Precision, Efficiency, Control: Alpha Beta's Smart Production Suite for Next-Gen Lead-Acid Battery

21 ABC

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Alpha Beta

Guardian of Energy

Why Lead-Acid Still Matters? Core Strengths

- 💰 Low Cost: 100–200/kWh vs. Li–ion's 120-220+
- ♻️ Recycling Champion: >98% recycling rate (global mature system), while Lithium recycling languishes at <10%
- ❄️ Extreme Temperature Tolerance: -40°C~60°C (superior to most lithium batteries)
- 🛡️ Safety & Reliability: 150-year proven stable chemistry
- ⚡ High Surge Power: Cold-cranking advantage (irreplaceable for automotive SLI)

Underestimated Growth Frontiers: Lead-Acid's Unsung Champion Domains

🚜 Emerging Market Electrification:

- India/Southeast Asia e-rickshaw market: Lead-acid dominates 95% (2024 TechSci Data)
- Preferred for cost-sensitive EVs, 2,000 vs.lithium 5,000+

📡 5G Base Station Boom:

- China's 2024 new base stations drove +18% lead-acid demand (MIIT Data)
- Short-term backup costs only 1/3 of lithium

🚚 Logistics Electrification Wave:

- Global forklift market: Lead-acid holds 65% share
- Cost Advantage for Cost-Sensitive EVs, such as short-haul logistics vehicles

Lead-Acid's Technological Evolution: Responding to Lithium Competition

Innovation Directions:

🔋 Lead-Carbon Batteries:

- Cycle life increased to 1,500 cycles (3x traditional)
- Deployed in China's wind energy storage projects (e.g., Xinjiang 200MWh Project)

⚡ Start-Stop Batteries (EFB/AGM):

- Essential for fuel-efficient vehicles, penetration >40% (driven by EU 2025 standards)

🔄 Smart Battery Systems:

- IoT+BMS enables lifespan prediction

Market Reality: Lithium’s Unreachable "Ironclad Domains"

Application Scenario	Lead-Acid Market Share	Lithium Replacement Barriers
Automotive SLI Batteries	**76%**	12V system compatibility/cost sensitivity
Telecom Backup Power	**52%**	Short-term backup cost-performance
Forklift Power Batteries	**68%**	Industrial TCO advantage

Conclusion Box:

