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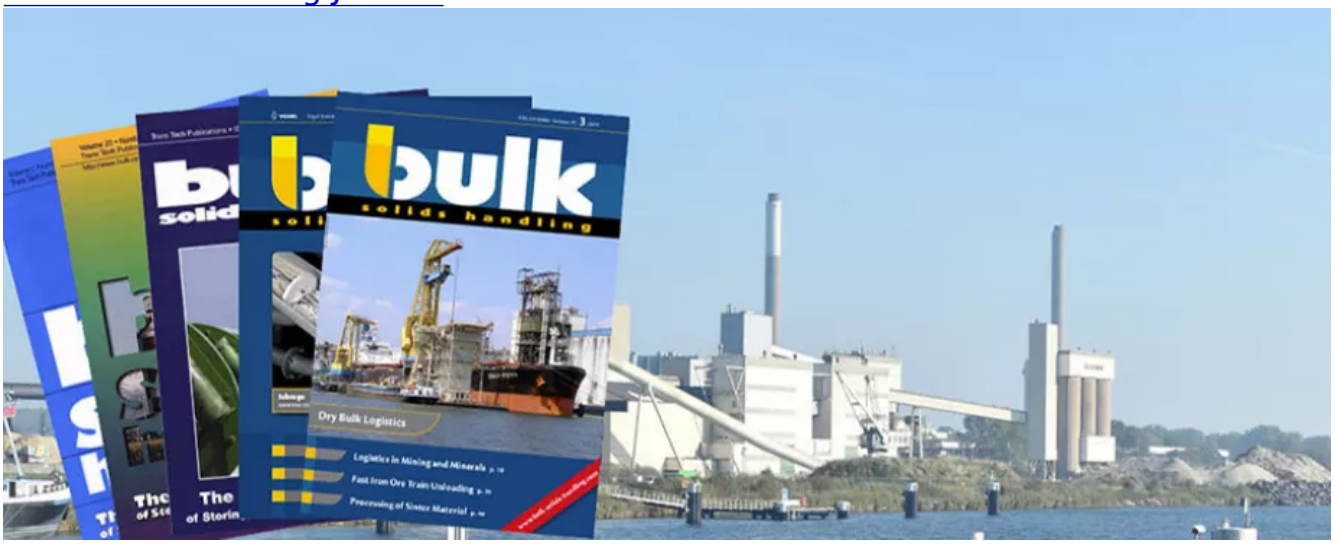

Technical Article

Biomass Bulk Terminals: Simulation and Design of Large-scale Operations

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Due to its ecological advantages and availability biomass energy is set to become a key to the future, leading to new dimensions in handling and transport facilities. This may also include large-scale bulk terminals. Advanced simulation models help to develop terminal solutions with high reliability and economic efficiency.

Energy derived from biomass materials and products has become significant for the current and future development of mankind. Various research have shown that to meet the EU.

demand in the long term future, significant amount of biomass materials and products will be imported into the European Union. Within the research presented in this article it is assumed that there is a need for a large-scale terminal to receive the import freight. To optimise the design of such a terminal and see the effects caused by stochastic influences (e.g. ship arrival pattern), a simulation model is used to assist the design. This article presents the development of such a simulation model; the model is further verified with an analytical model, and the verification shows that the model reflects the theoretical outcomes.

Many renewable energy sources have become increasingly significant in the world today under the concern for sustainability and the security of supply.

Among them are the biomass materials and products. More and more biomass materials and products are traded internationally and transported over long distances. This is due to that some regions have better potential to export while others need to import biomass to fulfil their need [1]. Bulk terminals around the world have been dealing with biomass materials and products for some time in small scope. However, with the expectation of growing scale in the international biomass trade market [1], a large-scale bulk terminal dedicated to handle biomass materials and products is adequate and supports the picture of large-scale biomass trades and long distance biomass supply chains.

This research focuses on the design of a large-scale biomass bulk terminal. This large-scale biomass bulk terminal handles both solid and liquid biomass materials and products, and the yearly throughput is set at 20 to 40 million tonnes, with an estimated share of solid biomass as 40 to 50 per cent [2]. Challenges in terms of handling and storage are caused by the large scale, the wide range of material properties, and the differences in material properties compared to other commonly handled bulk materials such as coal [3]. In addition, the terminal also faces other design matters, such as the storage capacity (up to four times lower bulk density compared to coal [3]), the replenishment of the storage stocks (no transparent data on demand pattern), and the capacity and suitability of the handling equipment. It is a common practice in container terminal design and operation to use simulation as a tool to assist these design issues [4]. It is only a recent development to use simulation models in the design of bulk terminals however [5, 6].