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Research Paper

The Impacts of Clinker Spills in Loading and Unloading Activities at the Private-Interest Terminal

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Abstract

The private-interest terminal functions as a berth for ships serving their interests to facilitate company product distribution. The clinker spill problems often occur during loading activities to bulk carriers at the private-interest Terminal. Clinker spills have negative impacts on clinker loading and unloading activities and the siltation of the jetty. This study aimed to determine the causes and impacts of clinker spills in loading and unloading activities at the private-interest Terminal. The method in this research is qualitative method with a case study approach. Data was obtained through observation, interviews, and documentation studies. The sampling method used purposive sampling. The results showed that the causes of clinker spills were shore grab leaks, the workers' mistakes in unloading clinker at the edge of the jetty, and the crane operator's negligence in operating the shore grab. The impact of a clinker spill is the siltation to the jetty, loss of cargo volume, and delays in loading clinker.

Keywords: *Clinker Spill, Loading and Unloading, Jetty*

INTRODUCTION

Loading and unloading activities often experience problems caused by handling clinker loads that do not comply with the existing regulations. One common problem is cargo spillage, which can hamper the loading and unloading process at the port (Eski and Tavacioglu, 2023). This problem also occurred in PT. Varia Usaha Bahari Tuban branch is engaged in loading and unloading services, particularly clinker, at the PT. Semen Indonesia, Tuban.

Clinker is an important material in the cement industry. It acts as an adhesive for construction (Gartner and Sui, 2018). Clinker typically has a small particle size, ranging between 5 to 25 mm (Schumacher and Juniper, 2013). The main material used for clinker-making is Calcium (Ca), generally derived from limestone or chalk (Sprung, 2008). Typically, clinker-making materials are mined from a certain area and processed in different locations. This is because clinker-making requires various infrastructure and facilities (Fore and Mbohwa, 2015). According to the data published in statista.com (Garside, 2023), global clinker production in 2022 is estimated to be around 3.8 billion metric tons, of which 2 billion metric tons were produced in China. The estimation for clinker production in Indonesia was only 79 million metric tons.

Clinker contributes to approximately 90% of the materials used in cement making (Schumacher and Juniper, 2013). Therefore, the availability of clinker becomes an important factor in cement production. In order to make cement, clinker needs to be mixed with gypsum and other materials such as granulated blast-furnace slag, limestone, and brick rubble (Sprung, 2008; Fore and Mbohwa, 2015).

Since clinker is produced in different locations, it should be shipped to a cement factory before cement production. Transportation of clinker is typically carried out through a private-interest terminal owned by the respective company (Ikhsani, Amrullah and Sitepu, 2022). Therefore, load transfer is needed, which sometimes requires several steps. Unfortunately, this could cause some problems. One of the most frequent problem found in loading and unloading

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activities, particularly for bulk cargo, is spillage (He *et al.*, 2018; Mohajeri *et al.*, 2021). Clinker spill is a problem that often occurs during clinker loading activities to bulk carriers at the private-interest Terminal of PT. Varia Usaha Bahari Tuban branch . The cause of the spill was the unloading of clinker from the dump truck at the pier by the loading and unloading workers (TKBM) when the loading and unloading activities were too close to the jetty area (Kanstin Jetty), resulting in some of the clinker cargo falling into the sea. The shore grab, which is leaked, also resulted in spillage of clinker loads during the loading process onto bulk carriers due to improper maintenance and a lack of checking the condition of the shore grab prior to loading and unloading activities. The presence of clinker spills can have an impact on clinker loading activities. The impact of the spill resulted in less optimal clinker loading activities and, if carried out continuously, could result in shallowing the jetty. It is because many clinker loads fell at the Jetty area and the sea.

Spillage of clinker could also be a potential threat to the environment. According to Elazaka et al. (2021), about 5% of clinker is dust waste that could be hazardous to the environment. This could be due to the use of hazardous materials such as iron ore (Young and Yang, 2019). According to Yang et al. (2016), the potential hazard of clinker is its trace element content, which could be leached to the environment. Therefore, clinker spills should be prevented as much as possible.

