Inland Waterway Transport in Aggregate and Other Rock Materials Carriage

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The importance of inland waterway transport for transport in the EU countries is highlighted. In Western Europe inland waterway transport is perceived as an environment-friendly system offering considerable potential. The carriage of aggregates and construction materials has a large share in the transport structure. In the transport on the Rhine aggregates constitute 15-20% of the whole transport on this waterway. In Poland, waterway transport has a marginal importance since its share in the total transport is below 0.5%. In Polish conditions the carriage of aggregates has a significant share in the total inland waterway transport. On domestic routes the share of aggregate carriage amounts to 50-80%. However, the carriage is over short distances and is connected with extraction of aggregates from the bottom of the waterways. The advantages of waterway transport in comparison with rail transport are demonstrated by means of an analysis of the costs of coal transport on the Oder.
Keywords: Inland waterway transport, transport structure, aggregate carriage, costs.

1. INTRODUCTION

Rock materials can be divided into two main groups: 1) crushed and block aggregates (C&BA) and 2) natural aggregates (NG) in the form of sand and gravel. Crushed and block aggregates are mined by mining companies. Since in Poland the mines are located at considerable distances from inland waterways the mined rock materials, similarly as coal, are carried using combinations of road-water transport or rail-water transport. Sands and gravels are not only extracted in open pit mines, but also from the bottom of water bodies (reservoirs, river beds). The extraction of aggregates from river beds necessitates the maintenance of the required waterway parameters (removing local sandbars, ensuring the required transit depth). The aggregates extracted from the bottom of waterways should be transported using the waterway system.

Aggregates are a bulk cargo which is unaffected by atmospheric conditions. The most advantageous ways of transporting such cargos are rail transport and water transport. In 2007 nearly 30 M tons of C&BA and over 13 M tons NG were extracted from the mines located in Lower Silesia. But only a small part of the materials was transported by water. Considering the advantages of waterway transport, the share of the latter in the transport of aggregates and stones should be increased. Currently, inland waterway transport participates in the carrying of sands and gravels extracted from the bottom of waterway. HYDROKRUSZ – one of the major companies extracting aggregates from the bottom of waterways – extracts about 130-140 thousand tons of aggregate per annum. Taking into account the Central Statistical Office (GUS) data for the years 2009 and 2010, this amounts to a 58-70% share in the Lower Silesia-Lower Silesia waterway transport.

2. WATERWAY TRANSPORT SHARE IN AGGREGATE CARRIAGE

2.1. TRANSPORT IN EU COUNTRIES

Besides road transport and rail transport, inland waterway transport plays a major role in the transport system of regions and countries. Owing to its commonly known advantages, inland water transport is widely preferred in transport development strategies. This particularly applies to the EU countries, as reflected in the EU transport development strategy. The basis for this strategy was laid down in the White Paper, European Transport Policy for 2010: time to decide **[7].** In the sixteen basic guidelines concerning waterway transport it is stated that: *Inland waterway and maritime shipping, particularly the short-distance shipping, together with rail transport should be recognized as the environment-friendly branches of transport which need special care and support on the European level.*

In 2006 the Commission of the European Communities issued the document: NAIADES – Navigation And Inland Waterway Action and Development in Europepromoting inland water transport (COM(2006)6 Brussels 23.01.2006 [6]. Because of the increase in foreign trade turnover, inland waterway shipping should be the means of transport which will contribute to the balancing of the EU transport system. The document highlights the environment-friendly character of water transport and its low costs as compared with those of the other transport systems. Three groups of instruments for the development of inland water transport are mentioned:

- Legal instruments – the harmonization of technical requirements and the standardization of transport documentation, personnel requirements and charges for infrastructure use.
- Policy instruments – the coordination of the pan-European transport corridors (TEN-T), the streamlining of administration, support for the upgrading of waterways, the priority for the creation and development of zones situated near the waterways.
- Support instruments – the promotion of waterway shipping, research into new water transport technologies, the facilitation of investment, the promotion of priority projects (No. 18 and 30) within the framework of TEN-T.

