Alumina supply study for a smelter expansion

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Abstract

In the scope of a planned Alba smelter expansion, the assessment of the alumina supply system for the present and projected operations was required. The alumina supply system included: ship arrivals, ship unloading at port, storage of the alumina in the port and smelter silos, trucking to the smelter and distribution of alumina to existing and projected potrooms. Within the Bechtel Mining and Metals business unit, the Technology Group provides modeling services for studies and detailed design. To demonstrate operability of future alumina handling to Alba, and jointly weigh alternatives, a discrete event model (DEM) has been developed, capturing all important elements of the targeted alumina handling and storage. Using the model, data was generated from several scenarios to size plant and smelter silos, to set number of trucks and reduce cycle time. Numerous schedules of ship arrivals, port and plant operating protocols were tested, aiding experts to corroborate unit sizes and operating strategies. Additionally, data was collected on fluctuation of vehicular traffic, vehicle servicing, and road and intersection characteristics were combined to assess traffic safety. The model proved to be a useful tool to configure a safe and efficient delivery system. The DEM can be adapted to smelters and ports with different arrangements and operating conditions.

Keywords: Alumina supply; port operation; trucking; process simulation; traffic analysis.

1. Introduction

Since the beginning of operation in 1971, Alba Smelter of Aluminium Bahrain (Alba) has systematically increased aluminium production. Preparing for the next smelter expansion, a feasibility study was completed jointly with Bechtel. A discrete event model (DEM) was developed to demonstrate how the alumina receiving, handling and transportation system from the port to the smelter behaves under present conditions (Lines 1 - 5) and smelter expansion (Line 6). The objectives were to keep all plant silos sufficiently filled, efficiently transfer alumina from port silos to plant silos and to maintain available storage capacity for arriving alumina ships. Present conditions were used for model verification and validation while data on projected operation was intended to check and corroborate early design alternatives.

Analyzing the alumina handling system chain and the alumina requirements, the study focused on the following sectors and activities:

- Ship arrival, alumina handling and unloading at port,
- Managing port silos inventories,
- Trucking alumina from port to smelter,
- Managing smelter silos inventories,
- Operation of the smelter with potline 6.

To address the study objectives, a dynamic simulation approach was proposed. The DEM demonstrated through animation the present and proposed work flow, shown dynamically changing data (e.g. inventory levels, waiting times, queue length, etc.) and calculated key

measures of port and smelter operation (e.g. port and smelter silos level variation, daily ship deliveries, ship demurrage, etc.). This paper presents the structure of the DEM and those typical outcomes sought after by design and plant engineers.

The following questions are required to be answered by the model:

- Is the existing port with two berths capable of handling the additional Line 6 raw materials?
- How many alumina trucks would be required?
- Is a supplemental alumina truck loading station at the port required?
- Are there any traffic intersections that would be critical with the increased frequency of truck traffic?

2. Alumina supply system

2.1. General arrangement

The overall site layout is shown in Figure 1. Battery limits for the studied alumina supply system are selected as below:

- Berth 1 and berth 2 at port (for ship receiving)
- Plant fenced perimeter (for location and access road to smelter silos)
- Marked route between port and smelter

Figure 1. Site layout.

rate from smelter silos from the truck unloading station and the efficient use of the extra truck loading bay would manage the alumina transfer to smelter. Improved ship scheduling would alleviate the ship queuing times.

For the projected (Lines 1 - 6) operation, the ship unloader required transfer rate was determined. An additional truck loading station with two unloading bays was proposed and the optimal size of truck fleet was determined. Improvements to plant silo inventory management were suggested to keep the port silo inventory low (i.e. to unblock ship unloading due to “full” silos). Effect of improved ship scheduling on ship queuing and demurrage was quantified and demonstrated.

6. Trademarks

Flexsim is a registered trademark of Flexsim group.

7. Acknowledgements

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