In loading and unloading activities at the port, provisions in the process of loading and unloading cargo or goods must be implemented (Fuadaturrahmah and Manurung, 2020). Starting from the regulations in the readiness of loading and unloading equipment and handling the loading and unloading process. With these regulations, it is expected that the loading and unloading company (PBM) appointed in the process of shipping cargo or goods at the port can carry out according to what has been determined in order to achieve a smooth loading and unloading process. However, in doing these activities, problems are often found in handling loading and unloading cargo or goods that are not carried out in the right way, namely fast, safe, smooth, and in accordance with procedures. Many loadings and unloading companies ignore this and are only concerned with the profit obtained from those activities without considering environmental aspects and the resulting impacts. Later in the handling, the process of loading and unloading activities are carried out not in accordance with regulations.

Appropriate loading and unloading activities are important in promoting the performance of cargo shipping, including in the private-interest Terminal—however, the loading and unloading activities in PT. Varia Usaha Bahari Tuban branch terminal still lacks performance, particularly regarding the clinker spillage issue. Based on the problems explained above, this research aimed to find out the causes of clinker spills during loading and unloading activities and the impact caused by a clinker spill on loading and unloading activities at the private-interest Terminal of PT. Varia Usaha Bahari Tuban branch.

LITERATURE REVIEW

Cargo Spillage

Cargo spillage is common in cargo loading and unloading activities, particularly for bulk cargo (Eski and Tavacioglu, 2023). During shipping, cargo must be transferred from one shipping vessel to another or from a shipping vessel to a storage or stacking location (Fraitag *et al.*, 2022). Particularly for bulk cargo, additional equipment is needed to enable the transfer to be performed, such as the utilization of pipeline, conveyor, and grab (Gan, Evans, and Yu, 2020). Unfortunately, since cargo is in bulk form, it is not stored in a specific container (packing), which would prevent it from being spilled (Matsuda, Hanaoka, and Kawasaki, 2020). During cargo transfer, bulk cargo could get spilled in various ways, such as blown by wind, equipment leakages, or improper handling procedures.

Cargo spill is a problem that could cause an environmental issue. Some cargo types are

hazardous to the environment, such as oil and certain chemical materials (Walker *et al.*, 2019). Therefore, cargo with high environmental risk should be handled through strict procedures. However, there are also some cargo with low hazards, such as iron ore, coal, grain, bauxite, and phosphate rock (Walker *et al.*, 2019). Among the cargos that frequently undergo spillage during loading and unloading activities is coal (Bindra and Karim, 2019).

Clinkers

Clinker is an important commodity frequently shipped through private-interest terminals. Clinker is the main raw material during the cement-making process, which is formed from clay, limestone, siltstone, and iron sand (Sutawijaya & Kayi, 2021). It is categorized as a half-finished material because it will be used as the main cement-making material. Typically, the composition of clinker in cement making is between 75 – 90% (Sprung, 2008; Schumacher and Juniper, 2013). Clinker is mainly formed from Calcium (Ca) mixed with some other materials, such as granulated blast furnace slag, pozzolanic materials, fly ash, limestone, and silica fume (Sprung, 2008).

Clinker is produced in various sizes ranging from 5 mm to 25 mm (Schumacher and Juniper, 2013). Due to the trace element content, clinker is potentially toxic when exposed to humans. Referring to Montañés, Sánchez-Tovar, and Roux (2014), trace element contained in clinker includes Cr, while Yang et al. (2016) also mentioned the availability of Ba and Zn. Kowalik et al. (2019) stated that clinker is strongly alkaline after reaction with water.

Loading and Unloading

According to Dewi & Saputro (2019) explain that loading and unloading is an activity carried out by loading or unloading cargo or goods from the hold to be unloaded to the pier or transport vehicle or barge, while loading is an activity carried out by loading or raising cargo or goods from the dock or transport vehicles or barges to be lifted to the hold with the help of ship cranes.

Loading and unloading activities are the main activities in port operation. Cargo would be loaded onto empty vessels for delivery and unloaded from the vessel upon arrival (Roy and de Koster, 2018). In the loading and unloading activities, different tools are used depending on the cargo types. A container crane is used for loading and unloading containerized cargo (Gharehgozli, Roy and de Koster, 2016). For bulk cargo, the tools frequently used are conveyor and shore grab (Gan, Evans and Yu, 2020; Rosita, Hermawati and Marini, 2023). However, in smaller ships, loading and unloading are carried out manually through human forces (porters) (Kondar *et al.*, 2020).

