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SAMALAJU INDUSTRIAL PORT

USING RENEWABLE ENERGY TO HANDLE BULK

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Malaysia's SCORE initiative is developing hydro-electric power, as an economical and reliable source of renewable energy. SCORE's Samalaju Industrial Park is a greenfield development that hosts major international companies in the specialty metals and petrochemical industries. They are fundamental parts of the energy-intensive manufacturing process for aluminum, high-strength steels, plastics/vinyl, and other products.

These process and manufacturing industries require large tonnages of a multitude of inbound raw materials and produce outbound bulk commodities and semi-finished products. To maintain continuous and reliable plant operations, they are rightly concerned about the availability, quality-integrity, and security of their inventory of these commodities. That was the challenge for developing the Samalaju Industrial Port, which is adjacent to and serves the industrial park.

PORT OR PARK?

In undertaking any major development, a key question is: 'What comes first?' The hydro-electric power and high-voltage transmission lines were first needed to attract energy intensive industry to the industrial park. For the port's justification, it is customers, those who have committed to building their new energy intensive processing and manufacturing plants in the industrial park that are imperative.

As a result, the industrial park is being constructed ahead of the port. Indeed, some process plants were already in production while tender documents for different portions of the port were just being prepared. While this impacts the initial ramp-up of plant production, it gave each industrial park company the opportunity to influence design aspects and details for port facilities. The industrial park came first and is the reason for the industrial port.

Press Metal Bintulu is a good example of a Samalaju Industrial Park resident. They import alumina and produce aluminum ingots and billets at their energy efficient smelter. They are now the largest aluminum producer in South East Asia. Because Press Metal's smelter was ahead of the port, an interim transport option was adopted. Press Metal constructed an alumina receiving terminal on an existing wharf at Bintulu Port, which is approximately 60km from Samalaju. Trucks then transport the alumina to Press Metal's smelter.

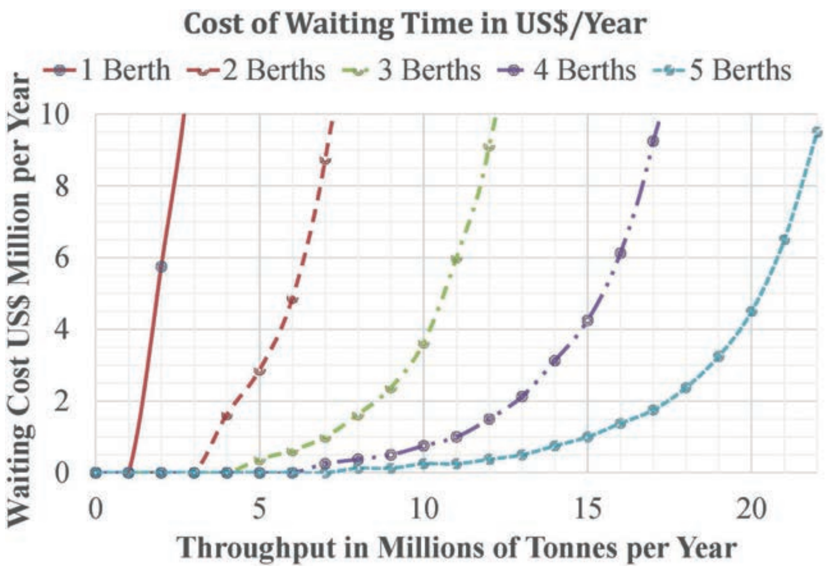
PORT DESIGN

Port elements were examined in a series of studies. A variety of concepts were considered and designs evolved as site information became available and Samalaju Industrial Park tenants committed to the development.

The expected vessel waiting time and demurrage cost increases rapidly with higher berth occupancy values. It is a key factor used to establish the number of berths needed for port economics.

Figure 1 illustrates the evaluation completed at the inception of the tender document stage for the wharf and bulk material handling system. It examines waiting time costs for one-to-five berths for a capacity range of up to 22 million tonnes per year and demonstrated that four berths would satisfy dock occupancy objectives for a 12.0 MTPA capacity, in comparison to three berths, for instance.

The values reported in Figure 1 might be viewed as a reasonable analysis, however the final completed design differed somewhat from the assumptions used. For instance, alumina can only be unloaded at Berth 4, not all berths.



MULTI-BULK COMMODITY CONVEYING SYSTEM

The initial development of the port is primarily a four berth jetty for Handymax size vessels. This 50,000DWT maximum vessel size was selected based upon the feedback from port users. The berths are arranged in-line, along the roughly 0.90km jetty. The complex includes four import conveyor systems and provisions for one export conveyor system. These belt conveyor systems include multiple ship unloaders, storage for different commodities, and provisions for distribution to Samalaju Industrial Park facilities via a future industrial park's belt conveying system or a truck loading terminal.

The assortment of dry bulk materials handled by Samalaju Industrial Port have rather different properties and characteristics. They range from alumina with a bulk density of 920kg/m3 and particles that are less than 100 microns in size to manganese alloy with a bulk density of 3000kg/m3 and a top particle size of 50mm. The conveying system had to be design to handle the specific attributes of each commodity.