In March 2011 the European Commission issued the document: ***WHITE PAPER: Roadmap to a single European Transport Area – Towards a competitive and resource efficient transport system.*** (COM(2011)144 28.3.2011) [8]. The document was posted on the webpage of the Ministry of Infrastructure to initiate the public discussion of the major points and directions in the development of transport by 2050. The document indicates the unused inland waterway transport capacities, particularly for transport over distances larger than 300 km. If the role of waterway transport is increased, this will greatly contribute to the energy efficiency of transport as a whole and thus to a reduction in pollutant emission into the atmosphere.

However, the strategies of developing transport in Poland do not foresee any significant increase in the inland water transport share. This stands in contradiction to the strategies of transport development in the EU.

In the EU countries, and also in other developed countries (e.g. the USA, Canada, Russia), inland waterway transport is treated equally with the other kinds of transport. This is owing to many advantages of this transport, such as:

- a low level of emitted pollutants,
- low energy consumption,
- low noise emission,
- substantial savings in land area occupancy.

In addition to the above advantages, inland waterway transport is characterized by:

- high durability of the means of transport and the infrastructure,
- high cargo capacity of the means of transport,
- a small number of collisions and the entailed costs of removing the resulting damage.

In many cases, e.g. extra large loads, inland waterway transport is the only viable form of transport. Such loads require the use of special means of transport (platforms) and marking out the routes. Traffic restrictions are introduced for the other users for the time of the transport, which may disorganize traffic over a large area. Such disturbances are avoided when the extra large load is transported by water.

In the EU countries in which normal conditions for inland shipping exist the inland waterway transport share in the total transport activity has shown stability over time. The main directions (corridors) of inland waterway transport in Europe are [5]:

- the Rhine corridor handling two thirds of the transport of the West European countries (200.5 M tons of cargo),

- the Danube axis together with the Rhine-Main-Danube Canal (50.4 M tons of cargo),
- the North-South axis – France, Belgium, Holland (72.8 M tons),
- the East-West axis – the connection between Holland, Germany, Poland and the Czech Republic (27.5 M tons).

The above amounts of cargo carried along the particular directions cannot be simply added up to determine the total amount of cargo transported on Europe's waterways since the same cargo can be transported along and credited to many directions.

The inland waterway transport share in the total transport work of the EU countries ranges from 3.3 to 3.9%. If sea transport and pipeline transport are excluded, this share increases to about 6% (fig. 1). It should be noted here that in several EU countries because of the geographical conditions inland waterway transport is not viable (the Scandinavian countries, Spain, Portugal, Ireland, Italy, Greece).

In the last ten years the share of aggregates and construction materials in waterway transport in Germany has amounted to about 20%. Figure 2 shows the share of aggregate carriage in the transport on the Rhine. In 2010 a marked decrease in aggregate carriage on the Rhine was recorded. The data shown in the bar graph for the year 2011 are for the first half-year and so cannot be considered as fully representative.

There is some difficulty in estimating the aggregate transport share. The Rhine Commission classifies the transport of stones, sand and construction materials as cargo group 1. This also applies to the transport in the other EU countries. In Poland the Central Statistical Office (GUS) used to specify the share of stones and sand in water transport until 2003. Since 2004 it has applied similar principles as the ones binding in the EU, specifying values for the cargo group: "*Metal ores and the other mining products*".

