

What is Artificial Intelligence & Machine Learning

Artificial Intelligence = Making machines smart

Machine Learning = How machines learn to become smarter with time

Glass Industry Relevance:

- AI in inspection = sharp eyes 24/7
 - ML in furnace = operator learning from past batches
 - AI in packaging = perfect stacker never tired
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Container Glass Manufacturing Process

End-to-End Glass Manufacturing Value Chain



Upstream

Mining

Transportation

Storage

Batch House

Furnace

Furnace
Bottle Formation

Downstream

Quality
Inspection

Packaging

Warehouse

Distribution

Customer Use

Recycling

Mining – AI/ML Applications

Challenges

- Unsafe silica sand mining → worker risk & downtime
- Slow, imprecise identification of glass-grade deposits

Current Practices

- Manual drills/haul trucks, scheduled maintenance
- Geologists survey and test samples

AI/ML Solutions

- Predictive maintenance on mining equipment → fewer stoppages
- AI mapping & drone surveys → accurate identification of silica reserves



Transportation – AI/ML Applications

Challenges

- Delays in hauling sand, limestone & cullet to glass plants
- High fuel costs, breakdowns disrupting furnace feed

Current Practices

- Manual dispatch scheduling, fixed truck routes
- Preventive fleet checks, reactive repairs

AI/ML Solutions

- AI route optimization → raw materials reach batch house on time
- Predictive fleet maintenance → ensures steady cullet/sand supply
- Autonomous trucks → reliable material transport within plant network



Storage – AI/ML Applications

Challenges

- Overstocking of cullet/sand vs. sudden shortages halting batch prep
- Manual handling → contamination & safety risks

Current Practices

- Operators monitor silo levels, reorder when low
- Forklifts move cullet/raw material manually

AI/ML Solutions

- IoT sensors + AI → real-time cullet/sand inventory visibility
- AI forecasting → matches furnace demand with stock levels
- Robotic conveyors → cleaner, safer raw material transfer



Batch House – AI/ML Applications

Challenges

- Wrong recipe mix leads to defective glass melt
- Underutilization of cullet due to quality uncertainty

Current Practices

- Operators weigh/mix based on static recipes
- Adjustments made after lab test failures

AI/ML Solutions

- AI recipe optimization → stable batch chemistry, consistent melt
- Predictive glass chemistry models → forecast strength, clarity, color, viscosity
- Batch-to-glass property prediction → ensures bottles meet fillers' requirements



Furnace – AI/ML Applications

Challenges

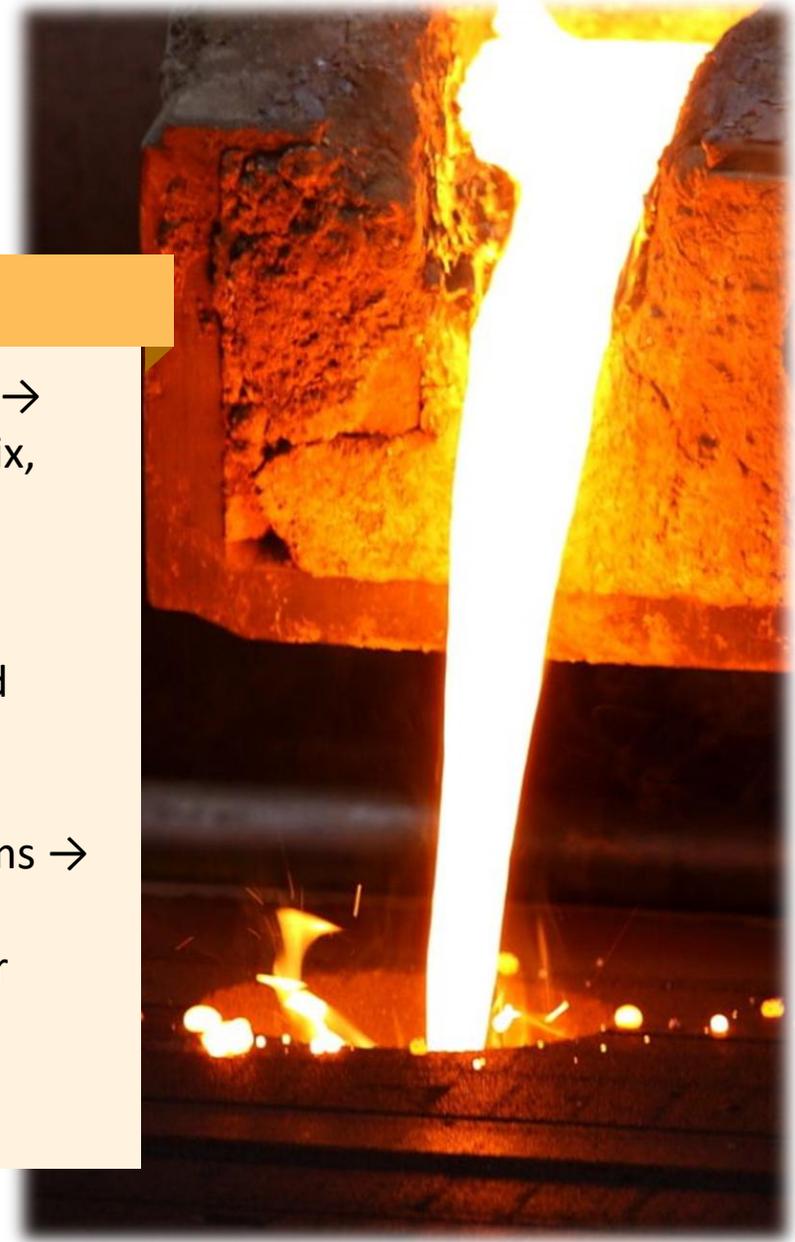
- Energy-intensive melting (~1500°C), high CO₂ emissions
- Furnace wear leads to costly rebuilds & downtime

