JOURNAL OF MARITIME RESEARCH

Vol XIX. No. II (2022) pp 39–43

ISSN: 1697-4040, www.jmr.unican.es

Compatibility of the Pusher-Barge System in Inland and Coastal Waterways Transportation System of Bangladesh

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ARTICLE INFO

Article history:
Received 19 Feb 2022;
in revised from 29 July 2022;
accepted 31 July 2022.

Keywords:
Pusher Barge, Unloading Time, Transport Capacity, Drop and Swap Operation.

ABSTRACT

This paper meticulously aims at studying the compatibility of Pusher- Barge system in Inland and Coastal Waterways of Bangladesh. Inland Water transportation system is relatively cheap mode of transportation and the transportation cost further will decrease if the Pusher-Barge system can be implemented in the country. Pusher barge can be used for different purposes like transportation of cement, coal, limestone, foods and dredged materials etc. We have compared the pusher-barge system with the existing cargo vessels for the transportation of raw materials for a cement manufacturing company in Bangladesh in the context of fuel consumption, freight rate, time and cost. Pusher-barge system is well recognized for its low cost of cargo transportation in inland and coastal waterways throughout the world. Pusher-barge is still a new concept for Bangladesh and it will make a huge profit for the owners of different factories and ship traders in Bangladesh if they can introduce this system. Different calculations have been carried out in Seven Ring Cement's cargo carrying fleet with pusher-barge systems and the study finds that it is more parsimonious and energy efficient than that of self-propelled cargo vessels. The main advantage of this system is the elimination of unloading time. Different Industries in Bangladesh including cement industries can use this mode with their requirement which will eventually increase profit. This study will also give the economic comparison of pusher barge system with existing cargo vessels.

1. Introduction.

A pusher barge system is a system to transport bulk cargo from one place to another by the nexus combining a pusher (propulsion unit) and a barge (functional unit). The system can separate propulsion unit from functional unit. Kaskin (1979) showed that the separability between propulsion unit and functional unit allows drop and swap operation where specialization of function (pusher for transportation and barges for cargo storage) which results in the transportation of cargo at a lower cost than that of general cargo ship transportation.

The Pusher-barge system in inland waterways of different countries has been introduced in the recent years. It is used for transporting coals, cements, cargo, containers, dredged materials etc. It started first in Ohio River of USA. The coal trade on the Ohio River needed a method of transporting greater tonnages of coal than individual vessels could handle. Marathon (2010) showed that the method of tying groups of barges together to make a solid push was developed in USA. Large amounts of coal and other bulk cargos were moved on the Ohio and other rivers with powerful diesel pushers. Barges are pushed ahead on the ocean as well.

In Japan consisting of four mountainous islands without navigable inland waterway, the introduction of pusher-barge method took place for the first time in 1963 for the transport of sand for building an artificial island in Kobe Harbor and its high economic efficiency was so rapidly and widely acknowledged

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that the push-barge train has soon become the standard method of reclamation. In 1970, Japan built M/V KORYO NO.105 & HAEYANG NO. 105 pusher-deck barge for the Korean flagship to transport bulk cargo. Later on, it was not so long before the shipping companies began to introduce this system for transporting limestone, coal, cements, containers, dredged materials etc.

Different experiments have been carried out with pusher-barge systems and all have shown that it is more economical and energy efficient than the self-propelled vessels.

IUMI (2003) described in their proceedings that RINA's engineers have carried out a study of the technical aspects of the integrated pusher barge system for the evaluation of new specific requirements as well as the use of the present ship technology, as applicable to these systems. In particular technical areas were investigated like seakeeping pusher/barge combined unit, global bending moment and sheer force at sea, local loads acting in way of connections and stress analysis criteria of the connecting structural members.

In Bangladesh pusher-barge systems have not yet been introduced in the industrial level. Cement industries as well as all other industries in Bangladesh can use this process to reduce their loading and unloading time.

In this research, we have compared the pusher-barge system with the existing cargo vessels for the transportation of raw materials in the context of fuel consumption, freight rate, time and cost. For this reason, we selected Seven Rings Cement factory for our research and in this paper, we have accumulated our findings.