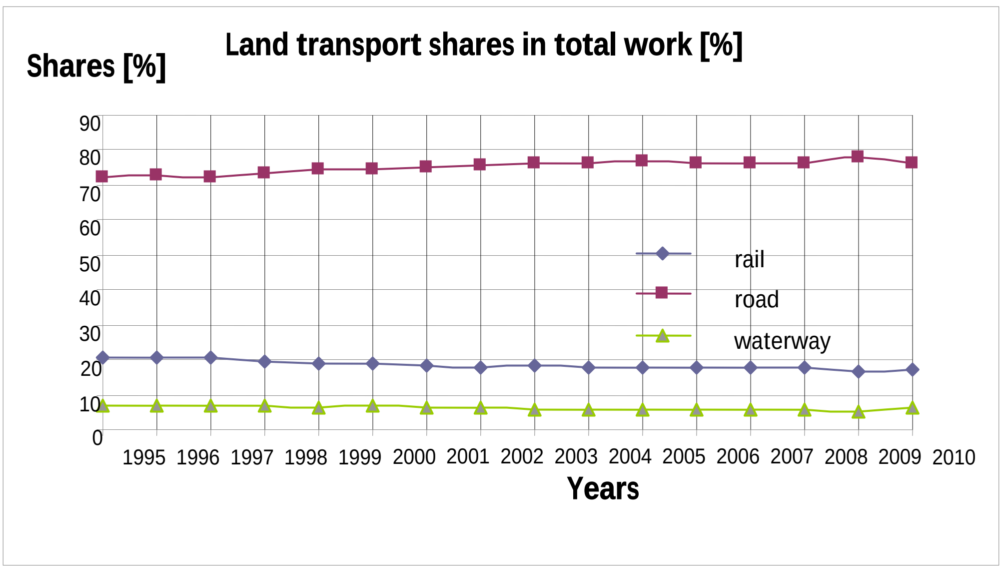

Fig. 1. Percentage shares of land transport in total transport work of 25 EU countries. In-house study based on [1].

Historically, inland water transport has been regarded as a system particularly suitable for transporting bulk goods. In the structure of the transport on the waterways of Germany, including on the Rhine, bulk cargoes still predominate. Over 50% of the cargoes are aggregates and construction materials, coal, petroleum and petroleum products (tab. 1).

Table. 1. Structure of inland waterway transport in Germany, in per cent of total.

Years	1950	1970	1990	2000	2005	2008	2009	2010
Agricultural and forest products	5.8	3.8	3.2	4.7	4.7	4.1	5.4	5.3
Food products and feedstuffs	2.9	2.9	4.6	6.2	6.7	6.4	6.8	6.0
Coal	36.0	10.2	10.2	12.6	14.2	14.1	14.1	15.6
Petroleum products	4.7	17.3	17.4	16.3	16.4	15.2	16.6	15.1
Metal ore and scrap metal	13.4	15.6	18.1	16.3	15.1	15.1	12.6	15.2
Steel and non-ferrous metal	4.3	6.2	5.7	5.8	5.6	5.9	4.3	4.4
Construction materials, aggregates	26.6	36.4	27.9	22.0	18.7	21.1	21.2	18.6
Fertilizers	2.9	2.6	3.1	3.3	2.6	2.3	2.1	2.4
Chemical products	2.4	4.2	6.9	8.0	8.4	8.6	8.8	9.1
Vehicles, machines, half-finished products	1.0	0.7	1.7	4.8	7.5	7.3	8.1	8.3
Total transport in M tons	71.9	240.0	231.6	242.2	236.7	245.7	203.9	229.6

Source: www.elewis.de [10]