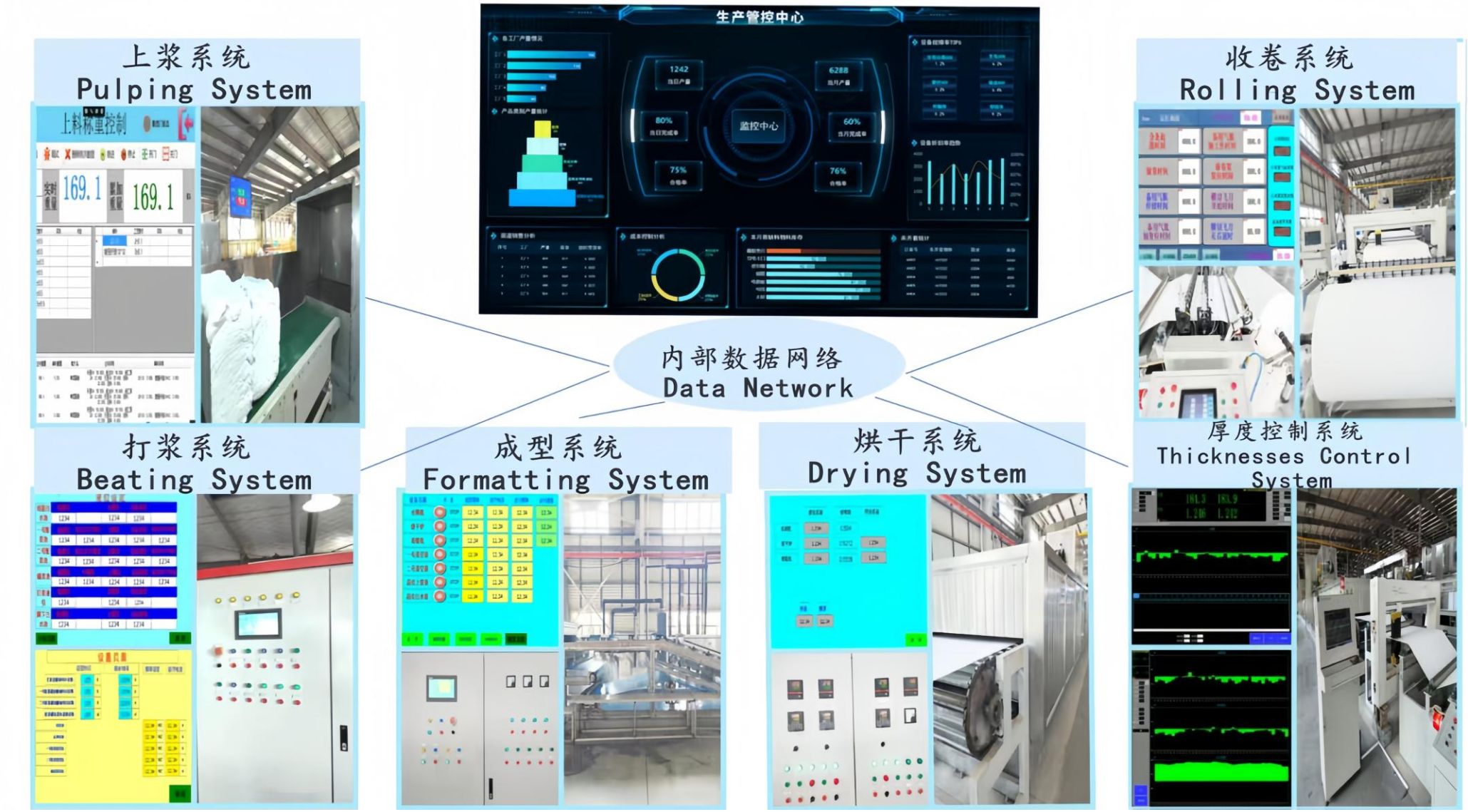
▶ 2027 Forecast: Global lead-acid market to maintain $90B scale (Frost & Sullivan)

▶ Irreplaceability = Cost × Reliability × Recycling Ecosystem

Powering Evolution: AGM Separators as the Critical Enabler

As we've seen, lead-acid batteries are evolving for premium applications, as a global AGM solutions leader, Alpha Beta powers this transformation in our own way.

