fluctuation during extrusion and pit defects on product surfaces; sharp drop of insulation resistance after water immersion with electric leakage risk; low crosslinking efficiency and insufficient heat resistance and aging resistance of cables; obvious batch differences of composite material mechanical and dielectric properties.

Troubleshooting Key Points

Low finished product main content and high mono/disubstituted intermediate content lead to insufficient interfacial bridging groups; pre-hydrolysis of stock solution generates polysiloxanes with lost filler coating capacity; excessively

high filler modification temperature causes volatilization and degradation of silane in advance; extreme system pH destroys condensation between silanol and inorganic fillers; unbalanced silane addition ratio with weak interface at insufficient dosage and excessive crosslinking embrittlement at excessive dosage.

4.2 Unsaturated Polyester and Vinyl Resin Glass Fiber Molding Compound Scenario

Common Faults

Delamination and peeling of molded products, whitening and cracking after boiling water immersion; poor glass fiber wetting with dry filament inclusion in material masses and unqualified mechanical strength; fogging and reduced light transmittance of cured paint films; turbidity of resin system during storage and short-term precipitation of flocculates; rapid attenuation of product weather resistance after high-temperature curing.

Troubleshooting Key Points

Residual oligomeric siloxane impurities in stock solution are incompatible with resin to generate fogging; uncontrolled pH of hydrolyzed preparation liquid outside 3.5–4.5 triggers rapid self-polymerization failure of silanol; oil stain impurities on glass fiber surfaces lack sufficient hydroxyl groups to bind with silane; excessively high curing temperature induces premature oxidative deactivation of vinyl groups.

4.3 Mineral Filler (Kaolin, Talc, Quartz) Modification and Masterbatch Processing Scenario

Common Faults

Filler agglomeration and caking, broken strands and unstable discharging during extrusion granulation; product hardening and embrittlement as well as declining impact strength after raising masterbatch filling amount; white siloxane bloom precipitation on masterbatch surfaces after storage; severe volatilization under high processing temperature, die carbon accumulation and oil spots on products; large batch fluctuations of filler dispersion effect.

Troubleshooting Key Points

Excessive residual free ethylene glycol methyl ether in stock solution volatilizes and loses under high-temperature processing; insufficient hydrolysis activity fails to completely coat filler surfaces; excessive silane addition causes migration and bloom precipitation of redundant silane; extrusion temperature exceeding 200℃ induces thermal decomposition failure of silane.

4.4 Insulating Coatings, Electronic Packaging and Photovoltaic Substrate Adhesion Promotion Scenario

Common Faults

Poor coating adhesion with metal and glass substrates, cracking and peeling after cold-heat cycling; blistering and whitening of paint films after boiling water and humid heat resistance test; high dielectric loss and unqualified insulation protection; fogging and turbidity of transparent varnish with reduced gloss; stratification and fine particle precipitation of coating system during storage.

Troubleshooting Key Points

Residual chloride ions and metal impurities in stock solution lower insulation performance; storage of hydrolyzed preparation liquid exceeding 24 hours mixes siloxane flocculates into coatings; oil stain contamination and lack of hydroxyl groups on substrate surfaces fail to form Si-O-M covalent bonds; acid-base additives in coating system catalyze secondary hydrolysis of silane.

4.5 Emulsion and Waterborne Acrylic Copolymer Monomer Modification Scenario

Common Faults

Low emulsion polymerization conversion rate and massive gel particles; poor water resistance and salt spray resistance of paint films with easy water seepage and whitening; emulsion stratification and floating oil during storage with insufficient stability; obvious fogging of transparent coatings and rapid loss of gloss outdoors.

Troubleshooting Key Points

Pre-hydrolysis of stock solution generates macromolecular siloxanes incompatible with waterborne emulsions; excessively high concentration of hydrolyzed preparation liquid forms gel impurities via rapid self-polymerization; polymerization initiators and acid-base buffers destroy vinyl activity of silane; excessive free alcohol content in the system interferes with emulsion film formation.