Loading and unloading activities are important processes in cargo handling. It should be performed appropriately to maintain the cargo's quality and quantity. Unfortunately, reduction of cargo volume is frequently found in the process of bulk cargo loading and unloading activities. Appropriate tool type, quality, and operational procedure are needed to carry out good cargo loading and unloading performance (Rasulov, Masharipov and Ismatullaev, 2021). In addition, appropriate operator skill is also needed (Gekara and Thanh Nguyen, 2018). Lack of any of the requirements would likely increase the potential of cargo spill.

Private-Interest Terminals

According to the Government Regulation of the Republic of Indonesia Number 31 of 2021 concerning the Implementation of the Shipping Sector Article 1 Paragraph 14, it stated that a private-interest terminal is a terminal that is located outside the work environment area and the port interest environmental area which is part of the nearest port to serve its own interests in accordance with its main business. A private-interest terminal functions as a place for ships to berth, loading, and unloading of cargo which serves its own interests as a support in accordance with the company's main business (Darsono, Syibli and Akmal Fajar, 2021). Private-interest

Terminal is generally located near the factory or goods storage. Therefore, there is direct access from shipping vessels to the storage and vice versa. The ports are also designed to fulfill the specific needs of the factory (Hidayat, Rusman and Lestari, 2023).

The private-interest Terminal is operated by the company under the supervision of the Port's Authority (Darsono, Syibli and Akmal Fajar, 2021). Therefore, during the operation, the port should comply with the regulations related to the port's operation. It includes the operational procedure as well as the safety and security standards.

RESEARCH METHOD

Research Method

The research method used in this study is qualitative with a case study approach. Referring to Hancock and Algozzine (2006), case study research allows the researchers to capture multiple realities that are not easily quantifiable. This research was conducted at the private-interest Terminal of PT. Varia Usaha Bahari Tuban branch starting from August 01, 2021, to July 31, 2022.

Sample Research Data Sources

The sampling method used purposive sampling. namely, selecting informants who understand the object of the study (Sugiyono, 2022). Informants in this research are Head of the Operational Unit of PT. VUBA Tuban branch, Supervisor of PT. VUBA Tuban branch, and Foreman PT. VUBA Tuban branch.

Research Data Sources

Primary Data

Primary data in this study were obtained through observation at the private-interest Terminal in PT. Varia Usaha Bahari Tuban branch and conducted interviews with the Head of the Operational Unit of PT. VUBA Tuban branch, Supervisor of PT. VUBA Tuban branch, and Foreman PT. VUBA Tuban branch.

Secondary Data

Secondary data in this study is in the form of photographs related to the problem of spillage of clinker in the process of loading onto bulk carriers in the reports on loading and unloading activities for the Safety Department from August 2021 to February 2022, and standard operating procedures (SOP) for handling clinker loading and unloading.

Data Analysis Techniques

The data analysis technique used is qualitative analysis.

Triangulation

This research uses two types of triangulation, namely source triangulation and technical triangulation. Source triangulation was used by researchers to examine the data that had been obtained from the three sources of informants. Then, an analysis was carried out so that later conclusions could be drawn. From the results of these conclusions, a request for agreement (member check) was then carried out on the three sources. The triangulation techniques obtained from observation, interviews, and documentation will be compared so that the three data sources produce the same and valid data.

FINDINGS AND DISCUSSION

The cause of clinker spills during loading and unloading activities at the private-interest Terminal in PT. Varia Usaha Bahari Tuban branch

Shore grabs were leaked

Leaks on the shore grab owned by PT. Varia Usaha Bahari Tuban branch is caused by a lack of maintenance on the part of the equipment. As a result of the lack of maintenance, the shore grab was leaked when used. It resulted in spills occurring when loading the clinker, causing some clinker loads to fall into the wharf area and the sea. If this happens repeatedly when loading clinker, it will result in less-than-optimal clinker loading activities private-interest Terminal in PT. Varia Usaha Bahari Tuban branch.

Unloading and stacking of clinker from dump trucks that are too close to the jetty

In the process of unloading and stacking clinker from dump trucks, clinker loads often spill into the sea. It happened because the loading and unloading workers made some mistakes when directing the dump truck driver to unload clinker to the jetty. The foreman directed it too close to the jetty, causing some clinker cargo to spill into the sea. The loading and unloading workforce has violated the standard operating procedure for handling clinker loading. The standard operating procedure explains that the unloading and stacking of clinker cargo at the jetty should be within 2 (two) meters from the jetty's edge. This rule aims to prevent spillage of clinker into the sea when unloading and stacking clinker in the jetty.