Smart Manufacturing is Our Strategic Response



Production Control Center – The Nerve Center

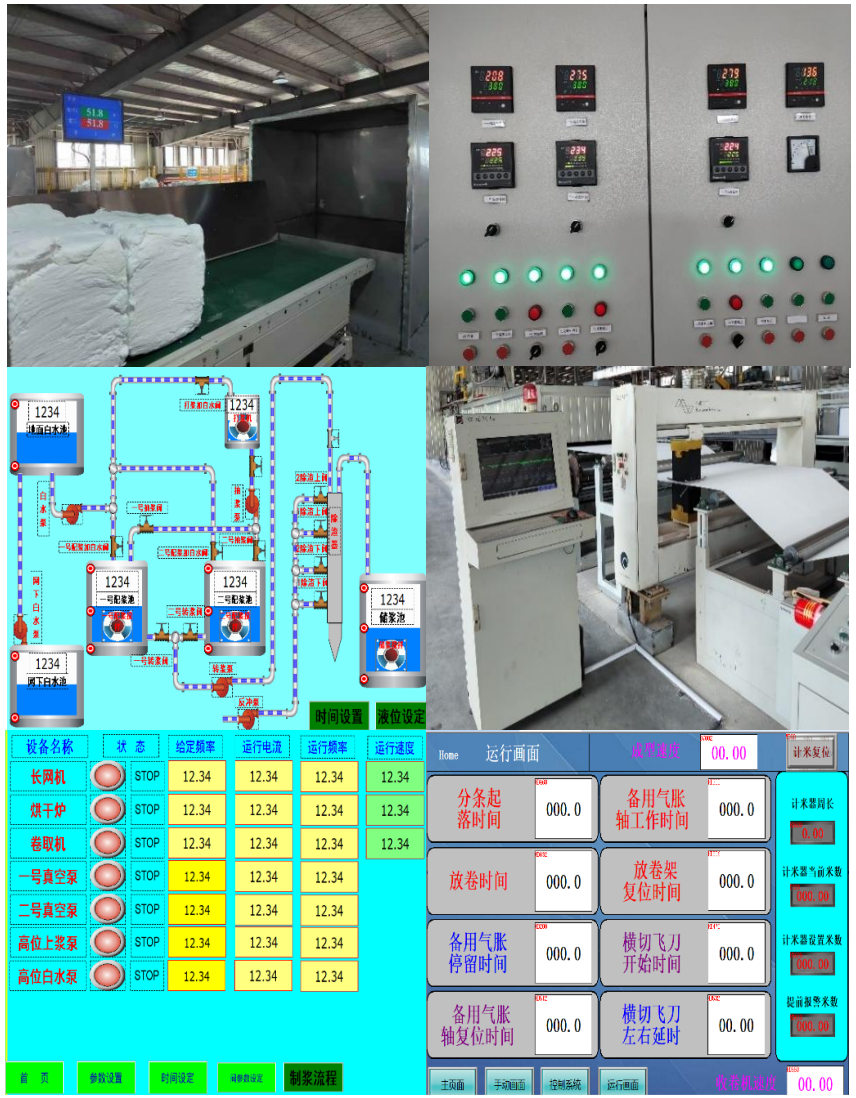
Role:

Real-time monitoring, data aggregation, and centralized command.

Key Functions:

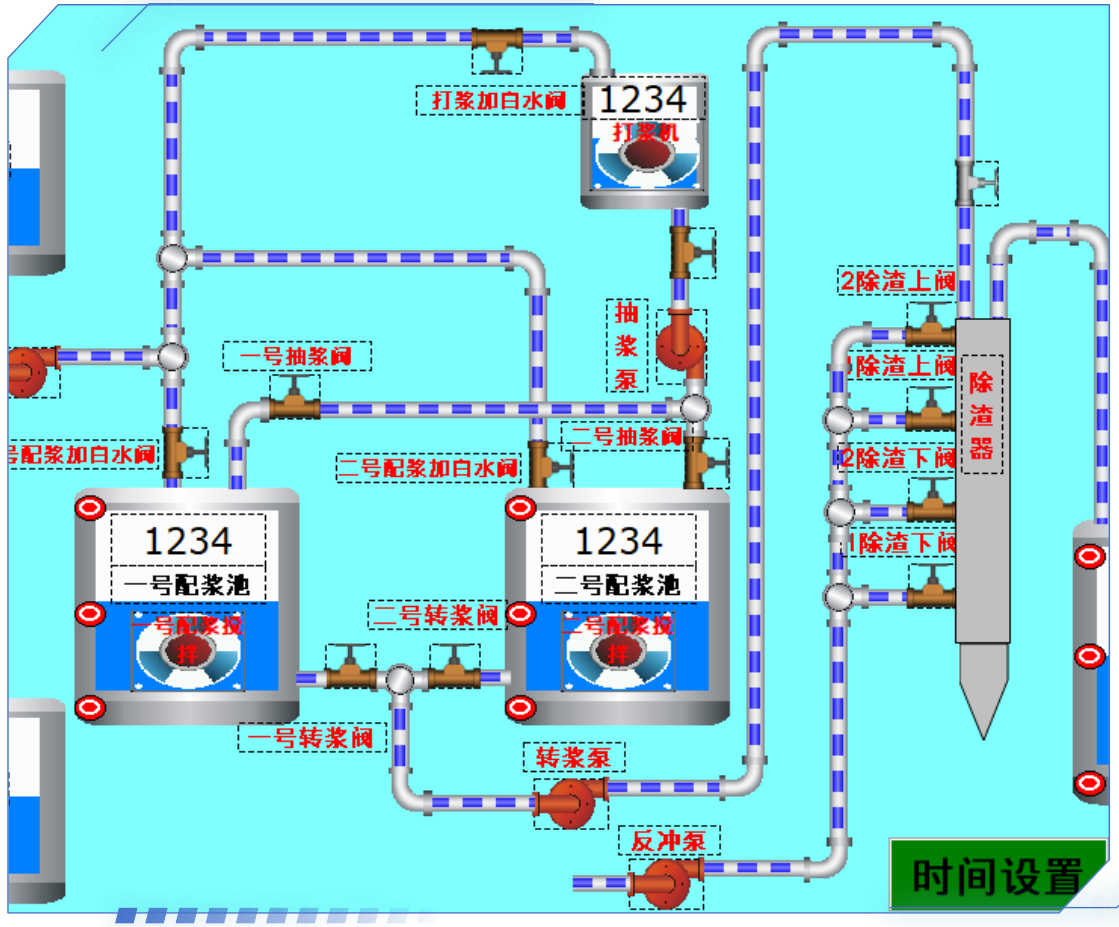
- Live data visualization (e.g., throughput, defects).
- Predictive maintenance alerts.
- Resource allocation optimization.

