An Industrial Visit to Adani Industries, Mundra, Gujarat was conducted under the aegis of IEI students chapter, EED, LDCE.

A Report on

Industrial Visit to Adani Mundra

Date of Visit: 02-04-2024 & 03-04-2024

Location: Mundra

Day 1 :

Our visit to Adani Port Mundra was an enlightening experience, where we first had the

opportunity to witness the remarkable Adani Port and SEZ Miniature. As the largest commercial port operator in India, Adani Ports and Special Economic Zone Limited (APSEZ) commands a significant share, approximately 25%, of the nation's cargo flow. Its extensive reach spans the maritime states of Gujarat, Maharashtra, Goa, Kerala, Andhra Pradesh, Tamil Nadu, and Odisha, boasting a network of 13 domestic ports. The installation of state-of-the-art cargo-handling infrastructure underscores APSEZ's commitment to excellence, ensuring the seamless management of diverse cargo types, including containers, liquid and dry cargo, and crude oil. Moreover, with over 15,000 hectares of land meticulously divided, Adani Port Mundra emerges as a testament to strategic planning and operational proficiency. From a student's perspective, witnessing the scale and sophistication of APSEZ's operations offers valuable insights into the dynamics of India's maritime trade landscape.

RMG Cranes

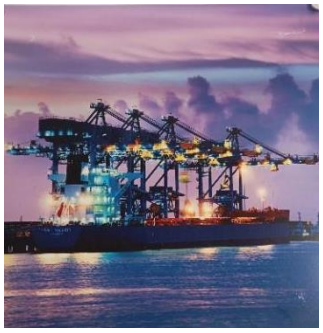
At Adani Port, we encountered RMG (rail-mounted gantry) cranes, pivotal in the container handling process encompassing loading, unloading, and stacking operations. These robust machines, integral not only to the port but also to container terminals and railway transfer yards, epitomize efficiency in cargo management. Noteworthy were the varying capacities observed, ranging from 60 to 80 tons, underscoring the versatility of these cranes in accommodating diverse cargo requirements. Positioned strategically along the railroad line, RMG cranes symbolize the seamless movement of goods across the port's expansive landscape. Additionally, our observation extended to RTG (Rubber Tyre Gantry) cranes, albeit with slightly lower handling capacities compared to their RMG counterparts. This firsthand encounter provided valuable insight into the intricate logistics involved in modern trade operations.

Port History

- **1994**: Approval granted by the Gujarat Maritime Board (GMB) for a captive jetty establishment at the Port of Mundra.
- **1998**: Formation of Gujarat Adani Port Ltd., a joint-sector entity, marked by the operational commencement of multi-purpose berths 1 and 2 at Terminal I, with the anchoring of MT Alpha-2.
- **1999**: Expansion continues with the opening of multi-purpose berths 3 and 4 at Terminal I.
- **2001**: The Port of Mundra signed a concession agreement with GMB for port development, operation, and maintenance, alongside the completion and integration of the private MUNDRA-ADIPUR railway line.
- **2002**: Partnership agreements with Guru Govind Singh Refineries Ltd. and Indian Oil Corporation Limited enhance the port's crude oil handling capabilities, alongside the initiation of a single-point mooring facility.
- **2003**: A sub-concession agreement is signed for the addition of a container terminal, coinciding with the incorporation of Mundra Special Economic Zone (India's first multi-product port-based SEZ). Additionally, berths at Terminal II commence handling bulk cargo.
- **2005**: Merger between Adani Port Limited and Gujarat Adani Port Limited takes place, with the operational launch of the single-point mooring facility.
- **2006**: The company name changed to Mundra Port and Special Economic Zone Limited (MPSEZ).
- **2007**: Terminal II witnesses further expansion with the addition of two bulk cargo berths, alongside the commencement of trial run operations. A service agreement with Tata Power facilitates power production for coal cargo imports, while equity shares in MPSEZ are offered to the public and employees, listed on the National Stock Exchange.

The Port of Mundra has evolved significantly over the years, playing a crucial role in trade and economic development.

About Port



The Port of Mundra boasts nine multi-purpose terminals, spanning a total length of 1.8 kilometers, accommodating vessels of various sizes. The depths alongside these terminals range from 9 to 16.5 meters, ensuring accessibility for a diverse range of ships. Each berth is meticulously designed to cater to specific vessel sizes and cargo types, with varying lengths and depths. For instance, Berth 1 can accommodate vessels up to 75,000 DWT, while Berths 7 and 8 are tailored for ships of up to 40,000 DWT. Additionally, the port offers extensive storage facilities, including closed dockside warehouses covering 137,000 square meters and open storage spanning 880,000 square meters. These facilities cater to a wide array of commodities, from wheat and sugar to steel sheets and coal. Plans for future expansion include the construction of two thermal power plants, as well as the development of a new terminal site to enhance further the port's capabilities in handling dry bulk cargo. From a student's perspective, understanding the infrastructure and plans of the Port of Mundra provides valuable insights into the complexities of maritime trade and logistics.