V. Troubleshooting Module for Abnormal Physical and Chemical Indicators

5.1 Unqualified Determination of Core Efficacy Indicators

Causes of Attenuated Interfacial Coupling, Filler Dispersion, Crosslinking and Insulation Performance

Insufficient conversion rate of alcohol exchange substitution dilutes effective trisubstituted components with mono/disubstituted intermediates; incomplete rectification decontamination and water washing desalting procedures accumulate polysiloxane and chloride salt impurities to trigger rapid gelation

after hydrolysis; high-temperature synthesis and high-temperature storage induce pre-hydrolysis of alkoxy groups and oxidative loss of vinyl activity; continuous catalysis of condensation by water, metal, acid and alkali impurities eliminates core functions of inorganic-organic interfacial bridging, filler coating, free radical crosslinking and insulation modification.

Qualified Judgment Standard (Industrial Grade Silane Coupling Agent A172)

Colorless to pale yellow clear transparent liquid without stratification, flocculent precipitates or strong pungent solvent odor; GC main component ≥98.0%, free ethylene glycol methyl ether ≤0.3%, refractive index 1.4260–1.4280, water content ≤0.1%, free chlorine ≤10ppm, heavy metal (Pb) ≤10ppm; stable under neutral conditions with clear hydrolyzed preparation liquid free of gelation within 24 hours under weak acid environment, excellent coating and dispersion performance for glass fiber, metal and mineral fillers, significantly improving dry/wet strength and insulation performance of composite materials with consistent batch stability.

5.2 List of Abnormal Physical, Chemical and Safety Indicators

1. Excessive water content: Incomplete dehydration during rectification, water absorption via failed packaging sealing, water condensation under high storage humidity, water ingress from logistics leakage
2. Yellowing, fogging liquid and flocculate precipitation: Pre-hydrolysis under high temperature, photooxidation, metal ion catalysis and residual polysiloxane impurities
3. Rapid gelation of hydrolyzed preparation liquid: Excessive mono/disubstituted intermediates, out-of-control pH, pre-hydrolysis deterioration of stock solution and overlong storage of preparation liquid
4. Low main content and coupling failure: Incomplete alcohol exchange reaction, excessive loss of main products via over-cutting light components during rectification
5. Excessive free ethylene glycol methyl ether: Insufficient vacuum desolventization procedure, volatilization under high-temperature processing and crosslinking interference
6. Excessive chloride ions and ash content: Residual acid-binding salts, incomplete water washing neutralization desalting and raw material hybrid silane impurities
7. Filler agglomeration and product pit defects: Incomplete filtration interception of polysiloxane micro-particles and attenuation of silane dispersion coating capacity

8. Sharp drop of wet insulation and strength: Residual impurity ions and insufficient interfacial bridging groups, excessive hydrolysis and loss of activity
9. Coating fogging and stratification: Incompatibility between macromolecular polysiloxanes and organic resins/emulsions
10. Poor storage stability: Lack of light-proof, oxygen-isolated and moisture-proof sealing protection leading to continuous pre-hydrolysis and condensation with monthly activity attenuation

VI. Rapid Troubleshooting Process for After-Sales Complaints by Grade

6.1 Grade I Fault (Unqualified Core Indicators)

Fault scope: Insufficient main content, excessive free alcohol/water/chloride ions, large-area fogging and gelation of stock solution, complete failure of interfacial coupling and unqualified third-party testing.

Troubleshooting sequence: Retest retention sample GC main components and impurities → physical and chemical testing of refractive index, water content and free chlorine → 24-hour stability test of hydrolyzed preparation liquid → benchmark test of glass fiber filling tensile strength and insulation → check batch COA quality inspection report → review full-process ledgers of alcohol exchange, neutralization rectification, filtration and filling → verify incoming raw material quality inspection records and light-proof constant-temperature moisture-proof oxygen-isolated storage records.

6.2 Grade II Fault (Application Function Faults)

Fault scope: Composite material stratification and sharp strength drop, filler agglomeration and pit defects, rapid gelation of hydrolyzed liquid, poor coating adhesion and whitening after boiling water immersion, excessive insulation loss, emulsion gelation and stratification, product bloom and fogging.

Troubleshooting sequence: Confirm downstream modification temperature, hydrolyzed preparation liquid pH, silane addition ratio, substrate surface pretreatment and system acid-base environment; check whether stock solution undergoes high-temperature high-humidity storage, open pre-hydrolysis and fogging deterioration; confirm timely use of fresh hydrolyzed preparation liquid with weak acid pH control and standardized stirring dilution; troubleshoot light-proof sealing performance of finished material storage; distinguish pseudo-faults caused by raw material quality defects and terminal overlong preparation liquid storage, overhigh processing temperature, substrate pollution and unbalanced formula acid-base.

