MULTIMODAL CONTAINER TRANSPORTATION OF GRAIN

Kirichenko, Sergey A., *SoyuzmorNIIproekt JSC, Moscow,Russia.*
Lahmetkina, Natalia Yu.*, Moscow State University of Railway Engineering (MIIT), Moscow, Russia.*

ABSTRACT

Record grain harvests in 2009 and 2011in Russia showed that the country's export capacity is limited by transport complex, carrying capacity of specialized grain terminals of ports, as well as fleet of specialized rolling stock of grain cars [1].

Transport infrastructure lags behind the needs of the agricultural industry. Part of the grain is loaded through the ports of other countries. On the other hand Russian transport industry is focused on forecasted average annual value of the export of grain, as downtime of special equipment in the lean years, caused by narrow profiling of equipment, results in a drop of economic performance of transshipment complexes. In this connection, containerization of export grain cargo flow is becoming increasingly of interest for researchers. The objective of the authors is to investigate multimodal container transportation of grain in railway-sea and automobile- sea traffic, using analytic, statistic and comparative methods. The article analyzes benefits, technical conditions and risks of container transportation of grain as well as highlights features of bulk cargo transportation with pre-tilting of the container during loading. Two main types of tilters – mobile and stationary are investigated. The practices developed for international shipments can be used for domestic transportation as well.

Keywords: marine, railway, car, elevator, grain, container transportation, technology, tilter, bulk cargo.

Background. *Record grain harvests in 2009 and 2011 showed that the country's export capacity is limited by transport complex, carrying capacity of specialized grain terminals of ports, as well as fleet of specialized rolling stock of grain cars [1].*

Transport infrastructure lags behind the needs of the agricultural industry. Part of the grain is loaded through the ports of other countries (Table 1).

On the other hand, transport is focused on the forecasted average annual value of the export of grain, as downtime of special equipment in the lean years, caused by narrow profiling of equipment, results in a drop of economic performance of transshipment complexes. In this connection, containerization of export grain cargo flow is becoming increasingly important.

Objective. *The objective of the authors is to investigate multimodal container transportation of grain in railway-sea and automobile- sea traffic.*

Methods. *The authors use general scientific method, analysis, statistic and comparative method.*

Results.

1.

Russia exports mainly raw commodities with low added value, while in import there is a large share of industrial products, new machinery and equipment. In view of this for many years, the domestic import of goods in containers exceeds containerized export, e.g. by 1,91 times in 2012 (Table 2) [2].

Therefore, the ports accumulate empty large-tonnage sea containers, that shipping lines would like to load with even cheaper raw goods on favorable terms, in order to eliminate the disadvantageous return of empty containers by sea for the shipowner. This point is confirmed by transportation statistics. Cereals are one of the most attractive goods for shipping companies.

The role of external factors that encourage container transportation of grain is growing. A significant part of the domestic supply comes as food aid to countries in Africa and the Middle East, mainly in transit through the ports of Egypt, Morocco, Tunisia, Algeria, Libya within the procurement and under the control of a wide variety of organizations, including the UN bodies.

The experience of recent years shows that the grain in large-tonnage containers is delivered to destinations faster and safer and does not lose its market condition. On the contrary traditional technology of transportation is followed by wetting of the cargo during handling in foreign ports and further overland transportation, by theft of part of the cargo when reloading, that inevitably results in losses of a part of grain cargo, which are written down as shrinkage, wantage.

Authorities of transshipment ports of transit developing countries are not capable to fully control the process, and it is quite difficult for international orga-

Table 1

Russian grain export shipments through ports (million tones)

	Total		Ports of Russia			Ports of Baltic			Ports of the Ukraine		
2011	2012	%	2011	2012	%	2011	2012	%	2011	2012	%
16,5	14,2	86,0	7,9	7,2	90,6	2,3	1,8	78,6	6,4	5,3	82,9

Table 2

Transportation of goods in containers through the ports of Russia (thousand tons)

Basin	Total			Export		Import		Transit		Cabotage	
Years	2011	2012	%	2011	2012	2011	2012	2011	2012	2011	2012
Arctic	1597	1730	108	105	91,5	120	102			1372	1537
Baltic	23249	24626	106	8504	8704	14745	15922				
Azov- Black Sea	5727	6080	106	2134	2486	3590	3589	2,5	1,4		2,8
Caspian	83,5	92,1	110	19,8	31,9	63,7	60,2				
Far Eastern	8768	10172	116	1098	1432	4217	4886	126	277	3326	3577
Total	39426	42701	108	11861	12746	22736	24560	129	278	4699	5116

nizations to prove that excessive losses have occurred due to other reasons than force majeure. It is easier for foreign partners to carry out by-number tracking and control of the passage of sealed containers with grain. In addition, the sender puts into each container a copy of quarantine certificate, certificate of quality, invoice. Those documents as a whole define precisely quantity and quality of grain in the container. In case of any deviations from the contract a relevant claim may be addressed to the seller [3, 4].

