



Energy Storage Manufacturing

Manufacturing Technology and Business Technology

Team 2

Aiham

Arzoo

Sai

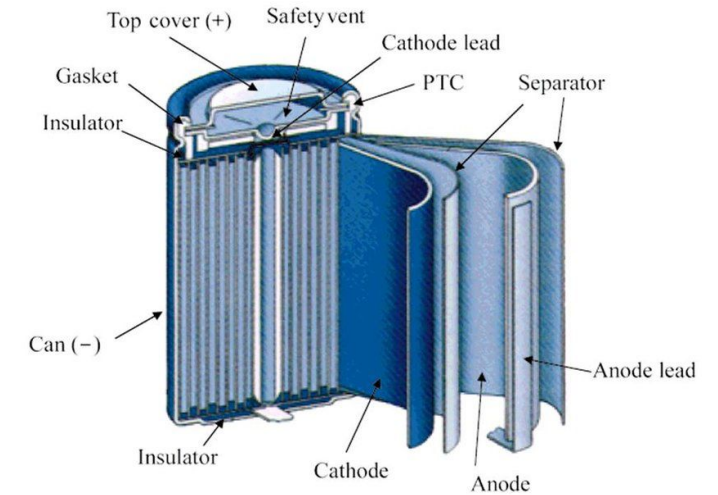
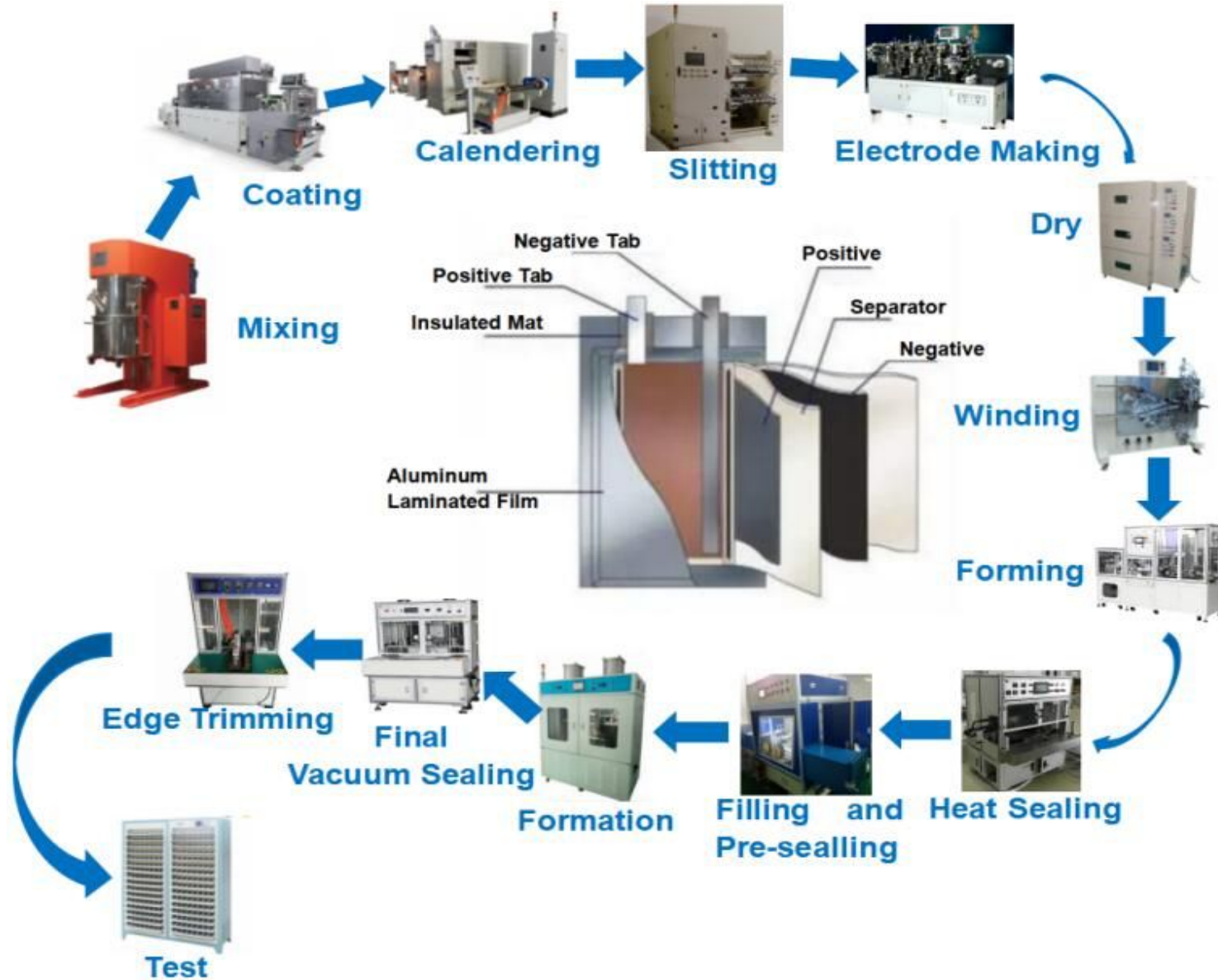
Senthil

Yogesh

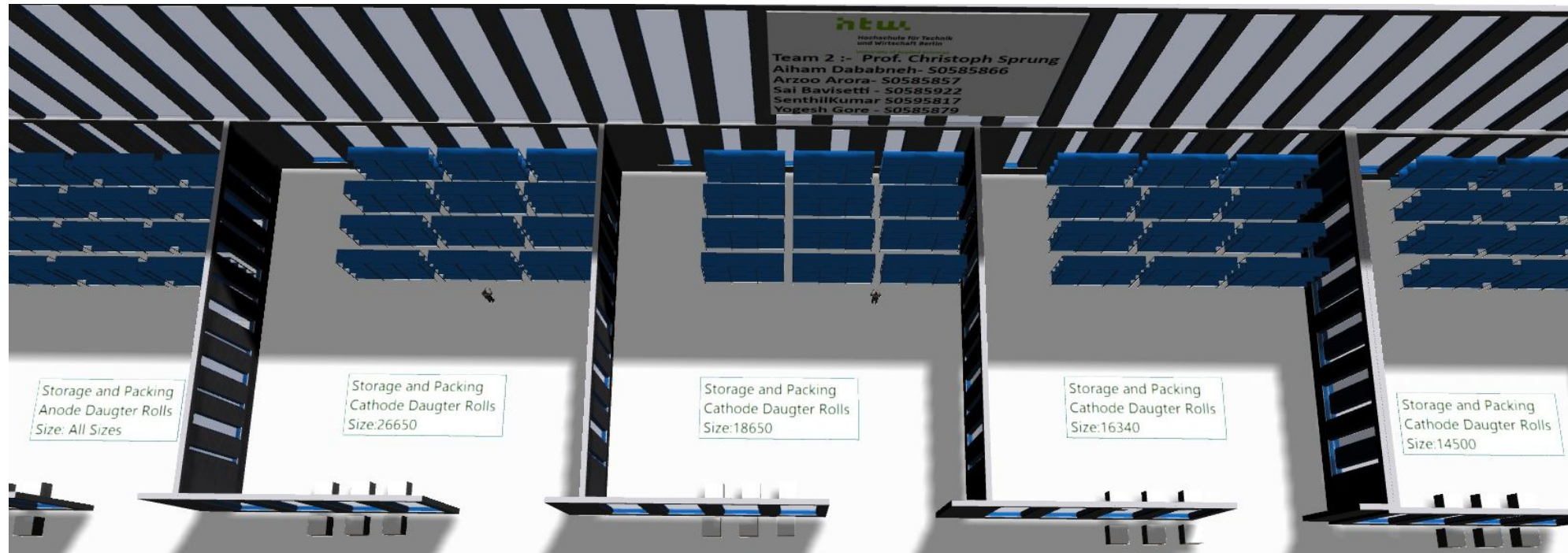
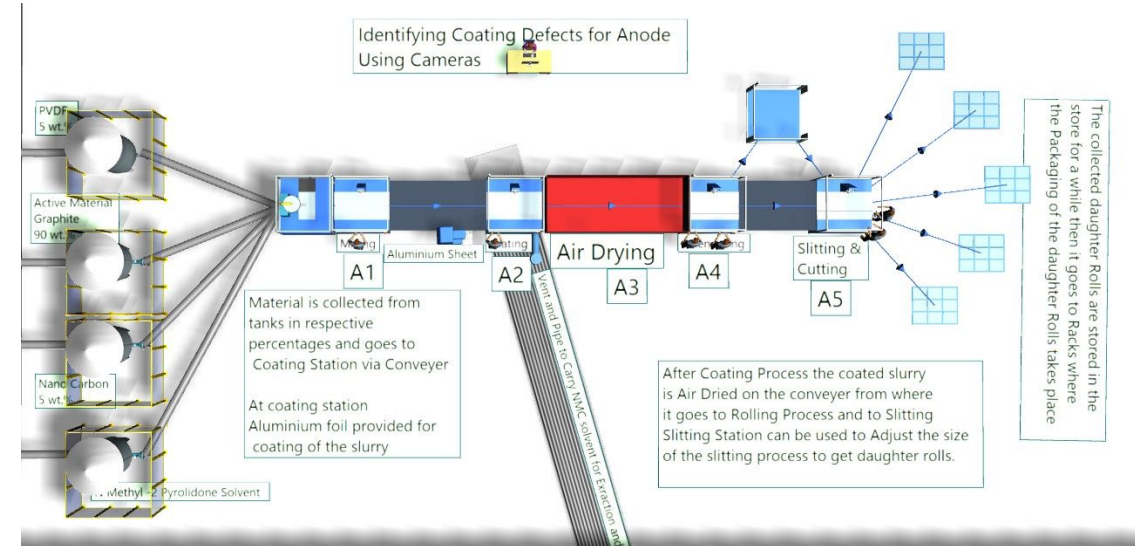