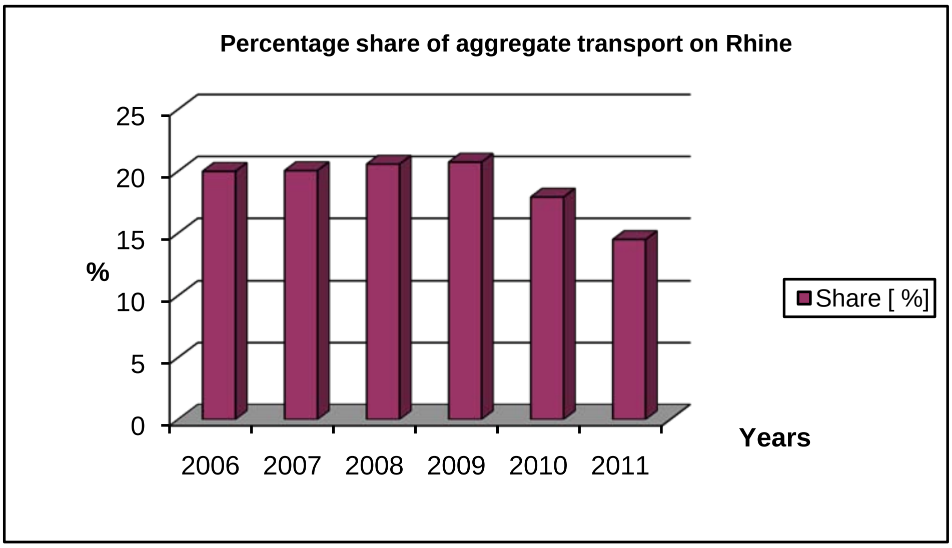

Fig. 2. Share of aggregates and construction materials transport on Rhine. Source: www.elewis.de [10].

2.2. WATERWAY TRANSPORT OF AGGREGATES AND STONES IN POLAND

Inland water transport in Poland is concentrated on the Oder Waterway (OW). On the Vistula it is local – limited to the Cracow and Warsaw areas and the outlet of the Brda to the Vistula. On the Oder, besides local traffic, it is concentrated on the stretch of the canalized Oder–the Gliwice Canal and on the Szczecin–West European roads route. In 2007, 88% of the cargo tonnage was transported on the Oder. In 2008 this share increased to 92% [9]. Except for short periods after the opening of the navigation season on the Oder, the navigation conditions downstream from Brzeg Dolny make navigation to Szczecin impossible. This a major constraint on the carriers operating on OW. The inland waterway transport share in the total transport share in Poland amounts to less than 1%. In 2008 it amounted to 0.5% and in 2010 to 0.3%. The structure of inland waterway transport in Poland is shown in table 3. Bulk cargoes predominate in the inland waterway transport structure. Over 60% of the cargos are aggregates and unprocessed construction materials. In 2008, 70% of the domestic cargoes were transported for distances up to 50 km. This amounted to 11.4% of the total transport work.

A little over 5.1 M tons of cargo, 3.6 M tons of which represented the share of international transport, were carried by water. The inland waterway transport in Poland has no share in the carriage of liquid cargos, containers, motor vehicles, machines, industrial equipment or hazardous materials. This is due to the existing navigation conditions and to the lack of a fleet properly adapted to transporting containers and to ro-ro shipping. According to the data presented in table 3, a major determinant of the size of inland water transport in Poland is the foreign interchange. Since 2005 over half of the cargoes have been transported as part of the foreign turnover. In 2008 the Polish carriers transported over 2.3 M tons of cargo as part of the traffic between foreign ports.

has amounted to about 1%, except for the years 2000 and 2003 when it amounted to respectively 5.6% and 3.7%. The ores share (in the years when such data were specified) ranged from 4.5 to 10% of the total waterway transport.

Figure 4 shows a comparison of aggregate carriage in the domestic and international transport and in the total domestic transport only. In the domestic transport the aggregate transport share is much more dominant than in the international transport. In the analyzed period (2005-2011) the share of stones, sand and gravel cargoes on domestic lines ranged from 65% to nearly 80%.

Table 1.3. Structure of inland waterway transport in Poland in thousands of tons.

