

# Utilization of containers for dry bulk handling in sea ports

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**Abstract.** The paper discusses the way to improve the transport logistics of main bulk cargos: ore, coil, fertilizers. The studies performed by many researchers show that the transportation by rail and road modes causes rather significant losses of cargo and produces a negative effect on the environment due to dust generation. In order to be competitive, the cargo handling system has to become more and more specialized, but the dark side of the specialization is the loss of liquidity and flexibility. The authors suggest that the containerization, which proved to be extremely efficient in general cargo transportation and handling, could be successfully extended to the bulk cargoes.

## 1. Introduction

The analyses of factors determining the competitiveness of transport logistics reveal the main demands meeting which would provide economic efficiency and service quality of the delivery chain. These factors are (a) the preservation of quality and quantity of goods; (b) ecological safety and (c) flexibility of the logistic system.

According to the existing statistics, the losses of weight during coal transportation by automobile transport approach 5 %. The transportation of fine coals at the distance of 500 km by railroad causes the losses of 0.5-0.6 ton per railroad car. This is equal to the loss of 1% of the transported cargo. The all-Russian railroad transportation of coal loses annually 3-5 mln. ton blown by airflows. [1]. The railroad car unloading, the coal storage in the warehouses and the ship loading are responsible for another 1%-2%. In addition to the weight loss caused by the dust generation, the open transportation of coal deteriorates the quality of several bulk cargos: decreasing the calorific value, grinding, growing of the ash content and humidity. The task of preserving the qualitative, quantitative and ecological characteristics of the cargo during transportation and material handling keeps being of key importance for the whole mining industry, since economic indicators of the cargo transmitting system turn out to be very sensitive to the parameters of transportation and logistics infrastructure.



## 2. Problem and solution

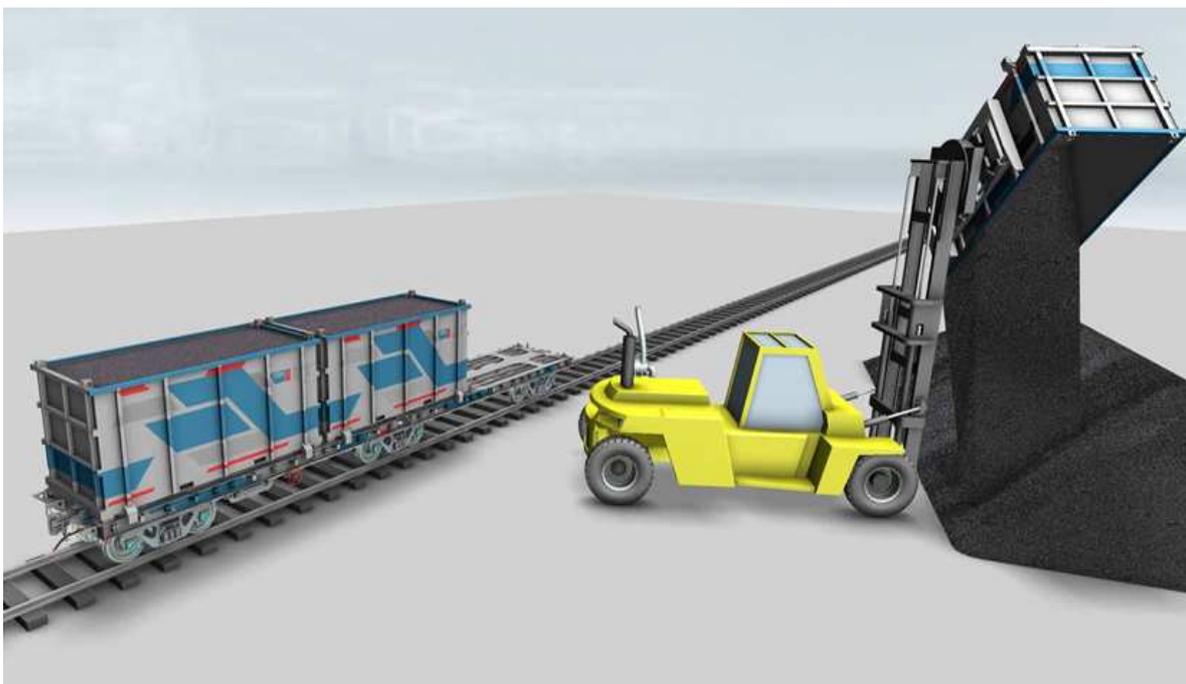
A perspective direction of searching for the most efficient ways of preserving qualitative and quantitative characteristics and provision of ecological safety is in transportation of those cargoes in special tare, containers. [2], [3]. An important advantage of this transportation technology for such delicate cargoes as fine coals is diminishing the risk of cargo damage and loss by minimization of the number of cargo handlings. [4], [5], [6].