Agenda

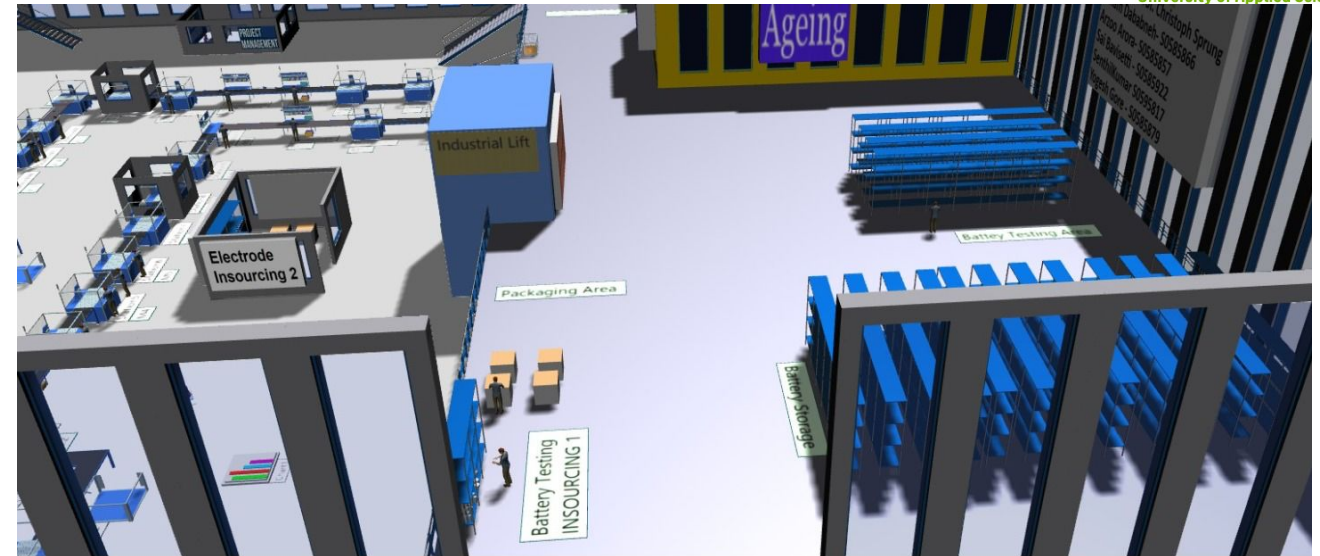
- Processes for Cylindrical Cell Production
- Factory Layout
- Cell Chemistries and Sizes
- Specific Processes
- Defects and their Identification
- Production Capacity
- Material Flow
- Battery Passport Codes
- Catena X