Advanced Raw Material Feeding System



- **Precision control of fiber ratios**
- **Poka-yoke management: System lockout with audible/visual alarms for ratio errors**
- **Automated statistics and analysis of fibers**
- **Fully enclosed system preventimg foreign matter contamination**

Automated Pulping System



1.Centralized process control:

Technicians preset system parameters via central control center, eliminating manual operations at individual control points.

2.Real-time parameter monitoring with automated alerts:

Continuous tracking of process variables triggers instant warnings during deviations.

3.One-touch automation:

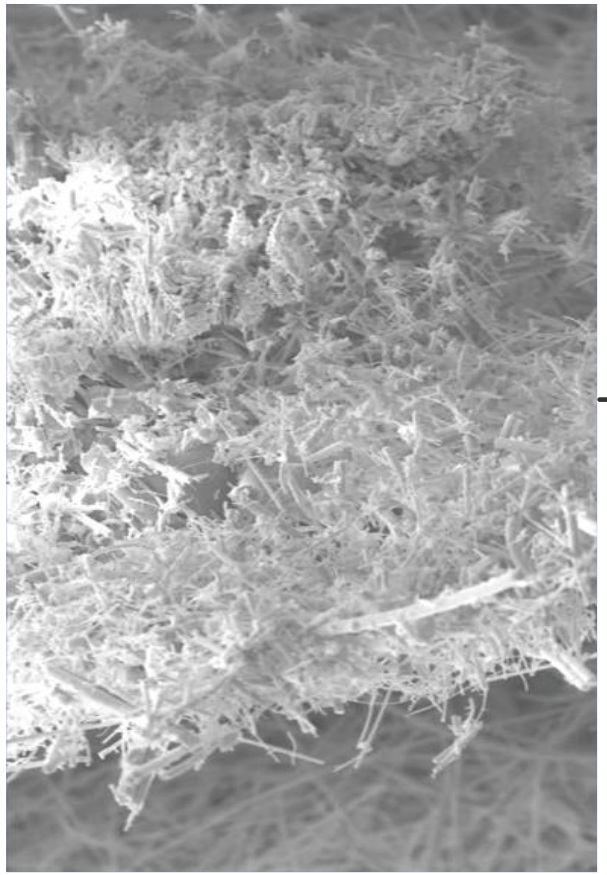
Field operators initiate full-sequence operations by pressing the "START" key, ensuring efficient and stable production without step-by-step interventions.