Several companies like Austrian “Innofreight” and Russian “Joint wagon company” already offer a concept of the innovative modular technological complex consisting of specialized rolling stock and a set of containers of different sizes and designated for different cargoes (Figure 1) [7], [8].



**Figure 1.** Unloading of open-top modules (containers) in the bunker by rotation

The concept assumes the utilization of the innovative rolling stock where the cargo space is structured into detachable modules of different sizes and types [9], [10]. A module detached from the chassis provides easier discharging (Figure 1) (<http://www.railwaygazette.com>), passing between different transport modes and handling with the standardized container handling equipment (Figure 2).



**Figure 2.** Handling of the module by the front loader

Variants of this cargo handling system provide very high flexibility, mobility, productivity and ecology during transportation of coal, ores, wooden splits, cement and similar bulk materials on their way from production sites to electric power plants, manufacturing plants and objects under construction.

The main material components of the container transportation system designated to handle bulk cargoes through a sea port are:

- specialized container fleet (open-top, closed with top hatches or side doors);
- specialized spreaders for opening/closing of container doors and hatches, and tilting for discharge (Figure 3),
- specialized “revolving” spreaders for discharging spreaders by rotation along longitudinal axes (Figure 4).



**Figure 3.** Spreaders for the discharge by tilting

Several companies have already implemented this efficient technical solution for bulk cargo (Austrian “Eurospec”, [www.ContainerRotationSystems.com](http://www.ContainerRotationSystems.com) and British “RAM spreader”, [www.ramspreaders.com](http://www.ramspreaders.com)). The technological processes provide discharging into the ship’s hold by these spreaders of any dry cargoes. Depending of the container type, the revolving spreaders automatically open the upper door (Figure 4).



Revolving spreader made by Rotainer  
**Figure 4.** Spreaders for the discharge by tilting

Revolving spreader made by RAM Spreaders

The revolving spreaders are very sophisticated and expensive devices, so the attempts to create the dry bulk containers with opening doors still continue. The task is very difficult due to very high requirements for the operational reliability of opening mechanism, especially in its automated variant. Certain success in this direction has been achieved by the Russian company "Kotta Container" (<http://kotta-container.com>).

Figure 5 shows the physical test of the container's durability by overloading when handling iron cast.



**Figure 5.** The bottom discharging revolving container's test

The containers are equipped with the bottom hatches, thus excluding the need of expensive rotation spreaders. The opening/closing mechanisms have a reliable patented construction.

There are three main types of containers already designed and tested for cargoes with different unit density, abrasiveness and fluidity (iron, iron casts, fertilizers, alumina etc.).

In Russian sea ports there is an excessive fleet of general purposed and specialized cargo handling equipment, which enables immediate utilization of containers for internal port transportation and handling system of different bulk cargoes according to the schema "railroad cargo front – port warehouse – sea cargo front – ship". This could be a possible direction of the business diversification or technological reversibility of specialized container terminal by creation of additional cargo front for container staffing, possibly outside the terminal area.

The technology of Containerized Bulk Handling could provide a solution for the problem of development of mobile transportation and handling systems for sea port bulk cargo handling ensuring the preservation of the qualitative, quantitative and ecological characteristics during their movement along the logistic chain.

### 3. Conclusions

1. Utilization of containers for bulk handling creates pre-conditions for geographical mobility of transportation business.
2. Containerization allows reducing significantly the problem of dust generation during transportation, storage and handling of bulk cargoes.

3. Containerization enables the improvement of the quality of port handling of “fragile” cargos by reducing the number of handlings.
4. Containerization enables the usage of the existing and efficient cargo handling equipment.
5. The technology is flexible, mobile and liquid, since in the contrast to the traditional bulk handling technology, the lack of cargo flows would not require the demolition of expensive facilities and would permit the container fleet to be used in other applications.
6. The storage of cargo could be organized according to marks and brands, thus facilitating the procedure of blending.
7. The containerization enables a significant increase in the railroad fronts’ productivity without construction of expensive wagon tipplers.

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