Current Practices

- Operators adjust air/fuel manually, often over-firing
- Fixed maintenance schedules, reactive repairs

AI/ML Solutions

- AI furnace control → optimal fuel/air mix, lower CO₂
- Predictive wear analytics → extend furnace life safely
- Closed-loop systems → steady melting conditions & fewer defects



Bottle Formation – AI/ML Applications

Challenges

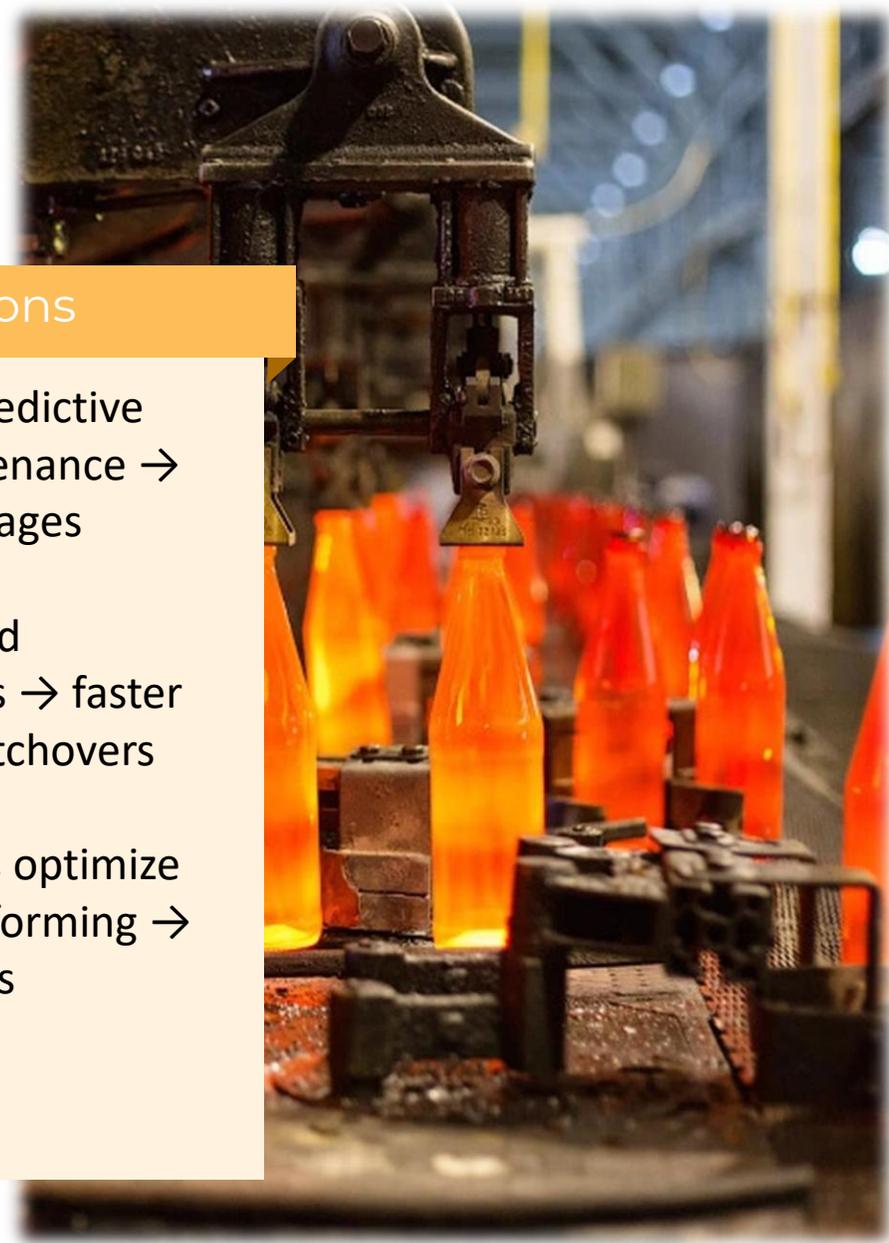
- Downtime during mold cleaning/changeovers
- Gob distribution issues → cracks, uneven walls