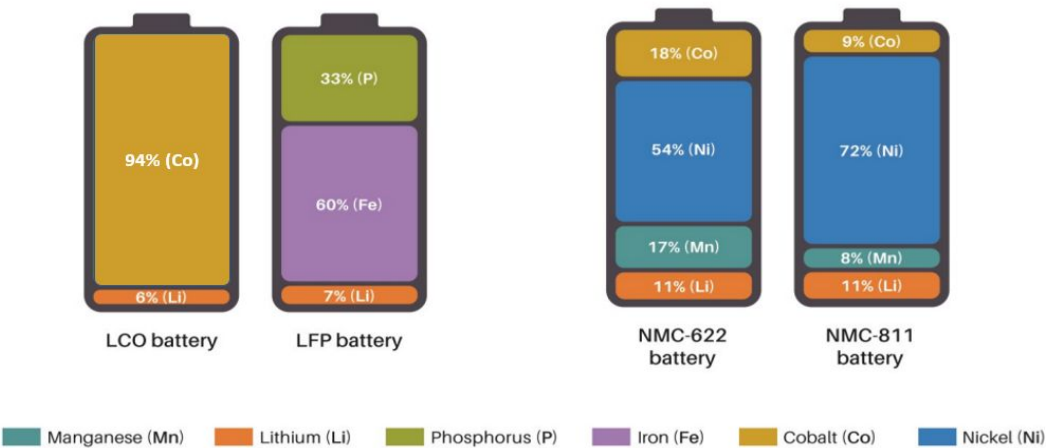


Warehouse 1 Simulation



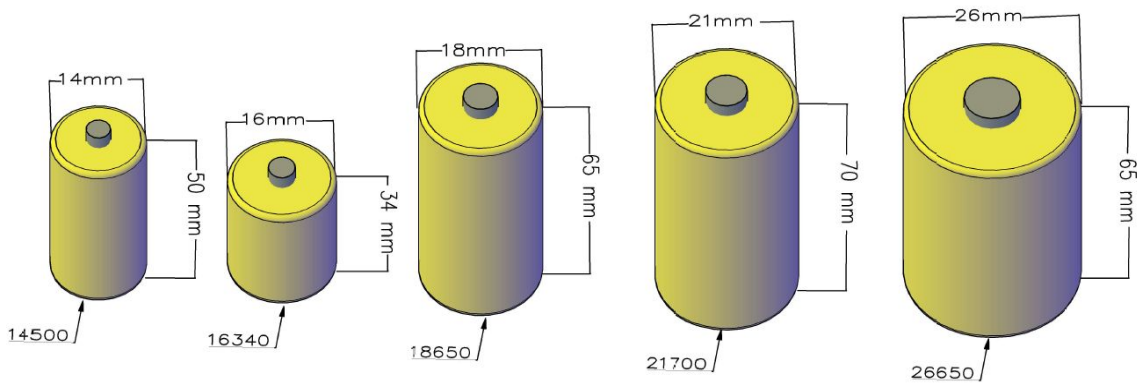
Warehouse 2





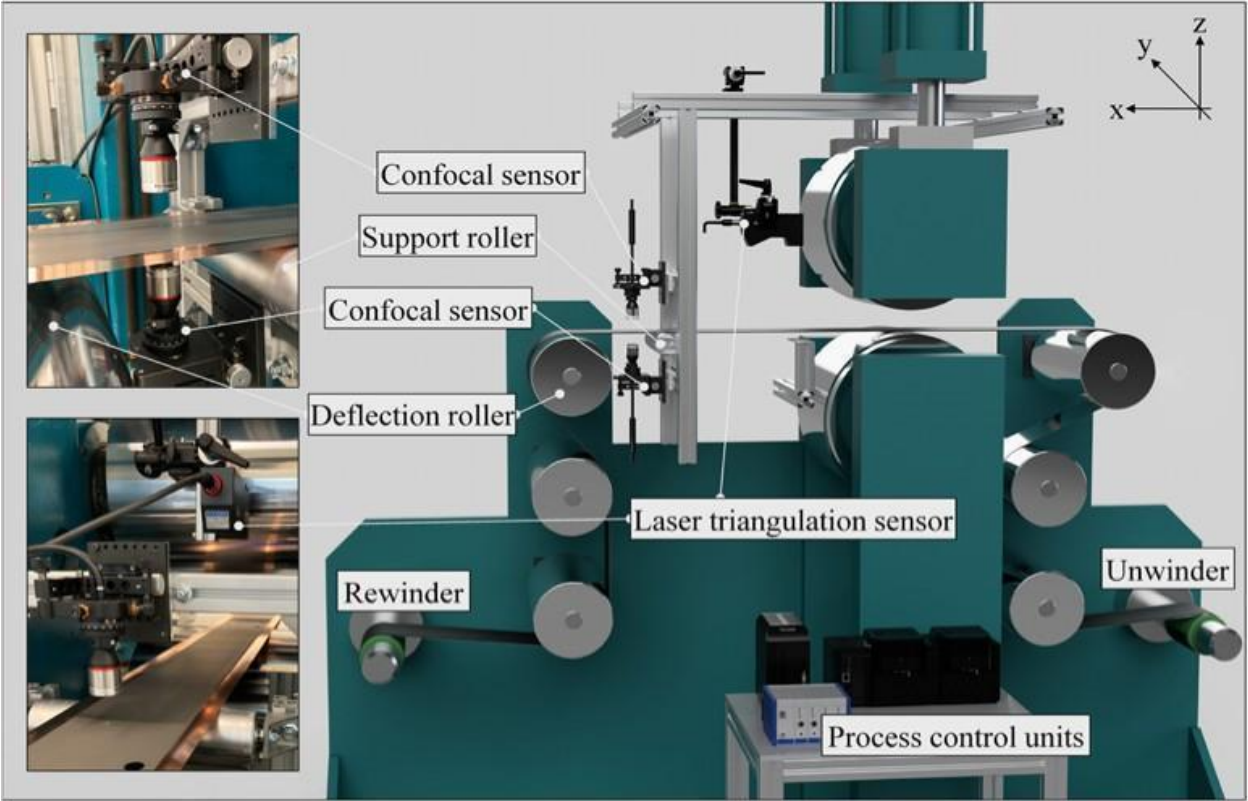
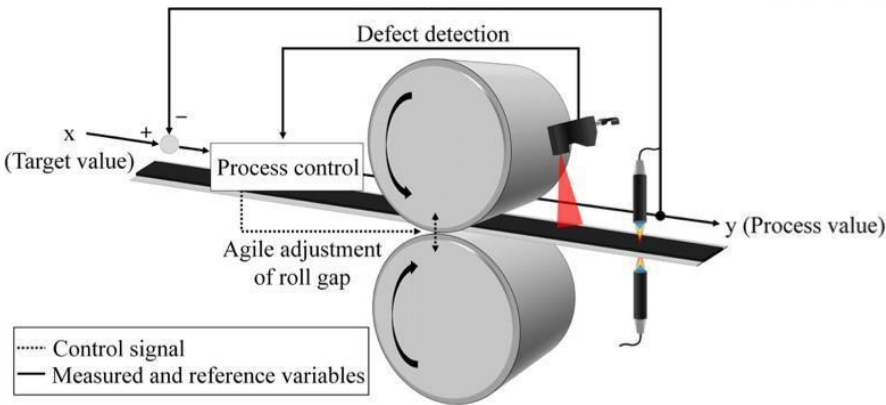
Chemistry	Abbreviation	Voltage (V)	Energy Density (Wh / Kg)	Life Cycle	Charge Rate	Discharge Rate	Applications
Lithium Cobalt Oxide (LiCoO ₂)	LCO	3.7	150-160	500-1000	0.7 - 1.0C charges to 4.20 V	1C - 2.50 V cut off	Mobile consumer devices, such as laptops, smartphones, and digital cameras
Lithium Iron Phosphate (LiFePO ₄)	LFP	3.2	80-120	2000-4000	C/2 to 4C. charges to 3.65 V	1C typical; 30C on some cells; 250V cut off	Stored energy for mission-critical environments. Also used in electric vehicles
Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO ₂)	NMC	3.6	100-140	1000-2000	0.7-1.0C. charges to 4.20V	1C typical; 2C on some cells; 2.50V cut off	Electric vehicle powertrains, cordless power tools, electrical grid storage

Cell Sizes



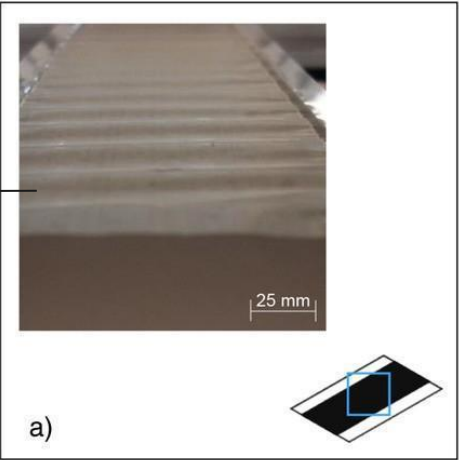
Names	Capacity(mAh)	Uses
14500	700-1000	Consumer electronics,such as LED flashlights, wireless audio, electric toys , digital cameras,etc.
16340	400-900	LED flashlights, headlights, laser lights, etc.
18650	1500-3500	Used in many laptop computer batteries, cordless power tools, certain electric cars, electric kick scooters, most e-bikes, vaping.
21700	3000-5000	E-bikes,solar street lights, LED lights, portable power tools,etc.
26650	2400-5750	Suitable for electric toys, backup power supply, UPS batteries, wind power generation systems, and wind solar complementary power generation systems.

Calendaring compresses and compacts the coated electrode onto the current collector metal foils to improve the energy density of the battery, provide consistent thickness, and to provide dust and humidity control for the electrode. It is an important process to affect the cell performance by controlling the electrode porosity and tortuosity.