With regard to the Russian shippers such claims are rare, since each elevator, sealing a container, realizes that it is fully responsible for the quality of its export goods. At the same time in case of shipping of large shiploads of 50–100 thousand tons, grain sold by different manufacturers is mixed, and therefore if there is any claim on quality after the ship has left the port, it is rather difficult to find a primary producer, who has committed a violation of contractual conditions.

In this regard, the task of improving technologies of container transportation of grain, of their adaptation to modern requirements is well-timed.

2.

At the moment, the basic technology of container carriage of grain is its loading in bulk in a horizontally standing container. This method assumes clean, dry sealed cargo tanks with working rubber door seals. Such containers typically have an airtight floor of plywood or metal sheet. Solid shipowners can afford to segment a fleet of large-tonnage containers, allocating food products or products in good packaging (textile, electronics, etc.) from general cargo flow to place in them [5].

For a long time the Russian industry has been manufacturing large-tonnage containers with wooden plank floor. Because of cracks between wood boards, fall of knots, as well as pollution with remnants of previous loads direct use of such a container for bulk grain (without additional measures) is not permitted.

It is unacceptable to use for grain any container after transportation of chemical goods, oil products and lubricant, raw materials and industrial products with smell, as well as animal skins and some other quarantine dangerous goods without proper cleaning and certification of a container with a surveyor. Container owner or freight forwarder, representing his interests, is responsible for suitability for transportation [6].

Before loading the container should be cleaned of dust and dirt. The entrance passage is protected by solid or slatted sealed shield, preventing falling of grain and its pressure on the door. Cargo space is filled with grain coming on a tray or conveyor belt, and then through the pipe of pneumatic loader through the open space at the top of the doorway. Shipping documents are put into the container with an indication of the actual weight of grain loaded, after that the doors are closed and sealed (Pic. 1).

The disadvantages of the considered technologies include:

a) in the horizontal position of the container it is possible to fill no more than 90–92% of its volume, resulting in underutilization of its carrying capacity;

b) it is necessary to install expensive disposable shields in the doorway that at export shipments will not be returned to the sender.

In recent years, transportation technology envisages a container liner of polymer materials, which is an additional barrier between cargo and container walls.

Pic. 1. Loading of grain in the container at the elevator.

This enables to use a wider range of containers of different technical condition. Although liner is disposable, for senders, located far from ports of export, its use is economically justified, because it is possible to exploit container fleet, existing de facto in regions [7].

Along with this a more progressive transportation technology of bulk cargo (grain, seeds, cones, cutting rubber, woodchips, pellets, expanded clay, etc.) with tilting of container upright, is implemented. In this case, it is filled completely. As with the most types of container transportation traffic rate is set per a container, the use of additional equipment and measures for its better filling is a crucial economic benefit, especially in long-range maritime export [8–10].

In order to set a container in upright position and back, special container tilters are required, as if the filled container is lowered by crane into a horizontal position, an ever increasing moment happens at the pendant, and brake devices on the crane winch can't keep the container [10].

3.

Global manufacturers produce stationary and mobile tilters, the latter are more common. A tilter of twenty-foot containers is a device with total weight of about 7–9 tons, providing tilting of 24- or 30-ton container in an upright position by means of two hydraulic cylinders. A hydraulic station has an electric drive. In mobile design a separate autonomous unit of gasoline or diesel generators is used (with a capacity of 3–4 kW), the device is connected alternatively to an external three-phase current mains.

In the Russian context mobile tilters are used more often. A significant proportion is rented from foreign intermediary firms. They are moved to the place of installation by means of railway platforms, since the majority of large companies in the country, including elevators, have approach lines.

Series tilters are focused on the export of goods from senders by automotive transport. An empty container is sent for loading using container trucks or container semitrailers. Tilting operator fixes fittings of container in locks of the device and opens its doors. For safety reasons, the car drives off.