6.3 Grade III Fault (Slight Sensory Physical Defects)

Fault scope: Slight pale yellow of stock solution, slight viscosity rise at low temperature, small batch fluctuation of mechanical properties and short-term slight fogging of hydrolyzed liquid.
Troubleshooting sequence: Troubleshoot high-temperature heat accumulation in storage, water condensation on barrel walls due to day-night temperature difference and logistics exposure to sunlight or freezing with packaging damage; check packaging sealing, light-proof, oxygen-isolated and moisture-proof performance; retest full set of physical, chemical and interfacial coupling stability indicators; distinguish physical phenomenon of low-temperature viscosity rise from true pre-hydrolysis gelation deterioration fault.

VII. Full-Process Prevention and Optimization Supporting Scheme

1. Raw material and alcohol exchange synthesis control: Adopt high-purity anhydrous vinyltrichlorosilane and refined ethylene glycol methyl ether raw materials, strictly control water content, heavy metals, hybrid silanes and oxidized impurities; segmented low-temperature closed precise alcohol exchange to raise trisubstitution target product conversion rate and strictly control mono/disubstituted intermediates and free chlorine by-products; multi-stage vacuum rectification + low-temperature activated carbon decolorization + multi-stage water washing desalting to completely remove free ethylene glycol methyl ether, chloride salts, colored polymeric polysiloxane impurities and catalytic metal ions, fundamentally guaranteeing high purity, low free alcohol, low pre-hydrolysis and long-term stable interfacial coupling performance.
2. Production process optimization: Complete alcohol exchange, neutralization water washing, decolorization and rectification under full-process nitrogen light-proof oxygen isolation; multi-time pure water multi-stage water washing to remove hydrochloric acid and acid-binding salts, drastically lowering chloride ion content and eliminating hidden dangers of catalytic pre-hydrolysis during storage; precise vacuum desolventization to control residual ethylene glycol methyl ether content and avoid volatilization interference of crosslinking under high-temperature processing; constant-temperature light-proof oxygen-isolated storage tank maturation and homogenization to unify batch refractive index, purity and hydrolysis activity; precision filtration and sealed non-open filling in clean workshop to eliminate secondary water absorption pre-hydrolysis, dust impurity cross-contamination and batch performance differences.

3. Packaging, storage and logistics control: Black light-proof high-barrier ether-resistant sealed HDPE barrels with airtight nitrogen filling for oxygen and moisture isolation; full-process storage at 10–30℃ with humidity ≤45% in light-proof dry warehouse, stacked off the ground with separate partition from strong acids, strong alkalis, water, alcohol solvents and metal catalytic materials; full-process light-proof constant-temperature protection for logistics to eliminate carriage exposure to sunlight and high temperature, sub-zero freezing and packaging leakage damage, preventing stock solution pre-hydrolysis fogging and gelation as well as attenuation of coupling and crosslinking activity.
4. Standardized terminal application: Seal and store stock solution in cool light-proof environment and use up quickly after opening; adopt deionized water for hydrolyzed preparation liquid, adjust pH to 3.5–4.5 with acetic acid, control silane concentration ≤2%, stir for 30 minutes until clear and discard unused liquid within 24 hours; fully dry and remove water from mineral/glass fiber fillers at modification temperature 100–120℃ to ensure complete condensation of silanol; match standard addition range of 0.3%–1.2% according to filler filling amount to avoid weak interface at insufficient dosage and bloom embrittlement at excessive dosage; control medium-low temperature process for rubber plastic crosslinking and emulsion polymerization to reduce oxidative loss of vinyl groups; maintain neutral to weak acid range for coating and insulation systems to avoid extreme acid-base catalysis of secondary silane hydrolysis; store modified composite materials under low-temperature airtight conditions to long-term stabilize filler dispersion, dry/wet mechanical strength, dielectric insulation and substrate adhesion performance, eliminating defects such as interfacial delamination and peeling, pit fogging, hydrolysis gelation, insulation failure and bloom whitening of finished products.

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