2. Methodology.

2.1. Case Study.

Seven Rings Cement factory is located in Kaliganj, Gazipur, Bangladesh near Shitalakshya River. This cement factory has 11 cargo vessels having an average of 2100 dwt capacity each for the transportation of cement to the consumers. The consumers are located within the range of 100 nautical miles from the cement plant. We are proposing 8-pushers and 10 barges each having a capacity of 2300 dwt which will replace the existing 11 cargo vessels. According to their existing vessel's principal particulars, the proposed particulars of the pusher barge system are shown in Table 1. The general arrangement of the pusher barge is shown in Figure 1. And from the weight Calculation it was found that the dead weight of the barge was about 2300 ton.

2.2. Comparison between Existing Cargo Vessel and the Proposed Pusher-Barge System.

The comparative study between existing and the proposed Pusher-Barge system is mentioned below.

Transport Cement Quantity

Q (cargo vessel) = 11 ships × 2100 dwt ×330 days per year ×1/2 days per voyage = 3.8 million tons of cement

Q (pusher barge) = 2 × 4 pusher ×2300 dwt ×330 days per year × 2/3 days per voyage = 4.1 million tons of cement.

Initial Cost of Building

Initial cost of Cargo vessel = 11 nos. ships× USD 0.94 Million average = USD 10.34 Million (approx.)

Initial cost of Pusher- barge system = 10 nos. barge × USD 0.26 Million + 8 nos. pusher ×USD 0.82 Million = USD 9.16 Million (approx.)

Annual Income

The profit from per ton of cement is approximately USD 1.41. As the weight of each cement bag is 50 kg so the profit per bag cement is USD 0.0705.

Annual income for Cargo vessel = USD 1.41 per ton × 3.8 million tons = USD 5.358 Million

Annual income for Pusher barge = USD 1.41 per ton × 4.1 million tons = USD 5.781 Million

3. Results and Discussion.

Findings of the present research are mentioned in Table-2 and Table-3 are as follows:

One of the main advantages of pusher-barge system is the increased transport capacity. As the unloading time is eliminated by the swap operation of the barge at the consumer as shown in Figure 2, the transport of cement quantity is increased. Two units of this system will operate in the transportation of cement to the consumer in the proposed 8 pusher and 10 barge systems as shown in Figure 3.

Pusher- barge system is a new concept for Bangladesh. It is a well-established water transportation system throughout the world. Its implementation will reduce the transportation cost for different industries of Bangladesh and also for inter-country transportation. The study has shown that the Pusher barge system will be economically beneficial for the country. The system will have superiority over the conventional system. In terms of business the owner of the pusher barge system will make more profits and so will be able to share the benefit with the cargo owners and so the commuters who are mostly the common people of the country through charging less freight rate.

The study has taken some specific scenario in consideration. The policy makers will have to make studies in practical operating environment before implementing the study results.

Further research will be required to introduce this system in the field of speed, cost, suitable combination of Pusher-Barge and their cyclic operation. The main advantage of this system is the elimination of unloading time. Different industries in Bangladesh including cement industries can use this mode with their requirement which will eventually increase their profit. So, the Pusher- Barge system can be applied both for transportation of raw materials and for the transportation of produced goods to the consumers.

