Roller

Manufacturing

Assembly and debugging

Bonding of the hub to the rubber layer: Use epoxy resin glue . The bearing is connected to the hub key slot and threads

Manufacturing of Inner core shaft

Manufacturing of outer rubber rollers

Injection molding, demolding after cooling, and then milling keyways or threads (for connecting springs and bearings)

Mold injection molding, mold design with tooth-like or wavy patterns

ABS processing

1. Monomer Mixing and Pre-polymerization

Raw material ratio: Styrene (St) : Acrylonitrile (AN) : Butadiene (Bd) = 50-70% : 20-30% : 10-20%.

Initiator: Azo diisobutyl nitrile (AIBN) or Di-t-butyl peroxide (DTBP).

Pre-polymerization: Partial polymerization at high temperature (80-100°C) until a conversion rate of 10-20% is achieved, forming oligomers.

1. Continuous Bulk Polymerization

Reactor: Tower or kettle reactor, pressure 0.5-1.5 MPa, temperature 100-130°C.

Process control:

Gradually increase temperature to promote reaction, achieving a final conversion rate of 60-80%.

Remove unreacted monomers (styrene, acrylonitrile) via vacuum devolatilization.

Material: ABS plastic

Production Process

Further processing

Raw material ratio: Styrene (St): Acrylonitrile (AN): Butadiene (Bd) = 50-70% : 20-30% : 10-20%.

Pre-polymerization

Initiator: Azo diisobutyl nitrate (AIBN) or di-t-butyl peroxide (DTBP).

Nitrile Rubber Production Process

Emulsion Polymerization

1. Monomer Pre-treatment

Acrylonitrile (AN): Dehydrate to moisture content <0.05% to prevent side reactions forming acidic substances.

Butadiene (BD): Wash with alkali to remove sulfides and oxygen impurities, avoiding chain transfer reactions.

Emulsifier: Sodium dodecyl sulfate (SDS) or rosin acid soap, used to stabilize the latex.

Initiator: Potassium persulfate (KPS) or AIBN, initiating free radical polymerization.

1. Polymerization Reaction

Ingredient ratio: Acrylonitrile 18-50% (affects oil resistance and elasticity), Butadiene 50-82%.

Reaction conditions:

Temperature: 40-60°C (controls molecular weight distribution).

pH: Adjusted to 7-8 (prevents acidic substances from inhibiting polymerization).

Process control:

Monomers are added gradually to maintain latex stability.

Reaction time 6-12 hours, conversion rate 60-80%.

1. Post-processing

Coagulation: Add a salting-out agent (e.g., NaCl or Na₂SO₄) to coagulate the latex into particles.

Washing: Multiple water washes to remove residual emulsifiers and unreacted monomers.

Material: Nitrile rubber

Production process

Post-processing

Polymerization reaction

Raw material pre-treatment

Acrylonitrile: Dehydrate to a moisture content of less than 0.05% to prevent the formation of acidic substances due to side reactions.

Aggregation: Add a salt precipitant to cause the latex to aggregate into particles.

Ingredient ratio: Acrylonitrile accounts for 18-50%, butadiene accounts for 50-82%. Temperature: 40-60℃; Gradually add the monomers; Reaction time: 6-12 hours

Butadiene (BD): Washed with alkali to remove sulfides and oxygen impurities, avoiding chain transfer reactions

Washing: Perform multiple water washes to remove residual emulsifiers and unreacted monomers.

Protective Layer

Material: Gelatin

Production Process

I. Raw Material Selection and Pre-treatment

1. Pre-treatment Process

Dehairing and Defatting:

Dehairing: Soak in sodium hydroxide (NaOH) solution (5-10% concentration) to soften and remove hair (12-24 hours).

Defatting: Remove fat and impurities using organic solvents (e.g., acetone) or alkaline detergents.

Crushing: Mechanically pulverize the skin material into fine particles (1-3 mm diameter) to increase reaction surface area.

II. Collagen Extraction

Acid Hydrolysis

Acid type: Hydrochloric acid (HCl) or citric acid (pH 1.5-2.5).

Conditions:

Temperature: 40-60°C, reaction time 12-24 hours.