The tilter with the help of hydraulics puts the container in the upright position. Grain is delivered by conveyor or chute from a hopper of the elevator. After complete filling special strain gauge balance in the device supports determine the mass of load grain, which is quickly imprinted on the prepared documentation. Documents are fixed on the inner door leaf,

Pic.2. Mobile port tilter with sloping frame.

Pic. 3. Mobile tilter for rail and intermodal traffic.

Pic. 4. Stationary tilter of Kola branch of Norilsk mining and metallurgical company.

and a shield is set in the doorway with the help of the electric hoist or manually [11, 12].

By operator's command a special device of the tilter with two extra hydraulic cylinders closes the doors of the container, and that is set into a horizontal position. The car drives up under the container and the operator lowers it to its regular place. After sealing the doors of the container it is ready for transportation.

By this technique the tilter loads three containers per hour. Deterrent is the paperwork if you want documents to be inside the cargo box with set net weight and required signatures [13].

When loading bulk cargoes in ports a modification of the tilter with sloping frameto is often used. (Pic. 2). This device enables to install additional empty large-tonnage containers on forks of lift truck.

Note that the container doors with bulk cargo are not opened when the container is in its horizontal position, since the pressure of the load may injure a worker. If in the port it is necessary to carry out customs, quarantine or other control of the contents, the vehicle is mounted on the section of road with a significant gradient in order that cargo presses toward the end of the container, and only then door bolts are opened.

In international freight transportation the presence of shipping documents inside the container has a great positive significance for foreign buyer of the goods, because often such cargo carriers are sold out at sea on board of the ship. If the net weight is not fixed, and the bill of lading contains only the total weight of the consignment placed in a group of containers, the execution of the sales transaction is only possible in foreign port of destination, which leads to additional port storage costs for the intermediary, extends the delivery time of the goods to the final recipient [14, 15].

Predominance of rail freightage, implementation of advanced technology which is crucail in terms of efficiency of transportation, are characteristic of Russian transport system with its considerable distance from the transshipment ports [15, 16]. The bulk of large Russian elevators, exporting grain, have railway approach lines [17]. By virtue thereof container tilters are engineered, with special regard to national specifics and operation of the enterprise mainly in connection with railways.

In these process schemes the tilter serves exclusively for the reversal of containers in an upright position. It is assumed to deliver empty containers on railway platforms, where they are removed from by overhead crane or container loader with the upper spreader and are installed on the tilter. On the back of tilter's frame ladder and working platform are placed. After reversal in a vertical position it is convenient to perform operations of the cargo securing in the space of the doorway from this platform.

Mounting of fasteners remains time-consuming operation. In view of this the design of polymeric liner in the tilt container is increasingly being used. Inside the liner there are additional longitudinal synthetic slings. After filling of grain it gets a shape of inner space of the container, wherein it engages its flutes. Behind closed doors, this de-

sign enables safe transportation without a shield in the doorway.

This option was tested at interport and road-sea routes. Its use in rail transportation is now being verified due to substantially larger longitudinal acceleration acting on the load as compared to road transport. Nevertheless, at the expense of some structural reinforcement of longitudinal slings, taking a longitudinal load at the displacement of cargo, we can expect that positive results will be obtained for 1520 mm gauge, where permissible longitudinal acceleration on the cargo is 4g, while abroad this option is 2g [18].

Mobile tilter of the type, used in St. Petersburg, is shown in Pic. 3. Pic. 4 shows a photograph of a stationary tilter, served by the loader with the upper container spreader. The unit is mounted in Kola peninsula branch of Norilsk mining and metallurgical company and is designed for transportation of ferroalloys and scrap steel in bulk, but may equally be used for another purpose.

Conclusion. *Technologies, used mainly on international routes, are advisable to be introduced wider in domestic transportation of grain in closed large-tonnage containers. This will reduce the demand for scarce grain cars during peak periods of mass displacement of bulk cargo in direct and mixed traffic.*

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Information about the authors:
Kirichenko, Sergey A. – head of the container transportation sector of JSC «SoyuzmorNIIproekt», Moscow, Russia, logik-trans@list.ru.
Lahmetkina, Natalia Yu. – Ph.D. (Eng.), associate professor of Moscow State University of Railway Engineering (MIIT), Moscow, Russia, naturla@mail.ru.

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