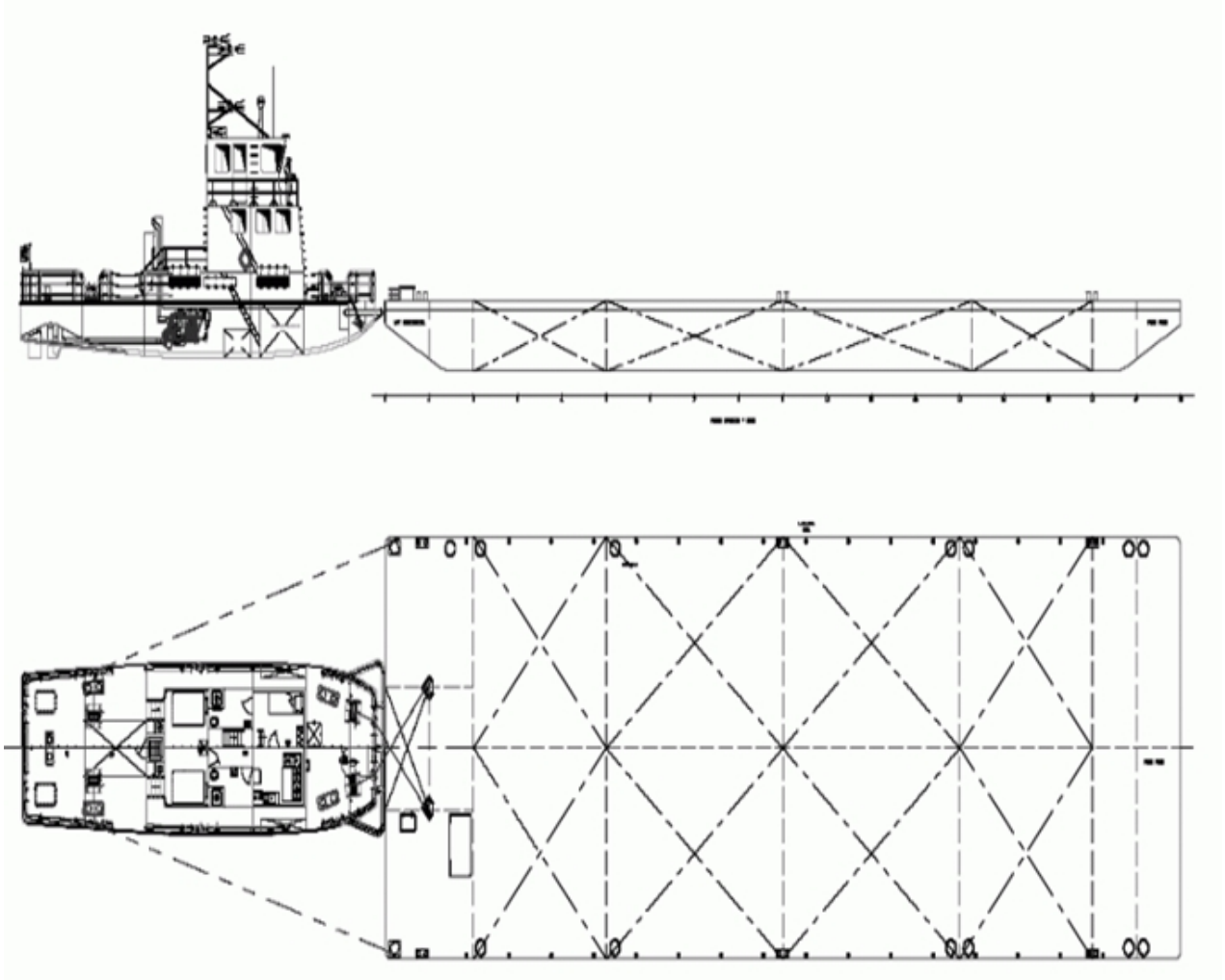
World Bank (2009) showed that about 58 million ton of cargo is carried every year throughout the country. It would be more economical if the pusher barge system can be used to carry this huge amount of cargo.

Table 1: Principal particulars of the pusher barge.

Particulars	Existing Cargo Vessel	Pusher	Barge	Unit
Length Overall	60.00-70.00	20.00-25.00	60.00-70.00	[meter]
Breadth Moulded	Approx. 15.00	9.00-11.00	15.00-16.00	[meter]
Depth Moulded	5.00-6.00	4.50-5.50	5.50-6.00	[meter]
Design draft	3.50-4.00	3.50-3.70	3.50-4.00	[meter]
Deadweight	2100-2400	--	2300	[Ton]
Pusher Barge Train Length Overall			87.00-90.00	[meter]
Service Speed			10.00	[Kn]

Source: Authors.

Figure 1: The general arrangement of the proposed pusher barge.



Source: Authors.

Table 2: Comparison of capacity between the motor barge and pusher barge system.