Fortune Oil Refinery

The visit to the Fortune Oil Refinery Plant provided a fascinating insight into the manufacturing processes of packaging materials for edible oil. Various packaging options such as pouches, bottles, jars, and tin cans were observed being produced on-site. The refinery imports crude oil from foreign sources and refines it using advanced technology, including PLC (Programmable Logic Controller) systems and cooling equipment. The final packaged products are stored in warehouses, with production adjusted based on market demand despite a daily refining capacity of 200 metric tons and a total refinery capacity of 5000 metric tons across different units. Key consumers of Fortune Oil Refinery include Nestle India and Parle, with their major products including Palmoline Oil, Palmcurline Oil, Soybean Oil, and Sunflower Oil. Each oil type undergoes specific heating processes for purification, with a noteworthy achievement of zero waste generation from raw materials through innovative recycling processes. Palmoline oil, derived from palm tree fruit pulp, and Palmcurline oil, extracted from its seeds, are particularly favored in the food industry for their neutral taste and odor properties, ideal for preserving snacks like namkeens and chips.

Oil refining from crude oil to edible palm oil:

• **Crude Oil Reception**: The refinery receives crude palm oil and stores it in tanks for processing.

• **Degumming:** The crude oil undergoes heating and mixing with phosphoric acid or citric acid to eliminate gums and impurities. The mixture is then separated using centrifugation.

• **Neutralization:** An alkali solution like sodium hydroxide is added to the oil to remove free fatty acids (FFA) and other impurities, forming soap stock which is separated through centrifugation.

• **Bleaching**: The oil is heated and mixed with bleaching earth (clay) to remove pigments, residual impurities, and Odors. Filtering is then done to remove the bleaching earth.

• **Deodorization:** Under vacuum and heat, volatile compounds causing odor and taste are removed, enhancing the oil's flavour and stability.

• **Fractionation:** The oil is cooled to separate it into various fractions such as stearin (solid) and olein (liquid), allowing for oils with specific melting points and textures to be obtained.

• **Filtering and Packaging**: Refined oil undergoes a final filtration to eliminate any remaining particles before being packaged for distribution.

Throughout these processes, stringent quality control measures are implemented to ensure compliance with food safety standards and regulatory requirements, ensuring the oil's purity and safety for consumers.

refining palm oil into cream

1. **Crude Oil Reception:** The process at the oil refinery begins with the arrival of crude palm oil, which is stored in tanks for further processing.

2. **Degumming:** Crude oil undergoes heating and mixing with either phosphoric acid or citric acid to eliminate gums and impurities, ensuring the cream's texture and quality remain unaffected.

3**. Neutralization**: The oil is treated with an alkali solution like sodium hydroxide to neutralize free fatty acids and acidic compounds, enhancing stability and reducing rancidity, crucial for cream production.

4. **Bleaching:** Mixing the oil with bleaching earth removes pigments, off-flavors, and residual impurities, ensuring a consistent color and taste in the cream.

5. **Deodorization:** Deodorization, conducted under vacuum and high temperatures, removes volatile compounds that may cause undesirable odors or flavors, ensuring the cream maintains a neutral aroma.

6. **Fractionation:** Though optional, fractionation may separate the oil into fractions based on melting points. In cream production, liquid fractions with desirable properties are typically retained.

7. **Homogenization (Optional):** Homogenization may be employed to create a smoother texture by breaking down fat globules, enhancing stability and mouthfeel.

8. **Cooling and Packaging:** The refined cream is cooled and packaged into suitable containers for storage and distribution, maintaining freshness and quality.

Waste Products:

1. **Glycerine:** A byproduct of fat and oil hydrolysis, used in pharmaceuticals, cosmetics, and various industrial products.

2. **Soap:** Produced during stearic acid manufacturing, utilized in household and industrial cleaning.

3**. Mineral Salts:** Generated during stearic acid production, potentially applicable in agriculture or industrial processes.

Management of these waste products must adhere to environmental regulations, focusing on recycling, reuse, or safe disposal methods.

PLC and SCADA in Oil Refinery:

• PLCs control industrial processes like temperature and pressure, offering real-time automation for precise operation.

• SCADA systems provide centralized monitoring and data acquisition, collecting insights from PLCs and sensors.

Overall, PLCs and SCADA systems automate control and monitoring in oil refineries, ensuring stable and reliable operation.

As the day concluded, we received a generous gift from the Fortune Plant: a 500-gram packet of Fortune Besan.

Day 2

On the second day of our visit, we explored the Adani coal basin, witnessing its efficient operations in handling large daily imports of coal. We observed how conveyors transport millions of metric tons of coal to both Tata and Adani thermal power plants, with the conveyors covered to prevent coal erosion during transfer. The storage area is strategically designed to convert coal into powder form, optimizing its efficiency as fuel.