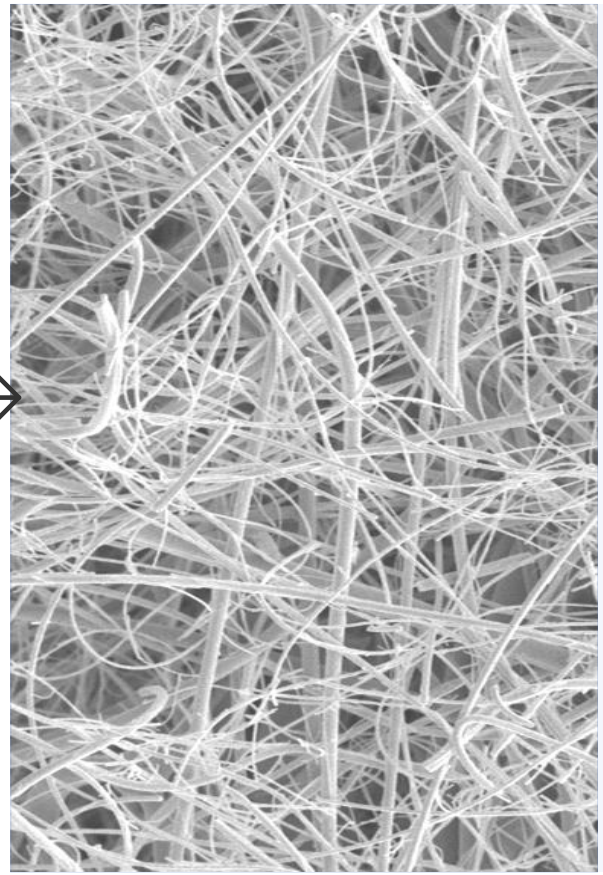
Water System

Water quality is crucial for performance of AGM separators. The water used in our production process is treated through a reverse osmosis purification system. This equipment removes over 99% of impurities from the municipal water supply, producing purified water with a conductivity of less than 5 µS/cm. As a result, the metal ion content in the separators is significantly reduced.

ICP Analysis of Production Water: Before vs. After Treatment		
Metal	Content before treatment (mg/L)	Content after treatment (mg/L)
Ag	0.08	<0.01
Al	0.02	<0.01
Cd	0.04	<0.01
Co	0.012	<0.001
Cr	0.023	<0.001
Cu	0.02	<0.01
Fe	0.018	<0.001
Mn	0.007	<0.001
Ni	0.003	<0.001
Pb	0.035	<0.001
Pt	<0.01	<0.01
Sb	0.02	<0.01
Sn	0.014	<0.001
Sr	0.40	<0.01
Ti	<0.01	<0.01
Zn	0.009	<0.001
Hg	<0.01	<0.01
K	1.42	0.12
Na	34.5	2.1

Scanning Electron Microscope image of separator





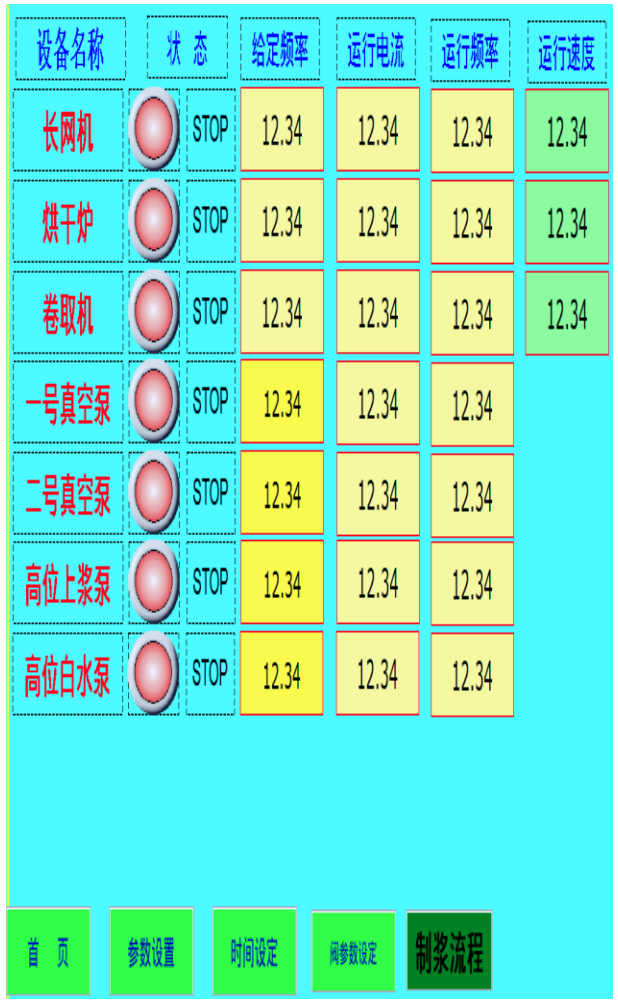
The AGM separators produced using purified water also exhibit exceptionally high purity, which can be clearly demonstrated in the SEM images.