Transport System	Number of Fleet	Transport Capacity	Difference of Capacity
Motor Barge	Pusher- Barge11 ships (2100 dwt)	3.8 million tons	base
Pusher- Barge	8 pusher & 10-barges (2300 dwt)	4.1 million tons	+300000 tons

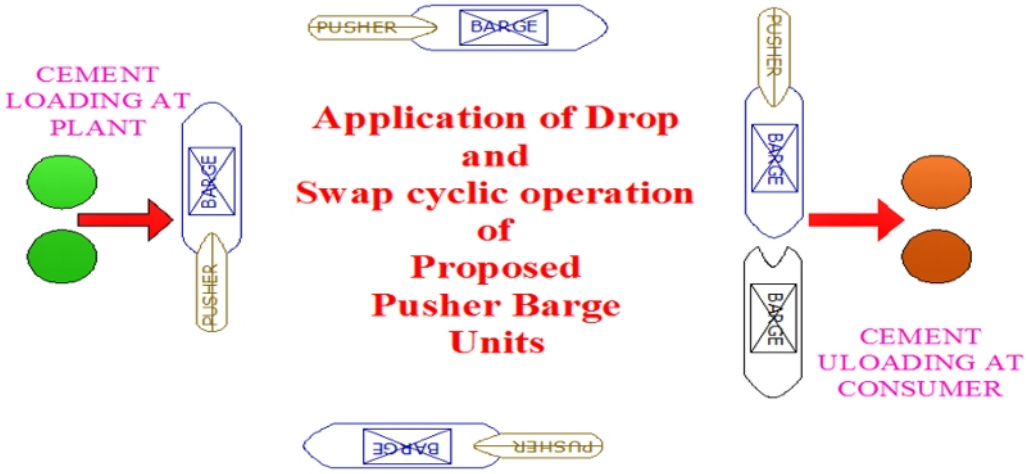
Source: Authors.

Table 3: Comparison of capacity between the motor barge and pusher barge system.

Transport System	Number of Fleet	Transport Capacity	Difference of Capacity
Motor Barge	USD 5.358 Million	base	USD 10.34 Million (approx.)
Pusher- Barge	USD 5.781 Million	+USD 0.423 Million	USD 9.16 Million (approx.)

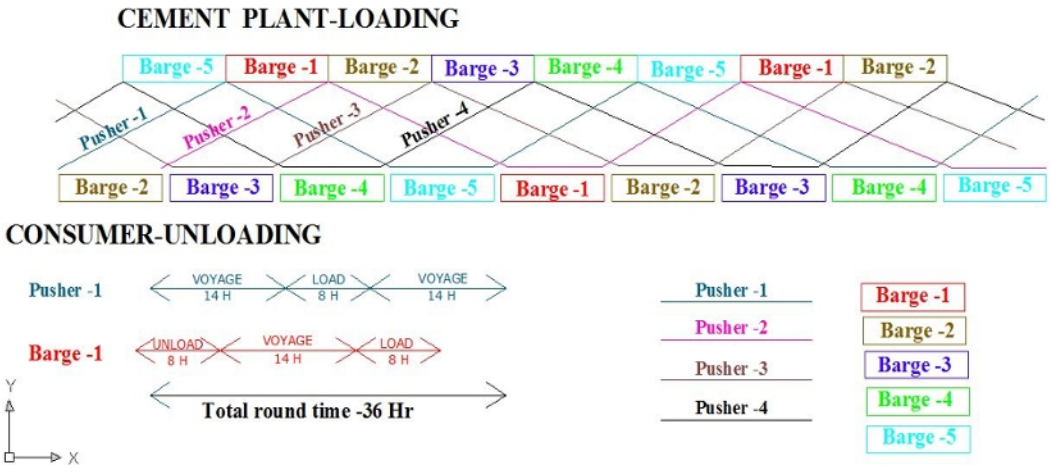
Source: Authors.

Figure 2: Drop and Swap cyclic operation for proposed Pusher- barge system.



Source: Authors.

Figure 3: Proposed Operation Schedule of Proposed 8 pushers and 10 Cement Barges.



Source: Authors.

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