<table>
<tr><th>Type of cargo</th><th colspan="7">Years</th></tr>
<tr><td></td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td></tr>
<tr><td>Hard coal</td><td rowspan="2">1908</td><td rowspan="2">1921</td><td rowspan="2">1859</td><td rowspan="2">2446</td><td rowspan="2">1471</td><td rowspan="2">1119</td><td rowspan="2">1060</td></tr>
<tr><td>Brown coal, coke</td></tr>
<tr><td>Ores</td><td>751</td><td>687</td><td rowspan="3">5339</td><td rowspan="3">3098</td><td rowspan="3">2238</td><td rowspan="3">1969</td><td rowspan="3">2182</td></tr>
<tr><td>Stones</td><td rowspan="2">4818</td><td rowspan="2">4929</td></tr>
<tr><td>Sand and gravel</td></tr>
<tr><td>Metals and metal products</td><td>640</td><td>395</td><td>923</td><td>359</td><td>245</td><td>296</td><td>223</td></tr>
<tr><td>Cement, nonmetal products</td><td>341</td><td>299</td><td>458</td><td>522</td><td>330</td><td>312</td><td>333</td></tr>
<tr><td>Fertilizers and chemicals</td><td>677</td><td>596</td><td>604</td><td>359</td><td>171</td><td>261</td><td>231</td></tr>
<tr><td>Grains and foodstuffs</td><td>340</td><td>275</td><td>351</td><td>383</td><td>518</td><td>517</td><td>504</td></tr>
<tr><td>Wood and wood products</td><td>-</td><td>-</td><td>241</td><td>151</td><td>167</td><td>165</td><td>128</td></tr>
<tr><td>Secondary materials, wastes</td><td>-</td><td>-</td><td>-</td><td>771</td><td>490</td><td>497</td><td>413</td></tr>
<tr><td>Other</td><td>132</td><td>46</td><td>17</td><td>20</td><td>25</td><td>5</td><td>19</td></tr>
<tr><td>Total [thou. t]</td><td>9607</td><td>9271</td><td>9792</td><td>8109</td><td>5655</td><td>5141</td><td>5093</td></tr>
<tr><td>Total in international transport [thou. t]</td><td>5141</td><td>4810</td><td>5786</td><td>4437</td><td>3482</td><td>3594</td><td>3214</td></tr>
<tr><td>Percentage share of domestic transport [%]</td><td>57</td><td>60</td><td>54</td><td>38</td><td>39</td><td>38</td><td>37</td></tr>
</table>

Source: in-house study based on GUS (Central Statistical Office) data.

In 2008 a marked fall in the waterway transport share in Poland occurred. This is due to the deteriorating navigation conditions on the Oder. Another factor is the takeover of the Polish carrier ODRANTRANS by the German carrier DBR, resulting in greater engagement in transport on the routes in Western Europe.

Figure 3 shows the stones, sand and gravel transport shares in the total domestic and international transport. The stones transport share