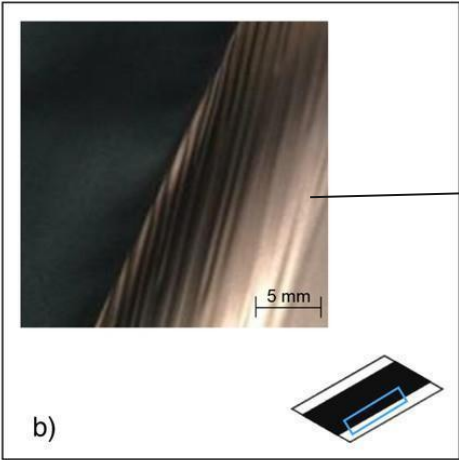


Roller Design	Stainless Steel
Roller Pressure	1000KN
Roller Temperature	100°C
Speed of Roller	20m/min
Effective rolling dimension	Φ400mmx450mm , effective roll width 150-400mm
Rolled precision	≤±0.0015mm (precision coating) ≤±0.003mm
Pressure control accuracy	≤0.15T

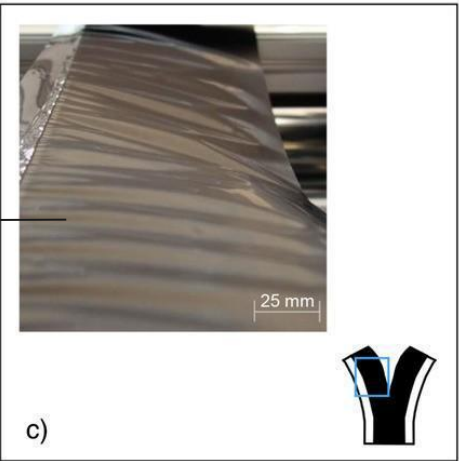
Electrode Corrugation



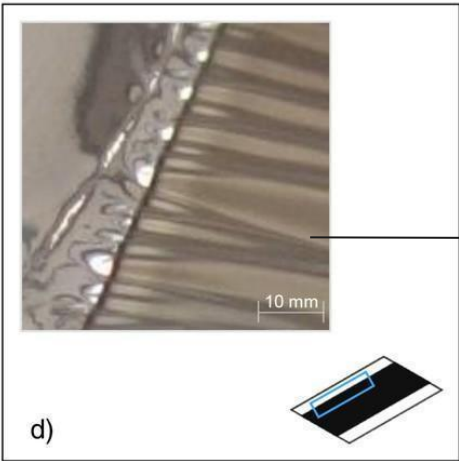
Foil Embossing



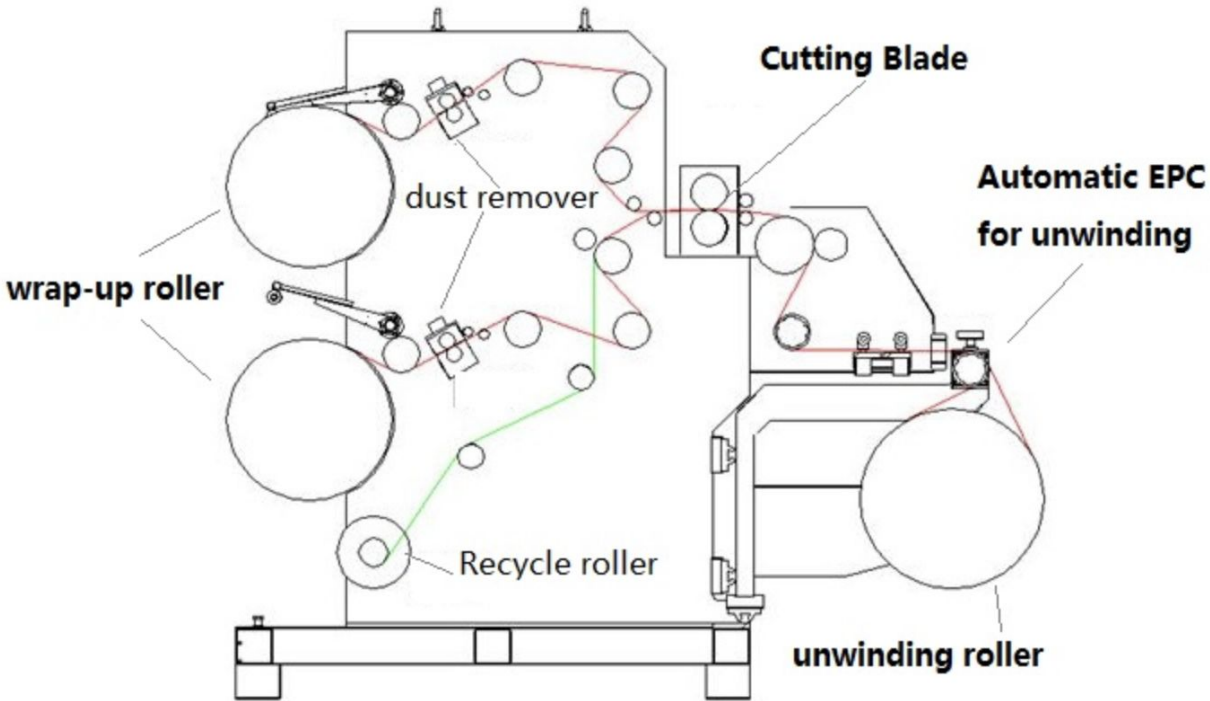
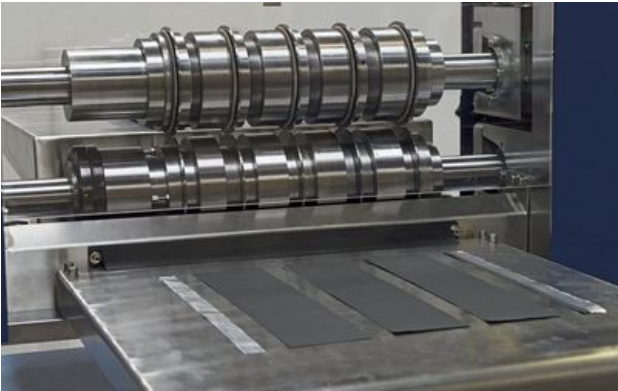
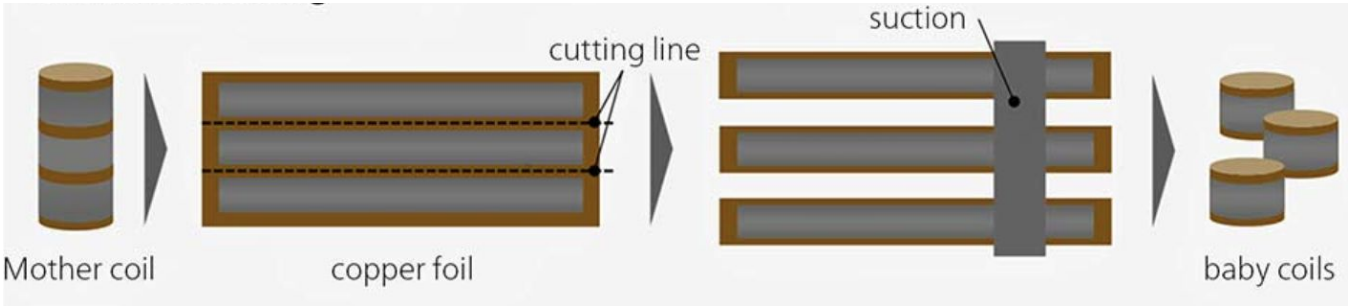
Saber Effect