Current Practices

- Manual mold swaps, scheduled cleaning
- Operator trial-and-error tuning

AI/ML Solutions

- AI-driven predictive mold maintenance → fewer stoppages
- Robotic mold changeovers → faster product switchovers
- Digital twins optimize gob flow & forming → fewer rejects



Quality Inspection – AI/ML Applications

Challenges

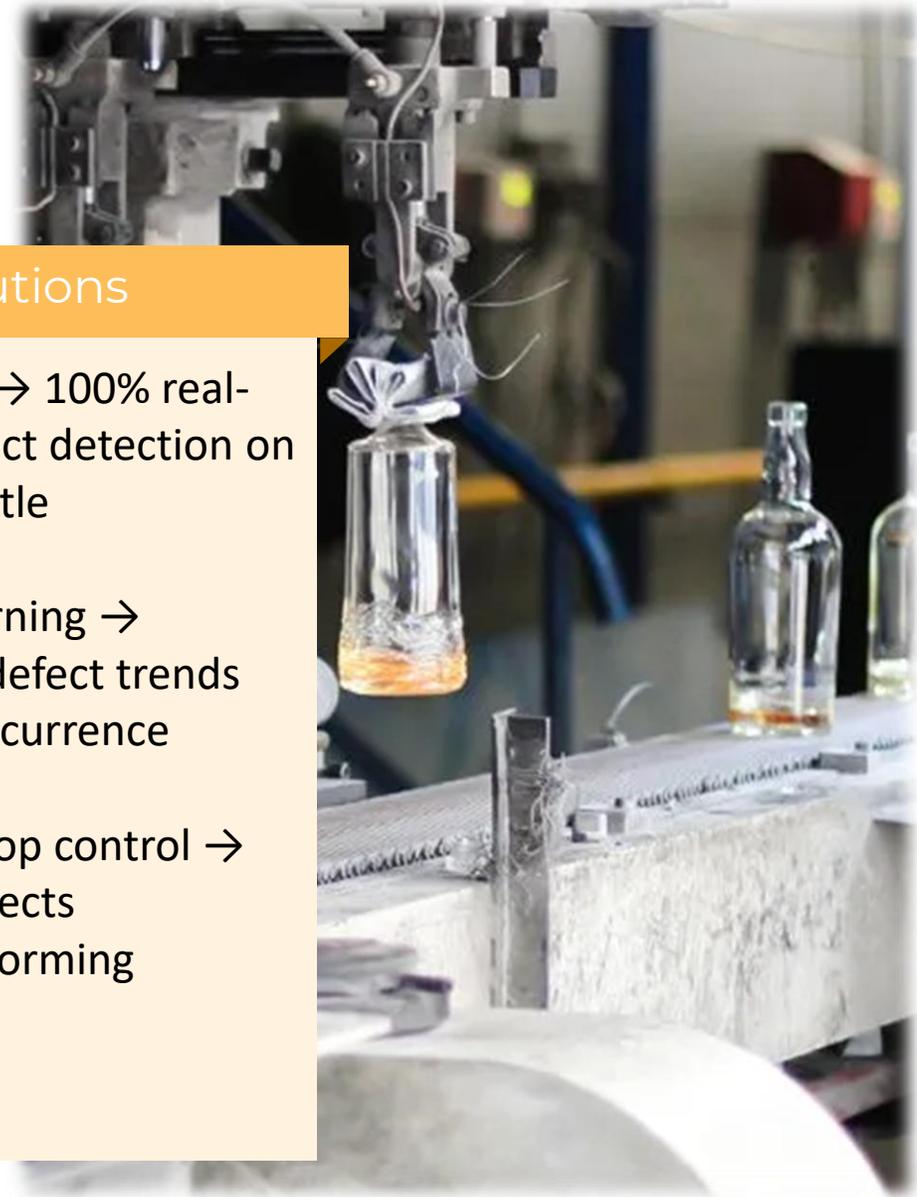
- High-speed lines miss scratches, bubbles, cracks
- Defects detected too late → wasted production runs
- Downtime during mold cleaning/changeovers
- Gob distribution issues → cracks, uneven walls

