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COMPLIANCE & STANDARDS

Aggregate Plant Dust Control: Meet TNPCB Standards While Maintaining Production

Control dust emissions at aggregate plants. Water spray systems, enclosures, and monitoring to meet TNPCB/KSPCB environmental requirements.

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Dust control is a critical compliance and operational requirement for aggregate plants in Tamil Nadu. TNPCB (Tamil Nadu Pollution Control Board) regulations mandate specific particulate matter limits, and failure to comply results in show-cause notices, penalties, and potential plant closure. Understanding effective dust suppression methods enables plant operators to maintain compliance while protecting equipment and worker health.

TNPCB Regulatory Requirements

Emission Standards for Stone Crushers

TNPCB specifies particulate matter limits under various categories:

SOURCE	LIMIT (MG/NM³)	NOTES
Stack emissions (process)	100	At any crusher or screening point
Fugitive emissions	Limited visible dust	No dust crossing property boundary
Ambient air quality (PM10)	100 µg/m³	Annual average
Ambient air quality (PM2.5)	60 µg/m³	Annual average

Compliance Documentation Requirements

TNPCB requires the following for operating consent:

- **Dust suppression system details:** Design, capacity, coverage
- **Water supply certification:** Source and adequacy
- **Stack monitoring reports:** Quarterly third-party testing
- **Ambient monitoring:** Regular monitoring at boundary
- **Green belt development:** Plantation around boundary
- **Maintenance records:** Log of dust control system upkeep

Dust Generation Sources in Aggregate Plants

Primary Dust Sources

SOURCE	DUST INTENSITY	PRIMARY CONTROL METHOD
Crusher feed point	High	Enclosure + water spray
Crusher discharge	Very high	Enclosure + wet suppression
Screen decks	High	Enclosure + spray system
Conveyor transfer points	Medium-high	Enclosure + spray
Stockpile loading	Medium	Water spray, low drop
Truck loading	Medium	Water spray, enclosure
Haul roads	High	Water tanker, surfacing

Factors Affecting Dust Generation

FACTOR	EFFECT	CONTROL STRATEGY
Material moisture	Dry material = more dust	Maintain >3% moisture
Fines content	More fines = more dust	Remove fines early
Wind speed	Higher wind = more dispersion	Windbreaks, enclosures
Drop height	Greater drop = more dust	Minimize free fall
Processing rate	Higher rate = more dust	Scale suppression accordingly
Rock type	Sofite rocks = more dust	Adjust suppression

Wet Dust Suppression Systems

Water Spray System Design

Wet suppression is the primary dust control method for crushers and screens:

System components:

- **Water supply:** Adequate quantity and pressure
- **Pump station:** Dedicated high-pressure pump
- **Distribution piping:** Corrosion-resistant materials
- **Spray nozzles:** Selected for coverage and droplet size
- **Control system:** Interlocked with equipment operation

Water consumption guidelines:

APPLICATION POINT	WATER RATE	PRESSURE
Crusher feed	1-2 L/tonne	3-5 bar
Crusher discharge	2-4 L/tonne	4-6 bar
Screen deck (each)	1-2 L/tonne	3-5 bar
Transfer points	0.5-1 L/tonne	3-5 bar

APPLICATION POINT	WATER RATE	PRESSURE
Stockpile spray	Variable	4-6 bar

Nozzle Selection and Placement

NOZZLE TYPE	SPRAY PATTERN	DROPLET SIZE	APPLICATION
Full cone	Circular coverage	200-400 µm	General suppression
Hollow cone	Ring pattern	100-300 µm	Fine mist, fogging
Flat fan	Line coverage	200-500 µm	Conveyor, linear sources
Air atomizing	Very fine mist	50-150 µm	Airborne dust capture

Placement principles:

- Position nozzles upstream of dust generation point
- Ensure complete coverage without gaps
- Avoid overspray that creates puddles or runoff
- Protect nozzles from impact damage
- Provide access for cleaning and maintenance

Fog/Mist Suppression Systems

High-pressure fog systems for airborne dust capture:

System characteristics:

PARAMETER	CONVENTIONAL SPRAY	HIGH-PRESSURE FOG
Pressure	3-6 bar	50-150 bar
Droplet size	200-500 µm	10-50 µm
Water consumption	Higher	50-80% less
Dust capture efficiency	Good for settling	Better for airborne
Capital cost	Lower	Higher

PARAMETER	CONVENTIONAL SPRAY	HIGH-PRESSURE FOG
Operating cost	Higher water	Higher power

Dry Dust Collection Systems

Baghouse Collectors

For applications where wet suppression is not suitable:

System components:

- **Capture hoods:** Enclose dust source with suction
- **Ductwork:** Transport dust-laden air
- **Collector unit:** Filter bags capture particles
- **Discharge system:** Rotary valve or screw
- **Fan:** Creates suction for system

Design parameters:

PARAMETER	TYPICAL VALUE	NOTES
Air-to-cloth ratio	2-4 m/min	Lower for fine dust
Capture velocity	1.0-1.5 m/s at hood	Higher for heavy particles
Duct velocity	18-22 m/s	Maintain particle transport
Outlet emission	<50 mg/Nm³	Better than spray alone