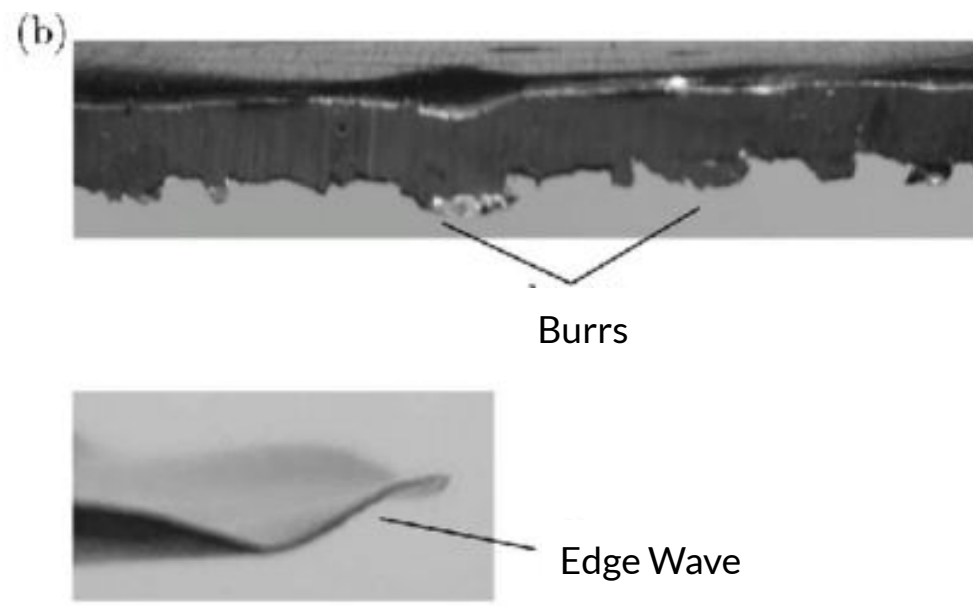
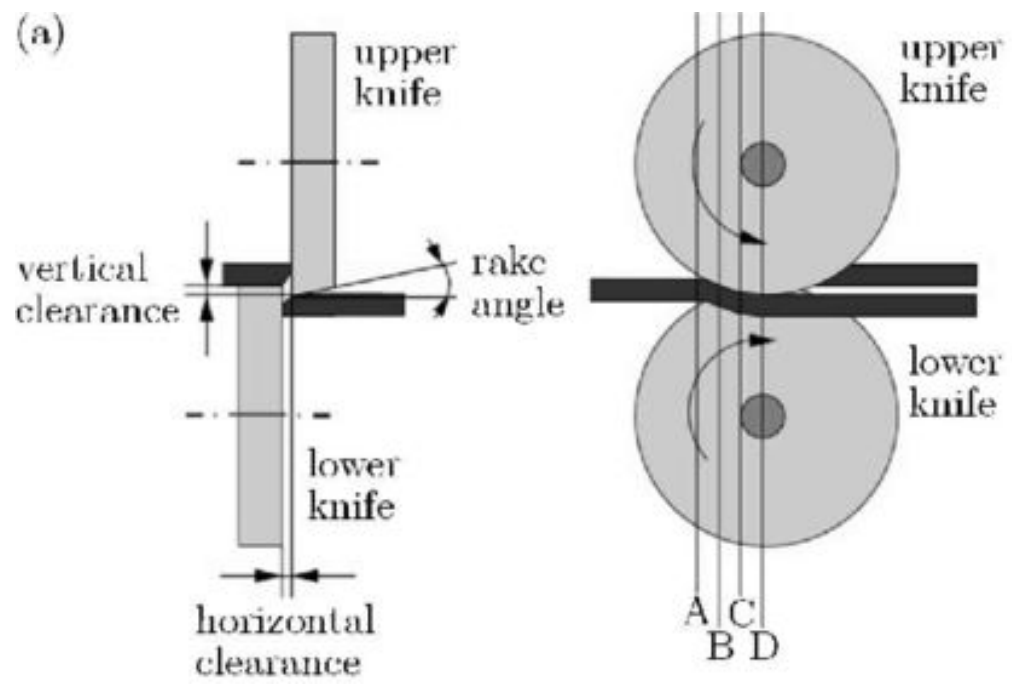
Corrugations at the coating edge



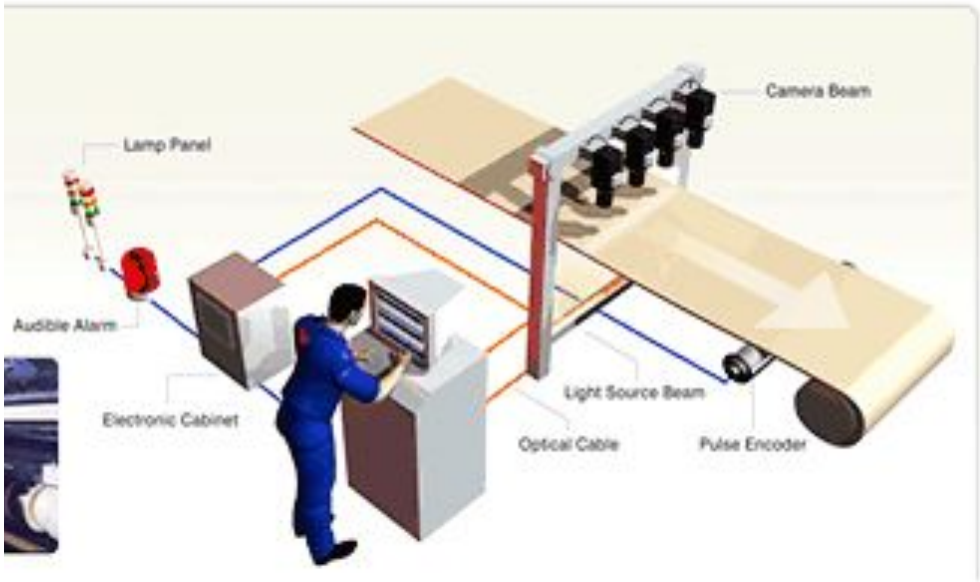
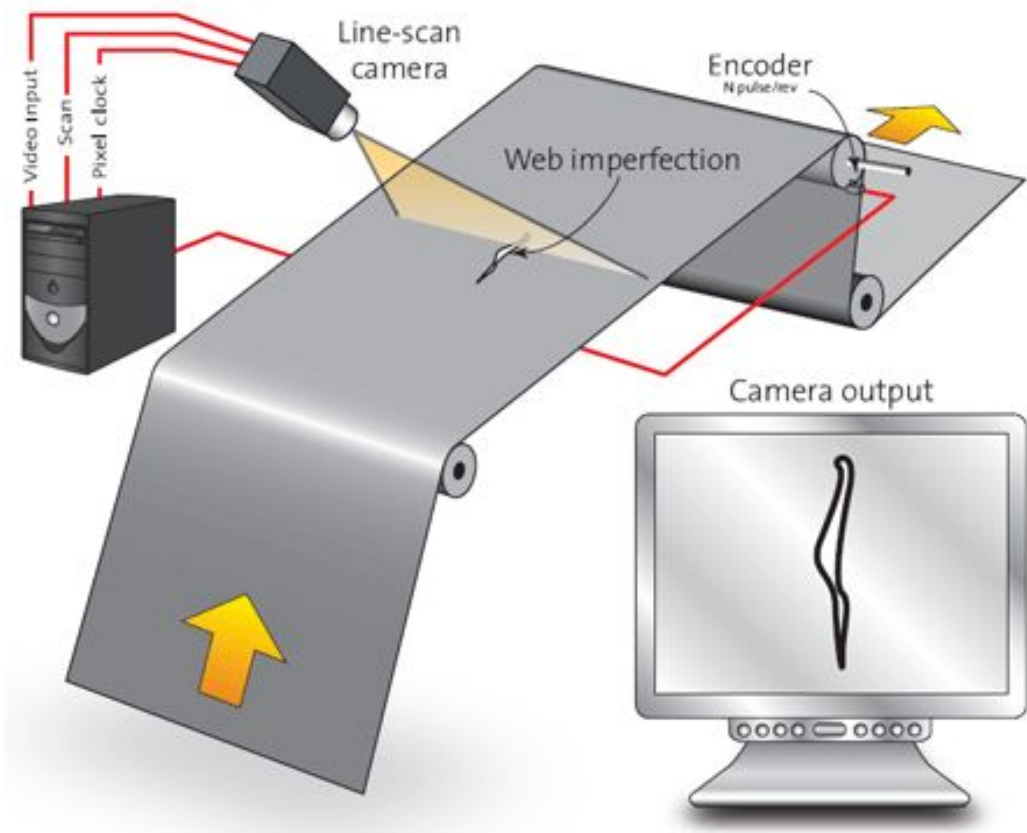
Slitting



