Feasibility Study of The Lithium-Ion Battery Manufacturing Facility Sponsored By MakeSens Inc.

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Abstract

- MakeSense has interested in establishing a full-scale 18650 Lithium-Ion Battery Cell manufacturing facility in Alberta due to increased green technology and electrical Adoption.
- Major deliverables are a 3D floor plan model and a 2D floor plan that help with the visualization of the facility as well as the feasibility study result and suggestions for improvement.
- The project focuses on production setup, facility design, equipment procurement, quality control, energy analysis, supply chain integration, and economic analysis
- The capacity production is ~200 M cell/year with CAPEX, OPEX, and Pay Back Period determined in varies of the operation time of the year, the market price of the cell, and the expected profit percentage yearly.

Introduction

- The recent shift towards green manufacturing and electric vehicles in North America has led to challenges such as rising prices, shortages, and delays in battery production. To address these issues, companies are looking to regionalize their supply chains, leading to a significant increase in battery production in North America
- Alberta is well-positioned to benefit from this growth in battery production. Establishing a full-scale cell manufacturing facility in the province could leverage its natural and human resources and play a significant role in the green industrial revolution.
- MakeSens Inc. has tasked this project with evaluating the feasibility of such a facility, assigning responsibilities to teams focused on process engineering, facilities design, supply chain management, quality control, and regulatory compliance.

Discussion

- The technology and materials were selected based on their suitability and cost-effectiveness at the time of the study, with consideration for future advancements.
- While the feasibility study focused on two scenarios, various factors can influence CAPEX, OPEX, and the Payback Period, suggesting potential expansion for sensitivity analysis in future studies.
- Regulatory frameworks governing battery manufacturing, including environmental regulations and health and safety standards, were not within the project scope but are essential considerations for project initiation. Similarly, while the location of the facility was not addressed in the study, it remains a critical factor requiring thorough due diligence and investigation.
- The layout of the facility underwent iterative revisions to optimize the flow of travel paths and minimize distances; nevertheless, there remains room for improvement to further reduce energy consumption while reducing process time throughout the entire facility.

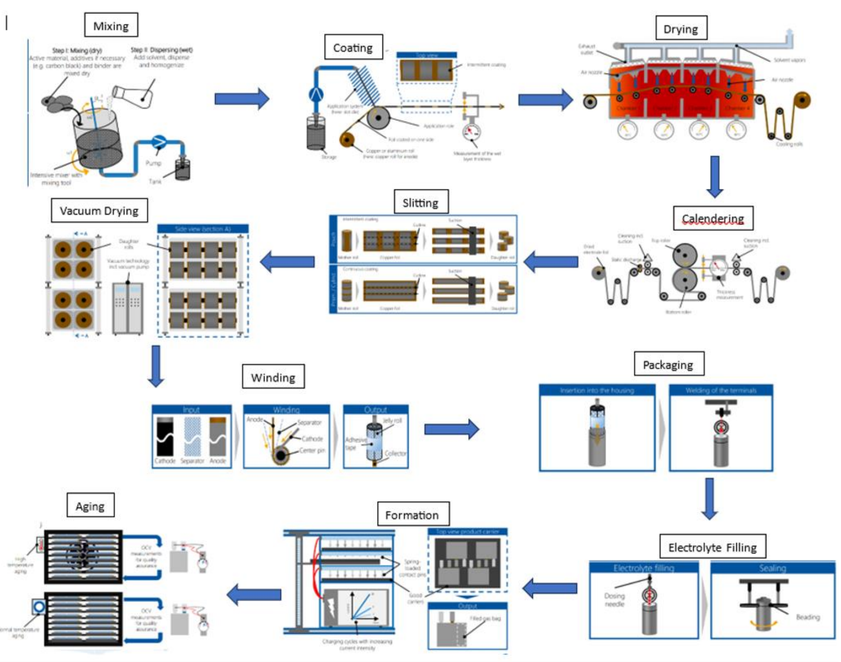

Figure 1: Lithium-Ion Battery Cell Production Process. PEM of RWTH Aachen University.E. (2018).

Conclusions

The feasibility study has provided valuable insights into the establishment of a full-scale Lithium-Ion Battery Cell manufacturing facility in Alberta. The manufacturing process, aligned with ISO standards, demonstrates a commitment to quality assurance. Energy consumption analysis highlights key areas for optimization, while the target yearly output and equipment procurement considerations contribute to operational planning.

Despite initial challenges, the feasibility study indicates a viable payback period, emphasizing the project's financial viability. Moving forward, continued attention to regulatory compliance, technological advancements, and facility layout optimization will be crucial for the success of the project.

Results

- The manufacturing process encompasses electrode production, and cell assembly and finishing, adhering to ISO 7 and 8 clean room and dry room conditions across 13 process units. Manufacturing regulations include ISO 9001:2015, which governs quality assurance at local, provincial, and federal levels
- Energy consumption is primarily driven by technical building services (39%), materials (34%), and process machinery (27%).
- Target yearly output is 2.3 GWh with operation of two 16-hour full-time shifts daily, 250 days annually. TOB Energy quoted CAD 157 million for a turnkey assembly, covering the assembly line and testing equipment
- Feasibility study includes CAPEX and OPEX, with increased contingencies for permitting, waste disposal, packaging, and shipment. Despite these adjustments, the feasibility of a 13-year payback period is determined. Considering duplicate equipment doubles costs and production, yielding an 8-year payback period
- The plant will have a capacity of 2.8 GWh, this requires a large-scale floor plan to accountant for the high cell production rate. The plant will have 8 rooms that are part of the manufacturing process, 2 rooms dedicated to approving the plant manufacturing process and environmental impact/safety of the plant. Adequate room has been made to allow for process flow changes in the future with a plant floor size of 500,000 million square feet.

Methods and Materials

Assumption: All required approvals are in place and the project scope focus on the following:

- **Production Setup and Facility Design**

Conducting the analysis of production requirements which involves process flow diagrams, equipment placement considerations, required materials.

- **Equipment Procurement**

Research and select appropriate machinery and equipment necessary for production which includes evaluating vendors, obtaining quotes, and ensuring compatibility with production needs and facility specifications.

- **Quality Control**

Develop protocols and procedures for battery quality assurance

- **Energy Analysis**

Conduct analysis of energy consumption patterns and identify opportunities for optimization and resource utilization within the facility.

- **Supply Chain Integration**

Analyze the supply chain for critical materials and components, and inventory management.

- **Economical Analysis**

Conduct economic analysis to evaluate the financial viability of the project which includes assessing initial investment costs, operating expenses, revenue projections, potential return on investment, and payback period to determine project feasibility.

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