Cyclone Collectors

Pre-collection for large particles before baghouse:

- Removes particles >10-20 µm efficiently
- Reduces load on baghouse filters
- Lower pressure drop than baghouse alone
- Returns collected material to process

Enclosures and Containment

Crusher and Screen Enclosures

Effective enclosure design minimizes dust escape:

Design principles:

- Enclose dust source as completely as possible
- Provide access doors for maintenance
- Include negative pressure ventilation
- Install rubber curtains at material entry/exit
- Seal gaps and openings

Enclosure materials:

MATERIAL	APPLICATION	ADVANTAGES
Steel sheet	Permanent enclosure	Durable, rigid
Rubber curtains	Access points, conveyors	Flexible, replaceable
Polycarbonate	Inspection windows	Visibility, impact resistant
Fabric screens	Large openings	Low cost, replaceable

Transfer Point Design

Proper transfer design reduces dust at source:

- **Reduce drop height:** Use rock ladders or cascade chutes
- **Center loading:** Material impacts material, not belt/chute
- **Controlled trajectory:** Hood design captures dust plume
- **Settling zone:** Allow dust to settle before exit
- **Skirt sealing:** Extend skirting to contain dust

Haul Road Dust Control

Water Truck Application

Most common method for unpaved road dust control:

Application guidelines:

CONDITION	APPLICATION RATE	FREQUENCY
Dry season, heavy traffic	2-3 L/m²	Every 2-3 hours
Moderate conditions	1.5-2 L/m²	Every 4-6 hours
Low traffic	1-1.5 L/m²	2-3 times daily

Chemical Suppressants

For extended dust control with less water:

TYPE	MECHANISM	DURATION	APPLICATION
Calcium chloride	Hygroscopic (absorbs moisture)	2-4 weeks	Spray or dry spread
Magnesium chloride	Hygroscopic	2-4 weeks	Spray application
Lignosulfonate	Binding agent	2-6 weeks	Spray application
Polymer emulsion	Surface binding	4-12 weeks	Spray with sealing

Road Surface Treatment

Permanent solutions for high-traffic areas:

- **Paving:** Concrete or asphalt (most effective)
- **Surface sealing:** Bitumen emulsion treatment
- **Crushed aggregate:** Coarse stone reduces dust
- **Regular grading:** Maintain smooth surface

Green Belt and Natural Barriers

Vegetation Requirements

TNPCB mandates green belt development:

- **Width:** Minimum 10m around plant boundary
- **Species:** Dense foliage trees and shrubs
- **Density:** 2000+ trees per hectare
- **Maintenance:** Regular watering and care

Effective species for Tamil Nadu:

TREE TYPE	GROWTH RATE	DUST CAPTURE
Neem (Azadirachta indica)	Fast	Excellent
Pongamia (Pongamia pinnata)	Moderate	Good
Cassia (Cassia siamea)	Fast	Good
Casuarina (Casuarina equisetifolia)	Fast	Moderate

Windbreaks

Physical barriers to reduce wind-blown dust:

- Natural vegetation barriers (trees)
- Artificial windbreak fabric
- Permanent walls at critical locations
- Stockpile orientation to reduce wind exposure

System Maintenance and Monitoring

Daily Maintenance Checklist

- ☐ Check all spray nozzles for blockage
- ☐ Verify water supply pressure

- ☐ Inspect enclosures for damage or gaps
- ☐ Confirm dust collection system operation
- ☐ Check road conditions and schedule watering
- ☐ Document any visible dust issues

Weekly Maintenance

- Clean or replace clogged nozzles
- Inspect and repair enclosure damage
- Check baghouse differential pressure
- Service water pumps
- Review dust monitoring data

Monitoring Requirements

PARAMETER	METHOD	FREQUENCY
Stack emissions	Third-party testing	Quarterly
Ambient PM10	High-volume sampler	Monthly or continuous
Ambient PM2.5	Gravimetric sampler	Monthly or continuous
Visual assessment	Observation log	Daily

Cost-Benefit Analysis

System Cost Estimates

SYSTEM COMPONENT	CAPITAL COST (RS)	ANNUAL OPERATING
Wet suppression system	10-25 lakhs	3-5 lakhs
Enclosures (basic)	5-15 lakhs	1-2 lakhs
Baghouse collector	25-50 lakhs	5-10 lakhs
Haul road maintenance	5-10 lakhs	8-15 lakhs

SYSTEM COMPONENT	CAPITAL COST (RS)	ANNUAL OPERATING
Green belt development	3-8 lakhs	1-2 lakhs

Cost of Non-Compliance

TNPCB penalties and consequences:

- **Show-cause notice:** Administrative time and cost
- **Bank guarantee forfeiture:** Rs 25 lakhs or more
- **Closure order:** Complete loss of production
- **Legal costs:** Appeals and litigation
- **Community relations:** Long-term reputation impact

Effective dust control requires a comprehensive approach combining wet suppression, enclosures, collection systems, and operational practices. Investment in proper dust control systems ensures TNPCB compliance while protecting worker health and maintaining good community relations.

Topics: #Dust Control #Environmental Compliance #TNPCB

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