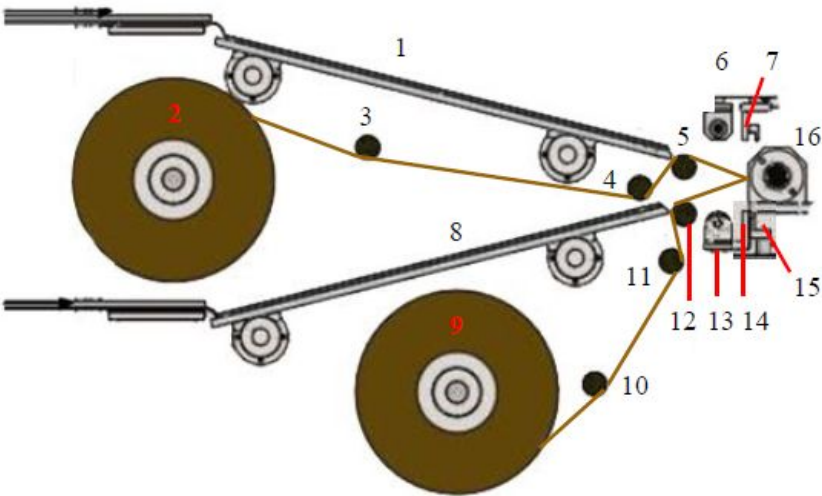
Working Voltage	220VAC +/- 10%, 3 phase, 50/60Hz
Max.Power Consumption	10 KW
Cutting Blade	Two round blades rolling to cut Blade Materials: Tungsten alloys Blade Diameter: 100mm
Cutting and Slitting Width	<ul style="list-style-type: none">● Slitting Number: 10 strips.● Slitting Width: 30 - 650 mm based on the sizes of cells● Slitting Accuracy : ±0.05mm
Cutting Speed	50 m/min
Rollers	Unwinding roller: 500 mm Max. (3" axis Pneumatic) Winding Roller: 450 mm max (3" Slip-shaft)



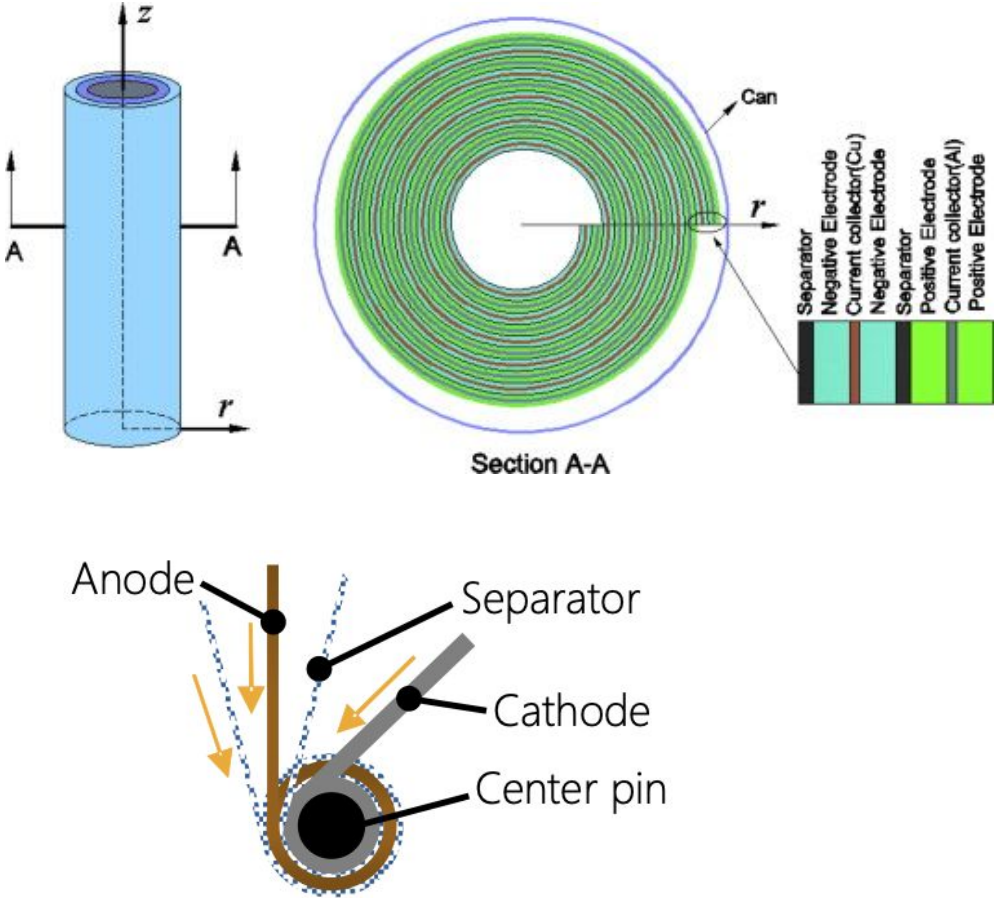
Defect Identification using In-Line Cameras



The winding structure is to roll the cathode sheet, separator, anode sheet and separator of the battery together through the winding of a fixed winding needle, and extrude them into a cylindrical or elliptical cylindrical . The wound electric core can form a hard shell cylindrical winding . Using this machine, cathode and anode films, separated by the top and bottom separator films, are rolled up into a hollow cylinder casing for cylindrical battery applications.



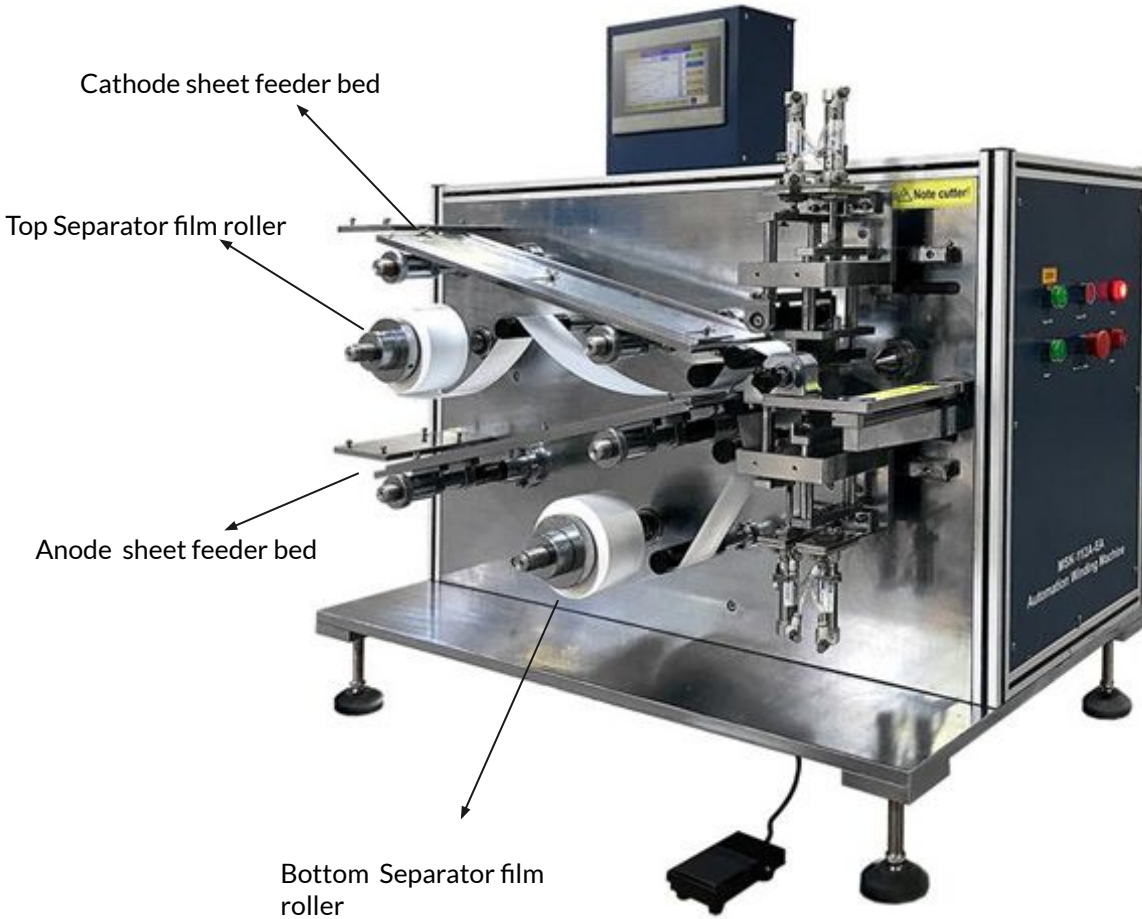
1	Cathode Sheet Feeder Bed
2	Top Separator Film Roller
3	Guiding Roller
8	Anode Sheet Feeder Bed
9	Bottom Separator Film Roller
10	Guiding Roller
15	Cutter
16	Winding Needles