Precision Multi-stage Diffusion Formation System

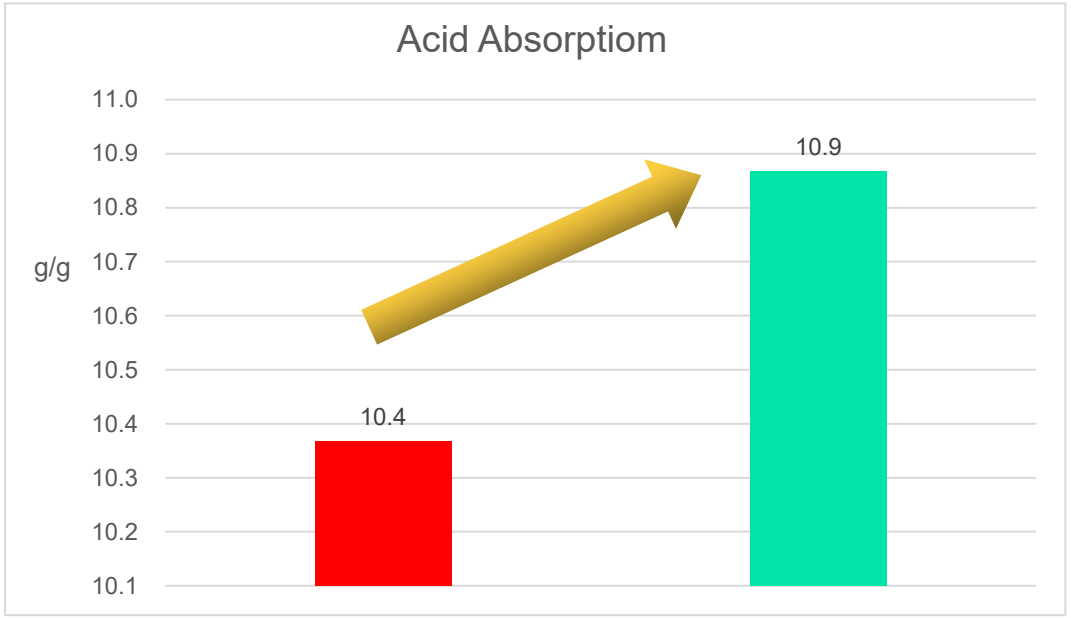
Centralized parameter configuration at Control Center