Commodity contamination was also a concern, for some products more than others. As a result, features were adopted to segregate commodities to minimize the possibility of contamination.

ALUMINA CONVEYING SYSTEM

Alumina easily aerates. It will disburse into a white dust cloud in the wind or fluidize into an uncontrolled stream as it flows through transfers and finds chute openings and gaps. For Press Metal, cross-product contamination of their primary raw material, the imported alumina, was a concern.

Press Metal chose to employ pneumatic ship unloaders, and Figure 2 illustrates one of the three unloaders and the gallery for the pipe belt conveyor.

Source: NEUERO Industrietechnik

Figure 2: NEUERO's Pneumatic Alumina Ship Unloader

To convey the alumina to the port's interface with the industrial park, pipe belt conveyor technology was elected. At Berth 4, the pipe conveyor is 'open', with the top strand configured as a conventional troughing belt conveyor, but it is enclosed in an elevated gallery. The three traveling ship unloaders can discharge anywhere along the full length of Berth 4, as needed for ship unloading plans.

Berth 4's gallery has a slotted roof that is protected by a roof closure/cover belt. The roof's closure/cover belt loops over the discharge chute of each ship unloader. At the shore end of Berth 4, the top troughing strand of the pipe conveyor closes into the circular pipe configuration, protecting the alumina as it is conveyed shoreward. The 2km pipe conveyor negotiates both vertical and horizontal curves, which eliminates a transfer. This is a much more economical than the 60km interim trucking arrangement.

GRAB BUCKET UNLOADERS

For commodities other than alumina, a variety of unloading technologies and design features were considered. Levelluffing grabs with an integrated machine-mounted, hopper was selected by Bintulu Port Holdings, the operator of the port.

FUTURE SHIPLOADER

Provisions for a future, separate shiploading system were provided. Because some export commodities have to be protected, the shiploading conveying system is enclosed and fitted with hinged doors on harbour side of the gallery that are actuated by a cam mechanism on the shiploader's tripper.

STOCKPILE STORAGE

The port provides strategic storage capacity for the industrial park's plants. The stockpile areas are arranged to accommodate multiple commodities. For any given commodity, terminal rules-of-thumb are to provide at least 1.5 times the tonnage of the largest vessel (50,000DWT) and 10% of annual throughput. Figure 3 illustrates these two stockpile sizing rules and how they intersect at 75,000 tonnes. Providing adequate, economical storage capacity for customers who have annual receipts that are less than 750,000 tonnes was considered.

Since each industrial park plant has their own plant-site stockpile, the strict application of these rules-of-thumb was considered to be inappropriate. A different approach was adopted. The number of individual pile and their sizes would vary and continually expand and shrink with storage allocated per ever changing operating conditions.

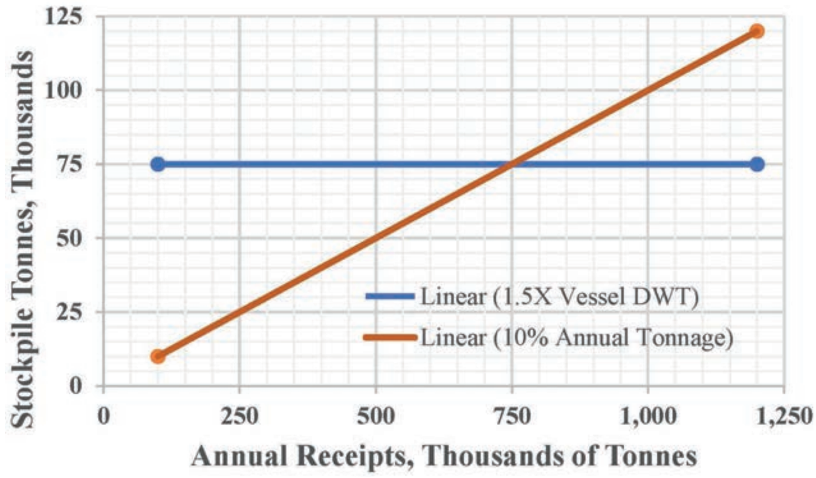
TRUCK LOADING

Commodities are currently being shuttled between the port and the industrial park by trucks. To reduce initial capital cost, mobile equipment is being used to load trucks directly from the stockpiles. As port receipts ramp-up, the inefficiencies and limitations of a mobile equipment mode of operation become excessive. Provisions for a future, truck loading terminal were provided. This facility will better manage truck queuing to mitigate traffic congestion automatically weigh commodities loaded into the trucks, eliminating the inefficiency separately weighing each load on a truck scale.