Current Practices

- Manual sampling + basic camera inspection
- Adjustments made post-defect discovery

AI/ML Solutions

- AI vision → 100% real-time defect detection on every bottle
- Deep learning → predicts defect trends before occurrence
- Closed loop control → auto-corrects furnace/forming settings



Packaging – AI/ML Applications

Challenges

- Glass breakage during palletizing/packing
- Downtime when switching SKUs (750ml vs. 180ml bottles)

Current Practices

- Fixed palletizer patterns, frequent operator intervention
- Manual recalibration for new bottle types

AI/ML Solutions

- AI-guided robotic palletizers → precision stacking, less breakage
- Adaptive packaging lines → auto-adjust to bottle SKU changes
- Predictive jam prevention → smoother, faster operations



Warehouse – AI/ML Applications

Challenges

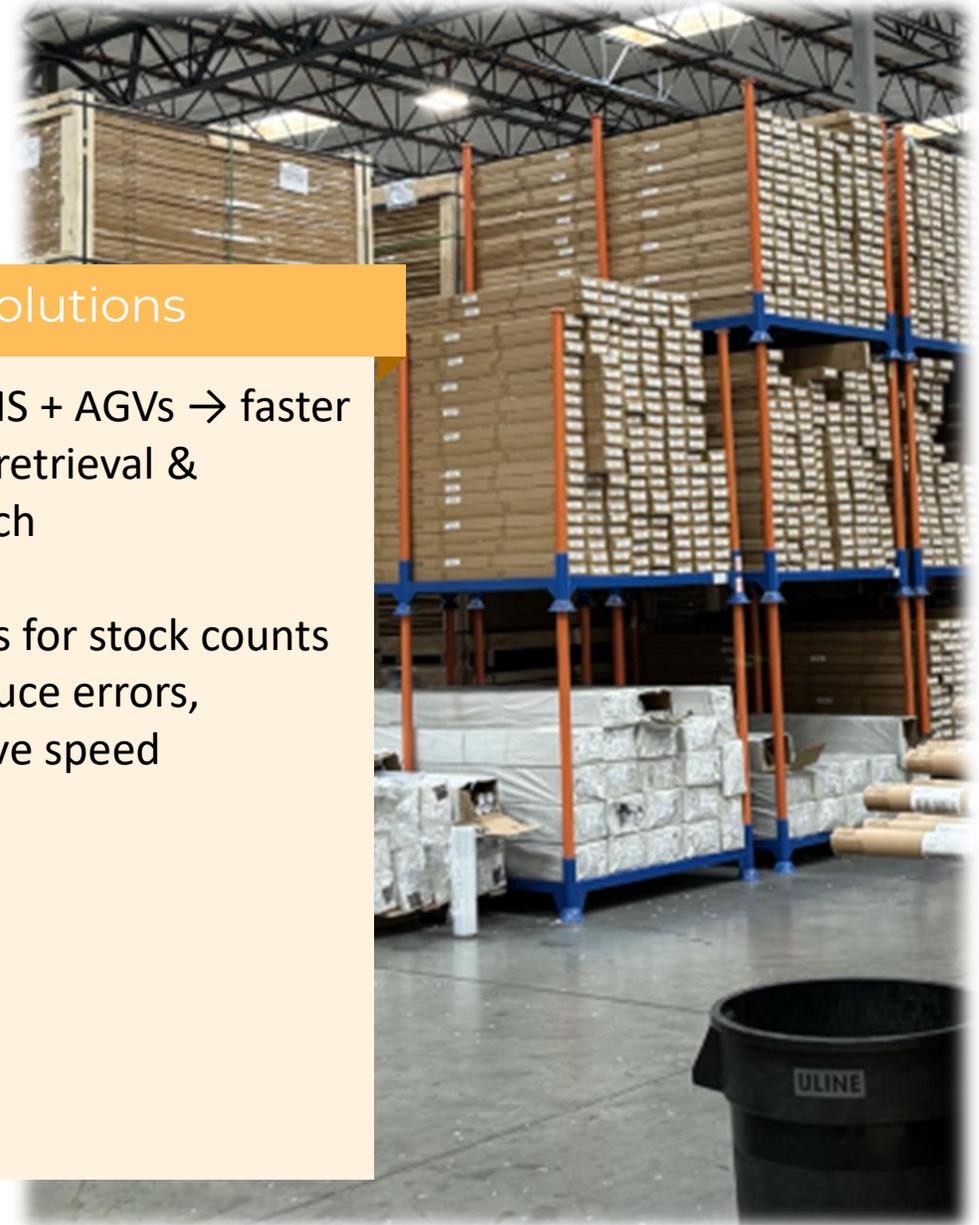
- Misplaced pallets → shipment delays for bottlers
- Over/under stocking of specific bottle SKUs

Current Practices

- Forklift drivers manually locate pallets
- Stock managed with periodic audits

AI/ML Solutions

- AI WMS + AGVs → faster pallet retrieval & dispatch
- Drones for stock counts → reduce errors, improve speed



Distribution – AI/ML Applications

Challenges

- Delays in supplying distilleries, breweries, F&B customers
- Demand fluctuations create shortages or excess stock

Current Practices

- Static delivery schedules, manual route planning
- Customers place orders reactively

AI/ML Solutions

- AI demand forecasting → proactive bottle dispatch planning
- Route optimization → faster delivery, lower costs
- Predictive fleet maintenance → reliable finished goods supply



Customer Use – AI/ML Applications