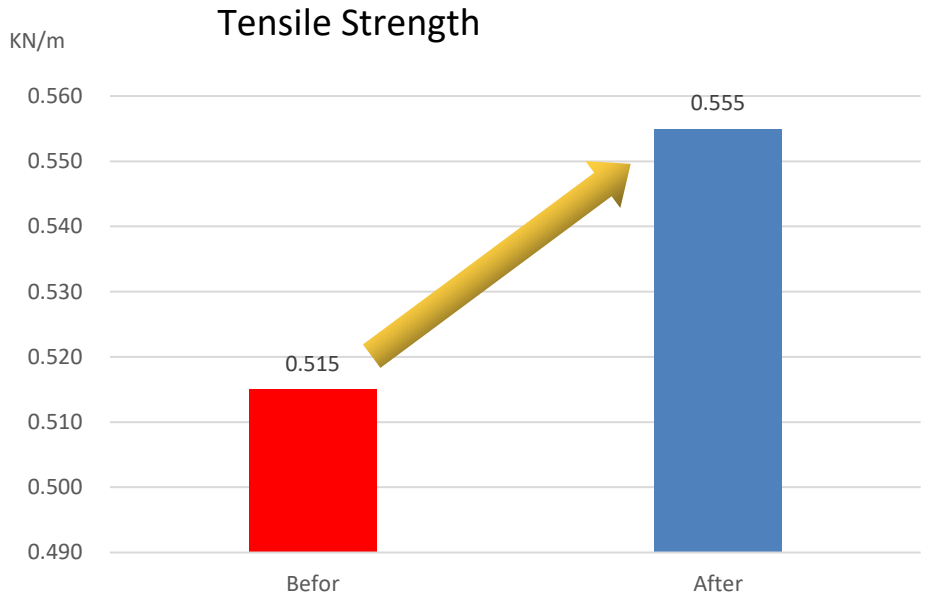
Real-time process monitoring with automated alerts

Integrated scanner system for continuous basis weight/thickness detection, enabling closed-loop auto-tuning based on scan results



Thermal Profile Impact on Separtor's Tensile Strength & Acid Absorption Performance





Under centralized intelligent control, the drying temperature is reduced while achieving optimized thermal profiles, preventing over-drying and aging of the glassfibers. This results in a significant improvement in the strength of the separators, and also resulting in significantly improved acid absorption with enhanced consistency.

Intelligent Drying System

1.Centralized drying parameter optimization

Control Center coordinates temperature settings based on product thickness and line speed, with continuous monitoring and real-time alerts throughout the drying process.

2.Closed-loop drying control

Auto-detection of temperature profiles and humidity levels in drying ovens, intelligently adjusting ventilation cycles to optimize drying efficiency and reduce energy consumption.

3.Enhanced process stability

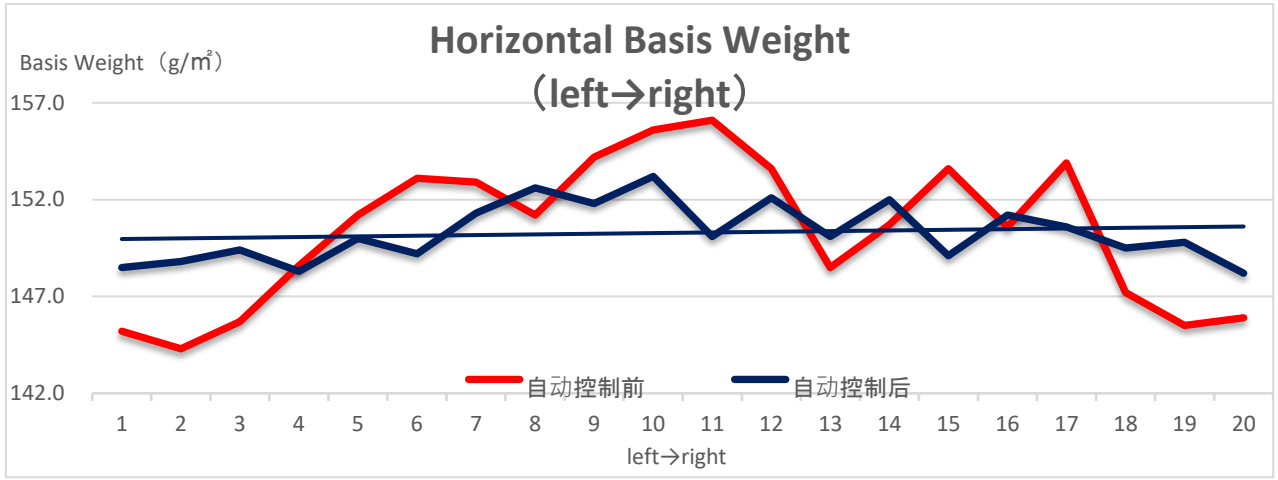
Achieves superior consistency in key paremeters (e.g. acid absorption) through stabilized drying conditions.