FUTURE SYSTEM

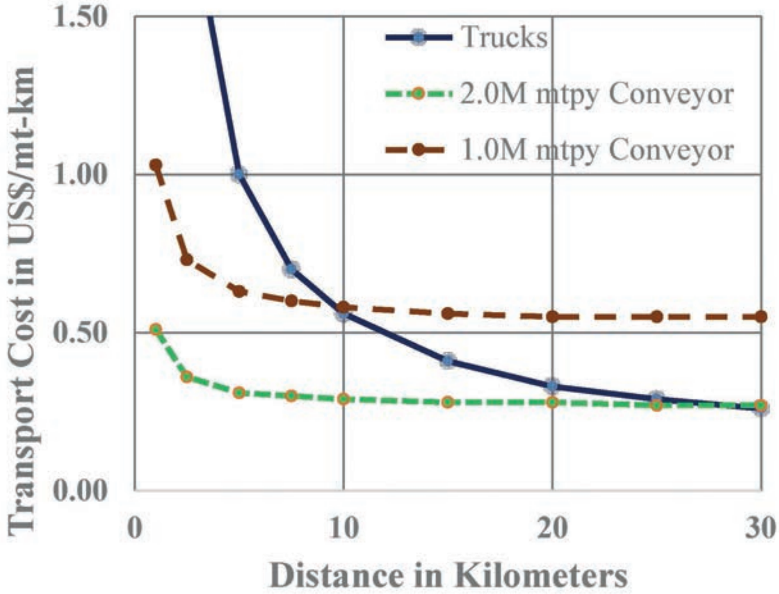
While the truck loading terminal was conceived during the specification stage as a useful feature, it would not be the most effective option for Samalaju. The proximity of the port to the process plants makes an industrial park conveyor distribution system the ideal solution. Belt conveyors are the most efficient and economical mode of transportation for short distances. The common factor for comparing different modes of transportation is their cost in US$/mt-km. What makes truck transportation expensive for short distances is their time spent waiting: queuing, loading, weighing, and unloading. As the travel distance gets longer, the influence of these factors significantly lessens.

Figure 4 illustrates an example cost relationship for trucks and a belt conveyor for distances up to 30km. The cost in US$/mt-km steeply drops for trucks as the travel distance increases. Two different scenarios are also illustrated for conveyors. The major cost for a belt conveyor is its capital cost, which is a fixed cost per kilometer. This capital cost is the same for both conveyor scenarios. As a result, the tonnage being handled by each is what makes a dramatic difference. A conveyor system handling 2.0 million mt/yr has half the cost in US$/mt-km than when this system only handles 1.0 million mt/yr. That does not happen for trucks, which are assessed on an hourly basis. If there are fewer tonnes to transport, fewer trucks are required. Trucks are advantageous in situations where tonnage varies. Conveyors are advantageous in situations where the annual tonnage is relatively high and stable.



Source: Energy Associates, P.C.

Figure 3: Stockpile Size Using Rules-of-Thumb



Source: Energy Associates, P.C.

Figure 4 – Transport Cost for Trucks vs. Belt Conveyor

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The cost advantage for conveyors for relatively short haul distances is the reason why a future Industrial Park Conveyor Distribution System will benefit the industrial residents. The truck loading terminal was conceived due to concerns that a common distribution conveying system for the industrial park is a new idea that would have to be approved and funded. Trucks will likely be the distribution mode of transportation for some time.

MAKING IT WORK

The design challenge was to enable the port to simultaneously manage an assortment of different tasks for multiple different commodities, with the utmost simplicity. A "Spine Design" was conceived for the belt conveyor system. It is the backbone of the system. The spine design will allow Samalaju Industrial Port to direct receipts to storage, truck-loading, and/or to the industrial park interchange transfer. Receipts can be split and routed into two different directions. Receipts can also be cycled between stockpiling and truck loading, for instance. The ability to bypass the port's stockpiles without slowing ship unloading reduces the port's stacking and reclaiming costs without burdening the ship unloading operation. Some commodities can be stacked while others are being reclaimed from adjacent stockpiles.

The system is operated from a control room tower, located above a central transfer hub. From this elevated position, operators have a 360-degree view of the harbor, stockpiles, future truck loading station, and future transfer to the industrial park conveyor distribution system – providing visual feedback to the operators, in addition to the computer displays of controls, system graphic diagrams, system status, stockpile inventories, fault/alarm announcements, and other screens.

Samalaju Industrial Port has a host of features and flexibilities that a greenfield development can provide. It minimizes the handling and transport costs for the raw materials and semi-finished products of Samalaju's resident process plants.

ABOUT THE AUTHOR

Daniel Mahr is a Professional Engineer and bulk material handling specialist, responsible for numerous projects at ports, terminals, power plants and industrial facilities. He is a past chair of ASME's FACT Division and its FSHT Technical Committee. Mr. Mahr is currently a member of ASME's B20 Safety Committee and Society of Mining Engineers. He has published over 50 articles on technology advancements, features, and issues; and assists as an Expert Witness in legal matters.

ABOUT THE ORGANIZATION

Energy Associates provides bulk material handling engineering/consulting services, from initial project planning through design and implementation. Responsibilities include improvement assessment, retrofit, conversion, remediation, and failure investigations.

ENQUIRIES

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