Challenges

- Fillers/distributors face uncertain bottle supply, leading to downtime in filling lines
- Demand surges (festive liquor, FMCG launches) are hard to predict
- Lack of real-time alignment between glassmakers and customers

Current Practices

- Customers raise orders reactively when stock runs low
- Demand planning based on past sales, not live market signals
- Feedback from fillers/distributors often comes post-production

AI/ML Solutions

- AI demand sensing → anticipates orders using sales, market, and seasonality data
- Vendor-managed inventory (VMI) → glassmakers restock fillers automatically, no stockouts



Reuse, & Recycling – AI/ML Applications

Challenges

- Impure cullet, inefficient sorting
- Unpredictable recycled glass supply

Current Practices

- Manual sorting, partial optical sorters
- Historical averages for cullet use

AI/ML Solutions

- AI optical sorters → ensure high-purity recycled glass recovery
- Predictive recycling supply
- AI-enabled recycling plants → move toward zero-waste circular economy
- Introduction of traceability technology → track recycled glass from collection to furnace,



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 - • **AI & ML are not replacing people – they are empowering the industry to produce smarter, deliver safer, and grow greener.**

— Future of Glass Manufacturing

This transformation represents a paradigm shift where human expertise combines with artificial intelligence to create a world-class, sustainable, and future-ready glass industry in India and beyond.



Thank You

Let's embrace AI & ML as catalysts to make India's glass industry world-class, sustainable, and future-ready.

Questions & Discussion Welcome.