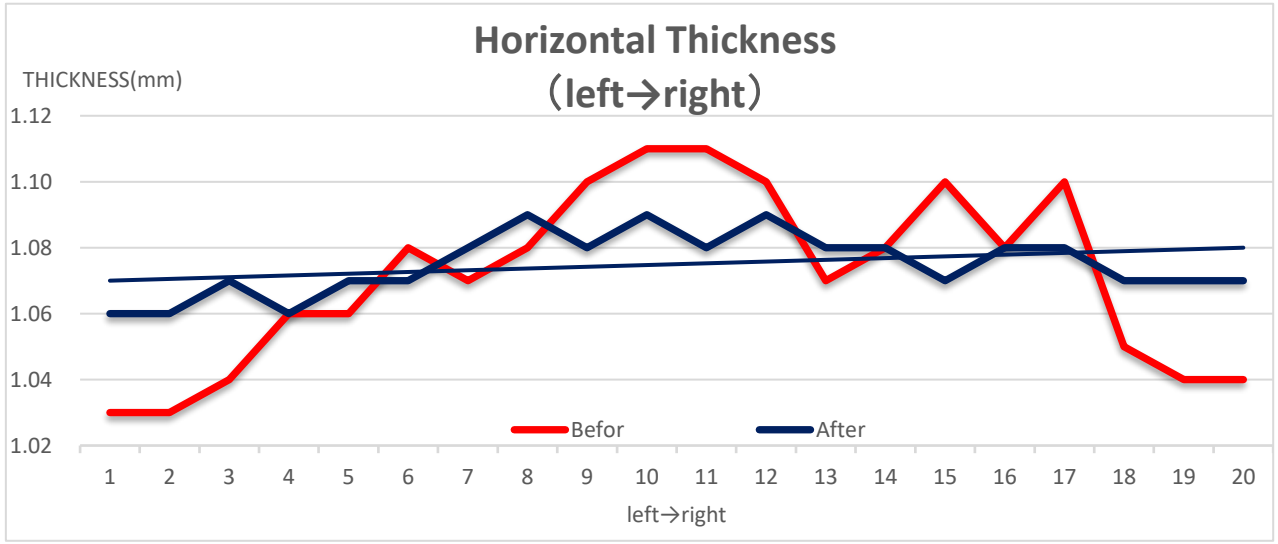
Online Basis weight & Thickness Control System

Industry-leading X-ray Scanner for Basis Weight & Thickness Measurement

- Full-web online scanning of grammage and thickness with 100% coverage monitoring
- Real-time data analytics with error-proof alarming
- Ensures cross-direction uniformity of separator rolls

Eliminating Basis Weight & Thickness Variation: Formation-Scanning System Synergy in Action





The formation system automatically modulates slice lip actuators based on real-time cross-direction (CD) basis weight and thickness profiles from online scanners, optimizing fiber pulp distribution uniformity and achieving grammage and thickness consistency.

Integrated Slitting & Rolling System

1.Centralized parameter configuration at Control Center

2.Ensuring dimensional stability and edge alignment of wound rolls

3.Precision control of length/weight per production orders, reducing material waste

4.Integrated slitting-during-rolling operation boosting productivity

Smart Manufacturing: Revolutionizing Separator Performance & Production Excellence

Alpha Beta

01 Radically Improved Efficiency: One-touch operations. Optimized drying cycles. Faster setups. Integrated processes. Predictive maintenance preventing downtime.

02 Unbeatable Consistency & Quality: Closed-loop control. Real-time scanning. Automated adjustments. Consistency is king in battery performance

03 Closed-Loop Process Control: Automated scanners adjust formation/drying dynamically; optimized thermal profiles boost strength & cut energy.

04 Significant Cost Reduction: Less waste. Less energy. Less downtime. Fewer quality rejects. Higher overall equipment effectiveness (OEE).

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Connect with Our Experts:

- Helen Jiang

sales@alphabeta.com.cn | +86 13912944131

- Victor Yang

sales@alphabeta.com.cn | +86 15952036983