Winding Machine



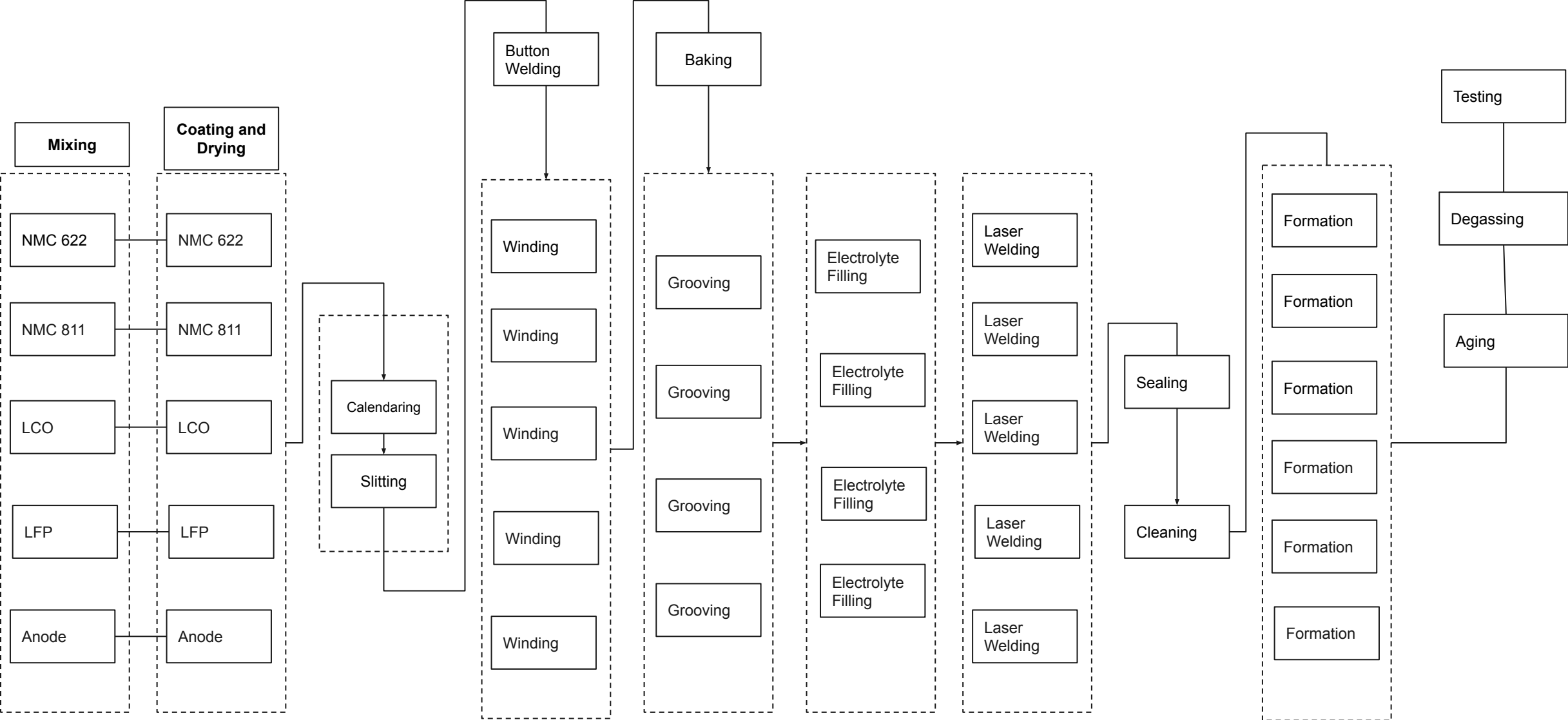
MSK-112A-EA



**MSK-112A-EA
Electrodes Assembler**



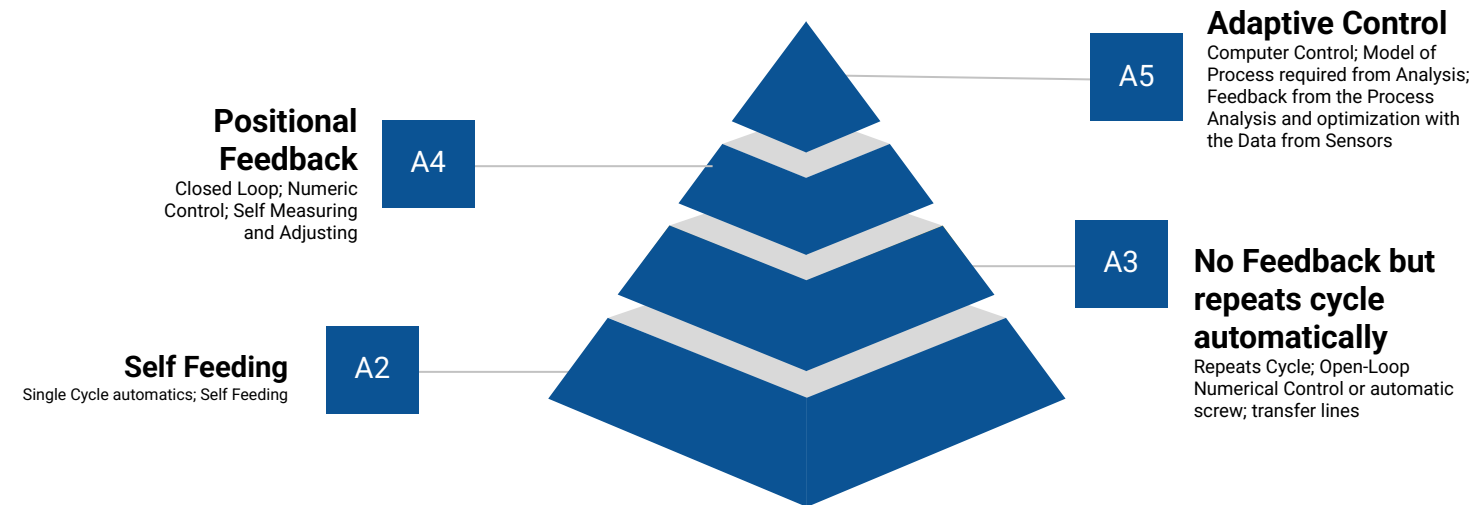
Material flow in the manufacturing line



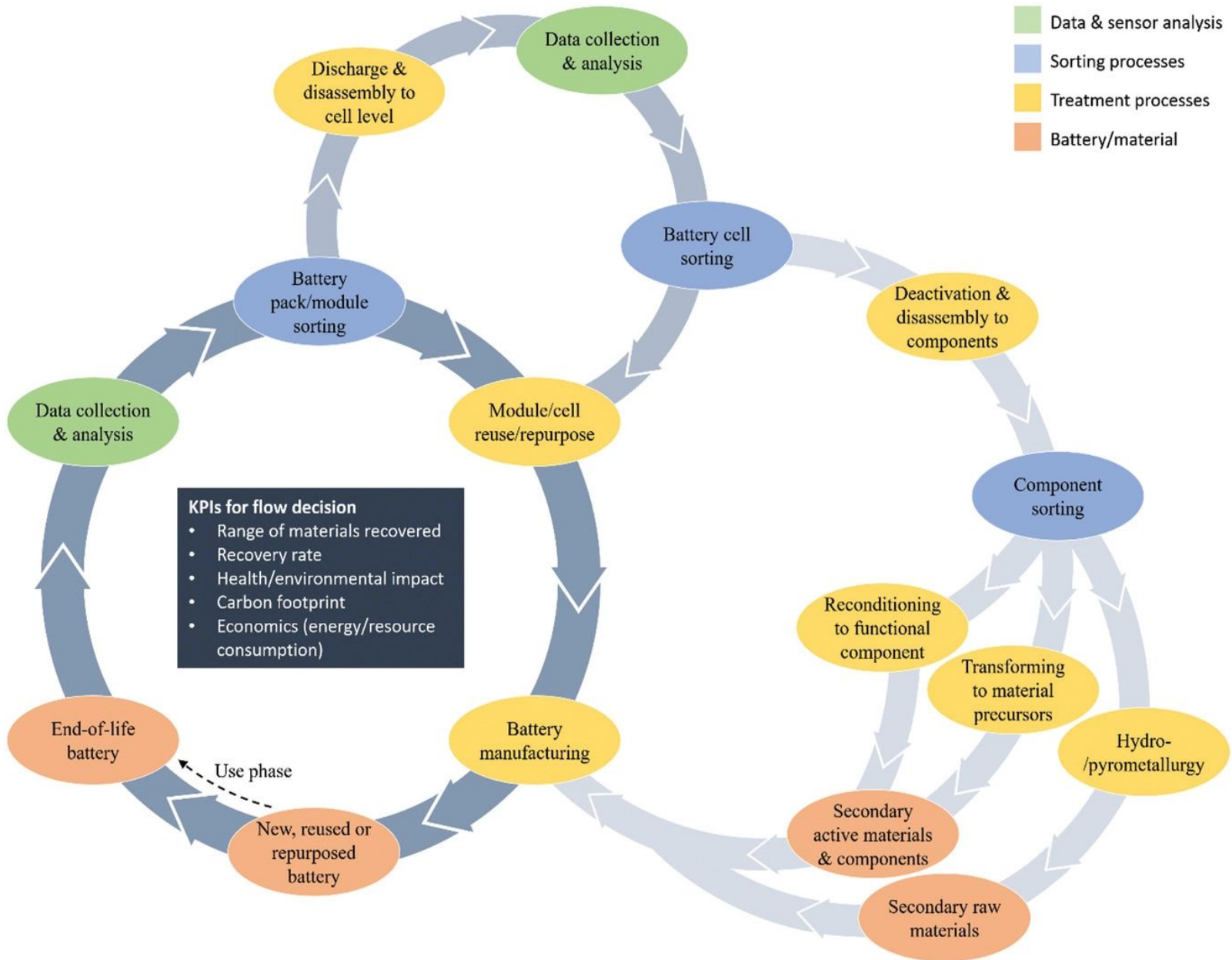
Cycle Time Calculation

	Battery Sizes				
	14500	16340	18650	21700	26650
Number of batteries in one batch	3741	4443	2241	1766	1472
Lead time for one batch (Days)	21.9	22.3	21.2	21.0	20.8
Cycle time (Batteries/Day)	39	41	33	29	26
Total chemistries	4	4	4	4	4
No. of batches per day	4	4	4	4	4
Capacity per day (Units)	631	661	520	463	419
Capacity per day (KWh)	2.27	2.14	6.55	27.78	8.67

Level Of Automation



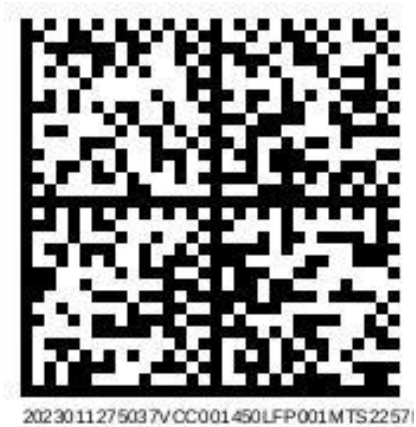
Process Station	Level of Automation
Mixing	A2
Coating	A3
Drying	A3
Calendaring	A5
Slitting	A3
Winding	A2
Autocase Feeding	A3
Button Welding	A3
Grooving	A3
Vacuum Baking	A3
Electrolyte Filling	A4
Laser Cleaning	A3
Sealing	A3
Formation	A3
Testing	A3
Quality Inspection	Manual



In the manufacturing of cylindrical cells, various international and industry-specific quality standards are implemented to ensure the production of high-quality cells.

1. **ISO 9001:** Quality management systems, covers all processes in the cell manufacturing plant, from raw material sourcing to final product testing.
2. **ISO 14001:** Environmental management systems, covers the environmental impact of the cell manufacturing processes and the management of resources.
3. **IEC 62133:** Safety requirements for secondary batteries and battery-powered systems. It covers aspects such as electrical safety, mechanical safety, and thermal safety.
4. **UL 1642:** Safety standard for lithium batteries, covers aspects such as thermal performance, overcharge protection, and mechanical abuse.