To address erosion concerns, the coal is consistently kept wet, a practice that not only prevents erosion but also contributes to environmental conservation. The basin area is adorned with numerous trees strategically planted to act as wind barriers, further reinforced by nets to shield both the coal and the environment from adverse effects. For transportation beyond the power plants, Adani utilizes xylos for filling coal into trucks and separate xylos for loading coal onto trains. The conveyor system spans 8 kilometers for Adani's TPP and 13 kilometers for Tata's TPP. Moreover, a long rail line facilitates efficient coal transfer to other states, ensuring seamless logistics and operations across regions.

Adani Solar Techno Private Limited

We visited Adani Solar Techno Park, where they observed the manufacturing process of solar panels using silica. Adani's in-house manufacturing plant enables them to produce 88% of their solar panels, making them the sole Indian company manufacturing solar cells. These cells are supplied for their hybrid plant, which currently boasts a capacity of 550 MW and is set to expand to 30 GW at Thawada, aiming to become the world's largest hybrid power plant by integrating wind turbines and other renewable sources. Key suppliers in this process include Vishaka and Company, providing glass for the solar panels, and Jash Energy, providing solar trackers. In the upcoming month, Adani aims to meet a production target of 1000 MW of solar panels at Thawada, showcasing their commitment to large-scale renewable energy production.

We also learned about the process of manufacturing a solar panel from silica, covering stages from ingot to wafer, wafer to solar cell, and solar cell to module.

- **From Ingot to Wafer:**

• **Silicon Ingot Formation**: Pure silicon is melted and crystallized to form a solid ingot.

• **Ingot Slicing**: The ingot is cut into thin slices using diamond wire saws, creating silicon wafers.

• **Surface Polishing**: The wafers undergo polishing to achieve a smooth and uniform surface.

- **From Wafer to Solar Cell:**

• **Texturing**: The wafer surface is textured to reduce reflection and increase light absorption.

• **Doping**: Doping with specific materials creates layers with different electrical properties, forming a PN junction.

• **Screen Printing**: Metal contacts and busbars are screen-printed onto the wafer to allow electrical connections.

• **Firing**: The wafer is heated to fuse the metal contacts and activate the dopants, forming the solar cell.

- **From Solar Cell to Module:**

• **Solar Cell Assembly**: Multiple solar cells are interconnected to form a solar panel.

• **Encapsulation**: The solar cells are encapsulated between protective layers of glass, EVA, and a backsheet.

• **Frame Installation**: The module is framed with aluminum or steel and sealed for durability and weather resistance.

• **Testing and Quality Control**: The assembled solar module undergoes testing for electrical performance, durability, and quality control checks.

We also learned about the two models of solar panels:

• **Monofacial Solar Panels**: These panels have solar cells on one side and absorb sunlight through the front surface only.

• **Bifacial Solar Panels:** These panels have solar cells on both sides, capturing sunlight from both the front and rear sides to produce additional power.

During their visit, we observed a 540 W standard solar panel comprising 144 cells, each with a power output of 0.7 W and a maximum power point rating of 0.789 W.

Adani Thermal Power Plant

Then we had the opportunity to explore the Adani Thermal Power Plant, which was quite impressive!

We observed multiple cooling towers. The plant consists of a total of 9 units, each comprising boilers and generators. Among these units, four are rated at 330 MW, while the remaining five have a capacity of 660 MW each. In total, the plant boasts a capacity

of 4620 MW, with each generator capable of producing 240 MW.

As we toured the facility, we came across a miniature model showcasing the layout of the Adani Power Plant. The model depicted all nine generating units, along with a substation, a 400 kV HVDC line, and a 500 kV AC line. Additionally, we observed a TV screen displaying real-time data on power generation. During our visit, the total generation was recorded at 2844 MW, with one of the units offline. The frequency was noted to be 49.95 Hz, and the load power factor was 61.5% of the rated capacity. It was fascinating to witness firsthand how the plant operates and the significant amount of power it can generate!

CONCLUSION

Industrial visits provide valuable insights into real-world applications of theoretical knowledge. Our recent visit to the Adani Thermal Power Plant was both enlightening and enriching. We witnessed the intricate workings of a large-scale power generation facility, from the towering chimneys to the bustling generator units. The sight of the cooling towers juxtaposed against the chimneys was particularly striking, highlighting the various components involved in the power generation process.

Exploring the miniature model of the power plant allowed us to visualize its layout and understand the intricate network of equipment and infrastructure involved in power generation. The real-time data displayed on the TV screen provided a glimpse into the

plant's operational dynamics, showcasing the magnitude of power being generated and the technical parameters involved.

Overall, the visit offered a comprehensive understanding of power generation processes, from boiler operations to electricity transmission. It underscored the significance of power plants in meeting energy demands and emphasized the importance of sustainable energy practices. As students aspiring to contribute to the field of engineering, this experience has broadened our horizons and reinforced the relevance of our academic pursuits. It has instilled in us a deeper appreciation for the complexities of power generation and the critical role it plays in driving industrial progress and societal development.

We are grateful for the opportunity to witness firsthand the practical applications of our studies and look forward to applying this knowledge in our future endeavours.