NESANS

TECHNICAL GUIDES

Sand Plant Flocculant Systems: Optimize Chemical Usage and Reduce Costs

Optimize flocculant usage in sand washing plants. Mixing, dosing, and application techniques to reduce chemical costs while maintaining performance.

Author: Sivabalan Selvarajan

Published: March 14, 2026

Reading Time: 7 minutes

Flocculant systems are essential for efficient water management in sand washing and aggregate processing plants. Proper flocculant selection, dosing, and system operation enables rapid settling of fine particles, allowing water recycling while producing clean water for discharge or reuse. Understanding flocculant chemistry and application techniques helps operators optimize chemical costs while meeting environmental requirements.

Understanding Flocculant Chemistry

Types of Flocculants

Flocculants are high-molecular-weight polymers that cause fine particles to aggregate into larger, faster-settling flocs:

TYPE	CHARGE	MOLECULAR WEIGHT	TYPICAL APPLICATION
Anionic polyacrylamide	Negative (-)	15-25 million	Most mineral and sand applications
Cationic polyacrylamide	Positive (+)	5-15 million	Organic-rich waste, municipal sludge
Non-ionic polyacrylamide	Neutral	8-15 million	Acidic slurries, special applications
Polyamine/ polyDADMAC	Strong positive	Low (coagulant)	Primary treatment, charge neutralization

Flocculation Mechanism

Effective flocculation involves several mechanisms working together:

1. **Charge neutralization:** Polymer counters particle surface charge
2. **Bridging:** Long polymer chains connect multiple particles
3. **Patch flocculation:** Localized charge patches attract particles
4. **Sweep flocculation:** Growing flocs capture smaller particles

Factors Affecting Flocculant Performance

FACTOR	EFFECT ON PERFORMANCE	OPTIMIZATION APPROACH
pH	Affects polymer charge and activity	Adjust pH to optimal range (6.5-8.5 typical)
Solids concentration	Higher solids need more flocculant	Dilute feed if necessary, adjust dose
Particle size distribution	Finer particles harder to flocculate	May need coagulant + flocculant
Water hardness	Calcium/magnesium affect polymer activity	Select appropriate polymer grade
Temperature	Cold water reduces reaction rate	Increase mixing time or dose
Competing ions	Can consume flocculant	Increase dose or pretreat water

Flocculant Preparation Systems

Dry Polymer Makeup Units

Most industrial flocculants are supplied as dry powder requiring controlled mixing:

Three-tank system components:

- **Wetting chamber:** Initial water contact, prevents lumping
- **Mixing tank:** Mechanical agitation for polymer hydration
- **Aging/storage tank:** Final maturation before use

Makeup procedure:

1. Fill mixing tank with clean water to setpoint
2. Start mixer at moderate speed
3. Create vortex in wetting chamber with water flow
4. Add dry polymer slowly through wetting chamber
5. Continue mixing for 45-60 minutes minimum
6. Transfer to aging tank, allow 30+ minutes maturation

Critical parameters:

PARAMETER	TYPICAL RANGE	CONSEQUENCE OF ERROR
Solution concentration	0.1-0.5% (1-5 g/L)	Too high: poor mixing, waste; Too low: weak flocs
Water temperature	15-30°C	Cold: slow hydration; Hot: polymer degradation
Mixing time	45-90 minutes	Too short: incomplete hydration, poor performance
Mixer speed	Moderate vortex	Too fast: polymer degradation; Too slow: lumping

Emulsion Polymer Systems

Liquid emulsion polymers offer faster makeup but higher chemical cost:

Advantages:

- Faster preparation (10-20 minutes)

- No dust handling
- Easier dosing control
- Compact equipment

Disadvantages:

- Higher cost per active kilogram
- Shorter shelf life (6-12 months)
- Temperature sensitive storage

Solution Concentration Guidelines

Optimize concentration for best performance and cost:

APPLICATION	STOCK SOLUTION	DOSING SOLUTION	NOTES
Sand washing	0.25-0.5%	0.025-0.05%	Dilute before dosing point
Thickener feed	0.3-0.5%	0.05-0.1%	Good mixing essential
Belt press feed	0.3-0.5%	0.1-0.2%	Higher concentration for shear resistance

Dosing System Design

Dosing Point Location

Proper dosing point location is critical for flocculant effectiveness:

Optimal characteristics:

- Good initial mixing with slurry
- Adequate retention time for floc formation
- Minimal shear after floc formation
- Accessible for adjustment and maintenance

Common dosing locations:

EQUIPMENT	DOSING LOCATION	NOTES
Thickener	Feedwell inlet or dilution zone	Avoid adding after feedwell
Clarifier	Inlet pipe or mixing chamber	Need flash mixing zone
Cyclone overflow	Discharge pipe, before launder	Use inline static mixer
Settling pond	Inlet channel with baffles	Create mixing then calm zone

Dosing Pump Selection

PUMP TYPE	ADVANTAGES	DISADVANTAGES	BEST APPLICATION
Peristaltic	No contact with fluid, good accuracy	Tube wear, pulsing flow	Small flows, accurate dosing
Progressive cavity	Handles viscous solutions, steady flow	Stator wear, higher cost	Larger flows, viscous solutions
Diaphragm	Reliable, handles pressure	Pulsing, valve maintenance	Moderate flows, general use
Centrifugal	High flow, low maintenance	Shear degrades polymer	Low concentration dilution only

Dosing Rate Determination

Calculate initial dosing rate from jar testing and site trials:

```
Flocculant dose (g/tonne dry solids) = typically 20-100 g/t

Dosing rate calculation:
Dry solids rate = Slurry flow (m³/h) × Solids concentration (kg/m³)
Flocculant rate = Dry solids rate × Dose (g/t) / 1000

Example:
Slurry flow: 200 m³/h
Solids: 100 kg/m³ (10% by weight)
Dose: 50 g/tonne
Dry solids: 200 × 100 = 20,000 kg/h = 20 t/h
Flocculant rate: 20 × 50 / 1000 = 1.0 kg/h active polymer

At 0.25% solution concentration:
Solution rate: 1.0 / 0.0025 = 400 L/h
```

Optimization Techniques

Jar Testing Procedure

Jar testing is essential for flocculant selection and dose optimization:

1. **Collect representative sample:**
   - Take sample from actual process stream
   - Test within 2 hours of collection
   - Record solids concentration and pH
2. **Prepare test solutions:**
   - Make 0.1% flocculant solutions of each product to test
   - Use same water source as plant makeup
   - Age solutions minimum 45 minutes
3. **Conduct jar tests:**
   - Add 500mL sample to each jar
   - Add flocculant at different doses
   - Mix rapidly for 30 seconds
   - Mix slowly for 2 minutes
   - Observe settling and supernatant clarity
4. **Record results:**
   - Settling rate (cm/minute)
   - Supernatant clarity (turbidity)
   - Floc size and strength
   - Underflow density achieved

Dose Optimization Strategies

SYMPTOM	PROBABLE CAUSE	ADJUSTMENT
Large flocs but slow settling	Overdosing - fluffy flocs	Reduce dose 20-30%
Small flocs, cloudy overflow	Underdosing	Increase dose 20-30%

SYMPTOM	PROBABLE CAUSE	ADJUSTMENT
Good flocs but break up	Too much shear after dosing	Relocate dosing point, reduce agitation
Variable performance	Inconsistent preparation or feed	Audit preparation procedure, stabilize feed
Works initially then fails	Solution degradation	Reduce holding time, check mixing

Continuous Monitoring

Install monitoring to optimize dosing in real-time:

PARAMETER	MEASUREMENT METHOD	USE
Feed density	Nuclear density gauge or ultrasonic	Adjust dose to solids loading
Overflow turbidity	Online turbidimeter	Feedback for dose adjustment
Bed level (thickener)	Ultrasonic or pressure	Detect upset conditions
Underflow density	Nuclear density gauge	Optimize thickener performance
Flocculant flow	Magnetic flow meter	Confirm actual dosing rate

Cost Reduction Strategies

Chemical Cost Analysis

Understand your flocculant costs to identify savings opportunities:

```
Current cost calculation:
Flocculant usage: 500 kg/month active polymer
Unit cost: Rs 350/kg
Monthly cost: Rs 1,75,000

Cost per tonne of solids processed:
Solids throughput: 50,000 tonnes/month
Cost: Rs 1,75,000 / 50,000 = Rs 3.50/tonne
```

Reduction Strategies

STRATEGY	POTENTIAL SAVINGS	IMPLEMENTATION
Optimize dose through jar testing	10-30%	Regular jar tests, operator training
Improve preparation quality	5-15%	Proper hydration time, water quality
Relocate dosing point	10-20%	Better mixing location
Use coagulant + flocculant	0-20%	Two-stage treatment for difficult slurries
Alternative polymer trial	10-25%	Test competing products systematically
Reduce feed variability	10-20%	Blend feeds, stabilize solids loading

Competitive Product Testing

Establish systematic testing protocol for alternative products:

1. Define performance criteria (settling rate, clarity, floc strength)
2. Test alternatives against current product in jar tests
3. Select best candidates for plant trial
4. Conduct extended plant trial (minimum 2 weeks)
5. Compare total cost including any process impacts

Troubleshooting Common Problems

Problem: Flocculant Not Working

POSSIBLE CAUSE	CHECK	SOLUTION
Wrong product type	Verify anionic/cationic requirement	Conduct jar tests with alternatives
Inadequate hydration	Check mixing time and solution age	Increase mixing time, use fresher solution
Degraded solution	Test fresh vs aged solution	Reduce holding time, check storage
Wrong concentration	Verify makeup ratio	Adjust concentration

POSSIBLE CAUSE	CHECK	SOLUTION
pH out of range	Measure slurry pH	Adjust pH if possible

Problem: Inconsistent Performance

POSSIBLE CAUSE	CHECK	SOLUTION
Variable feed properties	Monitor solids, size, chemistry	Install monitoring, adjust dose
Dosing pump issues	Verify consistent flow rate	Calibrate, maintain pump
Solution concentration varying	Check makeup procedure	Standardize and verify procedure
Mixing conditions changing	Observe dosing point operation	Ensure consistent hydraulics

Problem: High Chemical Costs

POSSIBLE CAUSE	CHECK	SOLUTION
Overdosing	Conduct jar tests at lower doses	Reduce dose incrementally
Poor mixing efficiency	Observe floc formation	Optimize dosing location
Wasteful preparation	Review solution management	Right-size batches, use in sequence
Suboptimal product	Test alternative products	Select better-performing product

Safety and Environmental Considerations

Handling Precautions

- **Dry polymer:** Wear dust mask, avoid inhalation, clean spills immediately (slippery when wet)
- **Emulsion polymer:** Wear gloves, avoid skin contact, clean spills with absorbent
- **Solution:** Extremely slippery—clean spills immediately, use appropriate footwear

Environmental Compliance

Ensure flocculant use meets environmental requirements:

- Use approved products for your discharge permit
- Monitor overflow clarity and discharge quality
- Avoid overdosing (excess polymer can contaminate water)
- Document usage for environmental reporting
- Properly dispose of waste solution and packaging

Optimized flocculant systems deliver significant benefits through improved water recycling, better solids capture, and reduced chemical costs. Regular jar testing, proper preparation, and systematic optimization ensure best performance from these essential water treatment chemicals.

Topics: #Chemical Dosing #Flocculant #Thickener #sand washing

NESANS

www.nesansindia.in
SF No 20/1, Eachanary Madukkarai Road, Coimbatore, TN 641024
+91 9578 799 755