5. **UN 38.3:** This is a UN standard for the transport of dangerous goods, which covers the safety requirements for the transportation of lithium batteries.





LFP 16340



LCO 21700



NMC 811.14500



NMC 622.26650



NMC 622.1865



Outsourcing 1

Electrodes:

Team 2 has the capacity to outsource production of 600 Electrodes of Prismatic Cells for Team3.

Line speed:

Production of the battery is 360 Minutes for 600 Electrodes.

Chemistry:

Battery Chemistry will be for LCO battery.
(4,2 X 21 X 31.5)

Outsourcing 2

Battery Testing:

Team 2 has the capacity to Test 192 Batteries a Day.
For testing of Prismatic Battery a separate machine is dedicated for 20% of the Testing support for team 3.

Duration for the Testing:

The Duration is 24 hours per back of 64/96/192 channels.

Outsourcing 3

Battery Testing

Team 1 is outsourcing 20% of their Battery testing capacity for testing of Cylindrical cells



Thank You

Hydrometallurgy, uses aqueous solutions to dissolve and separate metals from the battery components. This method is typically used for recycling nickel-cadmium and nickel-metal-hydride batteries, where the nickel and cadmium are dissolved in an acidic solution and then recovered by precipitation or electrowinning. It is also used to recover cobalt, lithium, and other metals from lithium-ion batteries.

CELL CHEMISTRY	MATERIALS	CASING	RECYCLING PROCESS
NMC 622	Nickel, Manganese, Cobalt	Aluminium	Pyrometallurgy
NMC 811	Nickel, Manganese, Cobalt	Aluminium	Pyrometallurgy
LFP	Lithium Iron Phosphate, Graphitic Carbon	Aluminium	Hydrometallurgy
LCO	Cobalt Oxide, Graphite Carbon	Aluminium	Hydrometallurgy