Negligence of the crane operator in operating the shore grab

The crane operator's negligence in operating the shore grab when they were about to take the clinker load at the wharf resulted in the shore grab often being slammed hard onto the wharf floor. As a result, the shore grab is often thrown, causing damage to the shore grab in the form of a bent bucket on the shore grab. This condition caused the shore grab not to close completely when transferring cargo from the pier to the ship. It resulted in leaks and clinker spills during loading.

The impact was caused by a clinker spill during loading and unloading activities at PT's private-interest Terminal. Varia Usaha Bahari Tuban branch

The siltation to the Jetty

As a result of frequent spills of clinker into the sea during the loading process it causes siltation of the pier at the private-interest Terminal. Regarding this, clinker has the same properties as cement. When exposed to water, it will turn into lumps and harden. If, during the loading process, a clinker spills into the sea, the clinker will harden on the seabed. If the clinker spill problem continues to occur without prevention, it will have an impact on the activity and depth of the waters at the jetty.

Loss to cargo volume

The amount of clinker loaded onto ships decreases. This spill causes a discrepancy in the amount of cargo that should be loaded onto the ship with the stowage plan and results in a shortage of cargo.

The delays in the clinker loading process

Shore grab damage can result in efficient loading of clinker. Shore grab damage that often occurs is that the shore grab has a leak. Shore grabs that experience leaks when loading clinker must be stopped because they result in spills. The shore grab is then repaired due to the lack of a reserve shore grab owned by PT. Varia Usaha Bahari Tuban branch, this repair had to be done, thus

requiring repairs to be carried out during loading and unloading activities. The waiting time for shore grab repairs hampered the clinker loading and unloading process.

Clinker spill is a problem in the private-interest Terminal of PT. Varia Usaha Bahari Tuban branch. Not only does it cause a loss of cargo volume, but it also has the potential to be hazardous to the environment. Therefore, it should be prevented as much as possible. Referring to the result, clinker spill in the loading and unloading activities is caused by several factors, including the tools' condition, stacking location, and operator's negligence in order to minimize the risk of clinker spill.

The research found that the shore grab used to transfer clinker was not optimal. Leaks found in the grab enabled the clinker to slip from the crane. Therefore, to prevent leaks, maintenance or repair is needed to the crane. In addition, the utilization of a conveyor is recommended to reduce clinker spillage. The conveyor is typically used in transferring materials between ships and storage (Mallah *et al.*, 2023). It has been used in transferring various kinds of cargo, such as mines, mills, and oil (Patel *et al.*, 2022). The utilization of a conveyor could prevent, or at least reduce, spillage of clinker during loading and unloading activities. Conveyor, which directly connects the storage location and ship, is also beneficial in reducing loading and unloading time operational cost and maintaining goods' quality through the minimization of contact with external subjects (Dafnomilis *et al.*, 2018).

The utilization of the conveyor also hinders the risk of clinker spill caused by the stacking process. Since clinker that will be loaded onto the ship or unloaded from the ship is directly taken to or sent to the storage. Therefore, trucks are not needed to transport clinker from the storage to the port (jetty). Moreover, the complex stacking process in the port area is also unnecessary. Finally, the use of the conveyor also hinders the crane operator's negligence. Since the conveyor could be placed as close as possible to the ships, crane operators could freely carry out the unloading process without being too worried about causing a clinker spill. Therefore, unloading activities could be performed more effectively and efficiently.

CONCLUSIONS

There are several causes of clinker spills during loading and unloading activities at the Private-Interest Terminal of PT. Semen Indonesia Tuban, such as shore grab leak, loading and unloading workforce (TKBM) mistakes in unloading and stacking clinker material at the jetty, and crane operator negligence in operating the shore grab.

The impact caused by a clinker spill during loading and unloading activities at the Private-Interest Terminal is the siltation to the jetty, loss of cargo volume, and delays in the clinker loading process. For further research, the research can be widened by comparing two companies with the same problems handling the clinker spill for deeper analysis.

Based on the actual condition of the loading and unloading process in the Private-Interest Terminal, it is necessary to propose the utilization of a conveyor in the loading and unloading process of clinker to avoid spillage caused by equipment damage, inappropriate stacking location and workers' mistakes.

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