Liquid-to-solid ratio: 1:10 (skin material : acid solution).

Purpose: Break down collagen into gelatin peptide chains while retaining partial triple-helix structure integrity.

III. Purification and Refinement

1. Neutralization and Washing

Neutralization: After acid hydrolysis, adjust pH to neutral using sodium carbonate (Na₂CO₃).

Washing: Multiple water washes to remove residual acids/alkalis and impurities (conductivity <1000 μS/cm).

1. Filtration and Concentration

Filtration: Remove suspended particles using a plate and frame filter press or centrifuge.

Concentration: Increase gelatin solution concentration to 10-15% via vacuum evaporation (temperature ≤60°C).

IV. Forming and Drying

1. Gelation

Cooling: Cool the concentrated solution to 30-40°C to form a gel (gel strength ≥150 Bloom g).

Slicing: Cut the gel into strips (1-3 cm width) for subsequent drying.

1. Drying Process

Methods:

Natural air-drying: Low temperature (20-30°C), ventilated drying (7-10 days).

Hot air drying: Tunnel oven at 40-60°C, humidity ≤30% (24-48 hours).

Final product specifications: Moisture content ≤12%, ash content ≤2%.

Protective layer

Material: Gelatin

Purification and refinement

Production Process

Raw materials and pre-treatment

After acid hydrolysis, the pH is adjusted to neutral using sodium carbonate (Na₂CO₃) and the residual acid/alkali and impurities are removed through multiple washes with water; the suspended particles are removed using a plate and frame filter press or centrifuge, and the concentration of gelatin is increased by vacuum evaporation.

Collagen extraction

Raw material selection: Pig skin

Pre-treatment: Dehairing: Soak in a sodium hydroxide (NaOH) solution (concentration 5-10%) to soften and remove the hair (time 12-24 hours).

Defatting: Remove fat and impurities using organic solvents (such as acetone) or alkaline cleaning agents.

Crushing: Mechanically crush the skin material into fine particles.

The raw materials are hydrolyzed using hydrochloric acid. Temperature: 40 - 60℃, reaction time: 12 - 24 hours.

Liquid-to-solid ratio: 1:10 (wet material: acid solution).

Forming and Drying

Cool the concentrated solution to 30-40℃ to form a gel-like substance. Then, store it in a low-temperature (20-30℃) and well-ventilated dry environment (for a period of 7-10 days).

Photosensitive Layer

Material: Silver Bromide

Production Process

1. Raw Material Preparation

Silver nitrate (AgNO₃): Purity ≥99.5%, dried to moisture content ≤0.1%.

Bromide (NaBr/KBr): Industrial-grade sodium bromide or potassium bromide (purity ≥98%), crushed to particle size <0.5 mm.

Reaction solvent: Deionized water (conductivity ≤1 μS/cm).

1. Chemical Reaction

Reaction equation:

 AgNO3 + NaBr →AgBr +NaNO3

- Process conditions:

Temperature: 25-40°C (avoid decomposition of AgBr at high temperatures).

Concentration: Silver nitrate solution 10-20% (mass fraction), bromide excess 10-20%.

Mixing method: Countercurrent stirring reaction (residence time 1-2 hours).

1. Post-processing and Purification

Filtration: Remove unreacted silver nitrate and byproduct sodium nitrate using a plate-and-frame filter press (filtrate is recycled).

Washing: Wash multiple times with cold deionized water (until filtrate conductivity <10 μS/cm).

Drying: Vacuum oven drying (temperature ≤40°C, vacuum ≤10 kPa), moisture content ≤0.5%.

Preparation of raw materials

Silver nitrate (AgNO₃)

Bromide (NaBr)

Reaction solvent: Deionized water

Chemical reaction

Post-processing

Filtering: Remove the unreacted silver nitrate and by-products of sodium nitrate using a plate-and-frame filter press.

Washing: Wash multiple times with cold deionized water.

Drying: Dry in a vacuum oven.

AgNO3 + NaBr →AgBr +NaNO3

Reaction conditions: Temperature: 25 - 40℃

Concentration: Concentration of silver nitrate solution 10 - 20%, bromide excess 10 - 20%

Photosensitive layer

Material: Silver bromide

Production process