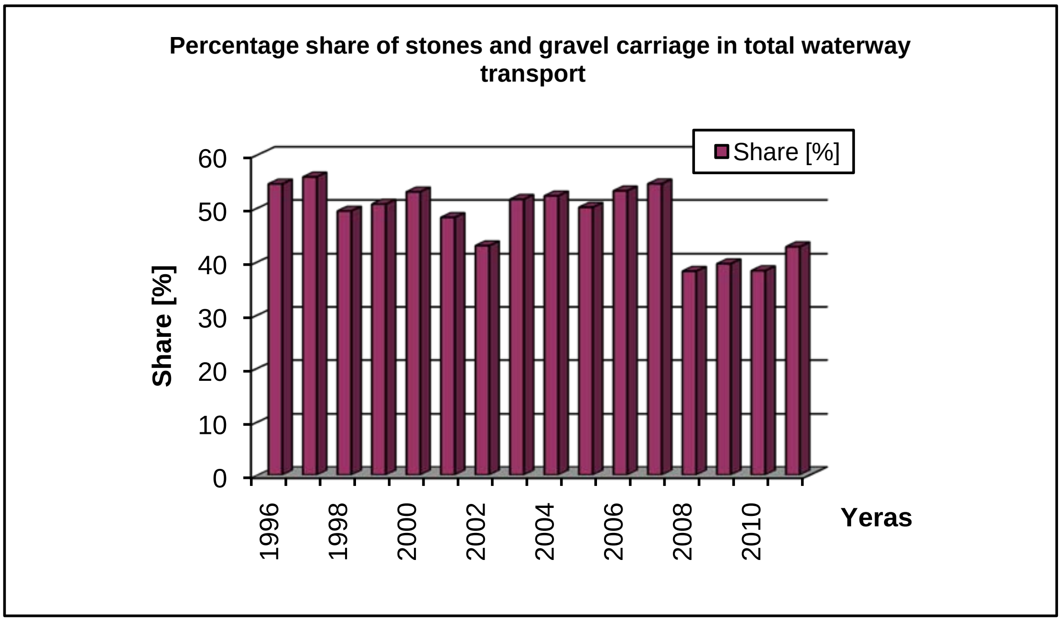

Fig. 3. Aggregates carriage share in total waterway transport [2], [9].

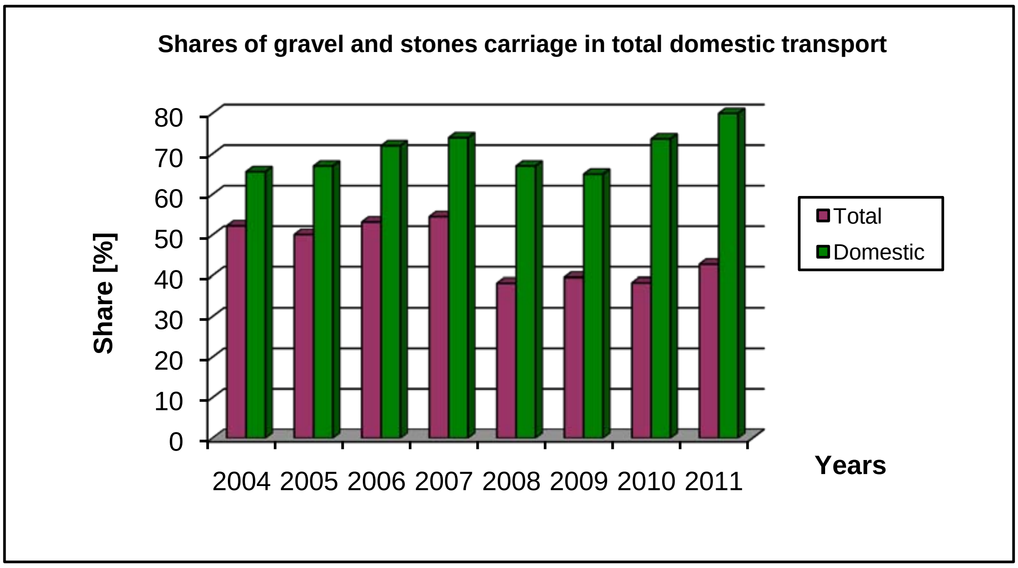

Fig. 4. Aggregates carriage share in total international and domestic transport [2],[9].

The marked decrease in aggregates carriage on international lines is the result of the economic crisis. The decrease applies to transport as a whole (not only to inland waterway transport).

Aggregates are transported for short distances, mostly below 49 km. In 1996 the aggregates carriage share in cargo tonnage amounted to about 50%, but this share would then decrease to 12-30% of the total transport work. In the case of the Lower Silesian lines the average distance ranged from 5 to 14 km. The data indicate that the transport of aggregates by water is connected with

aggregates extraction from the bottom of waterways.

Except for aggregate extraction from the bottom of waterways, the carriage of aggregates and stones needs to be conducted in the combined transport system. Historically, along the stretch of the Oder from Wrocław downstream there have been several ports functioning as transhipping ports. The ports are: the City Port in Wrocław, the cargo handling ports in Ścinawa, Malczyce, Głogów and Nowa Sól. In the past all the above cargo handling ports had good connections with the railway system. Currently, except for the City Port, the other ports are closed and need renovating. In the case of aggregate extraction in the Lubin-Legnica copper mining region, combined truck-ship transport is viable. This applies particularly to the Obora, Szczytniki and Lubień mines.

In Poland the prevailing opinion is that combined transport is more expensive than rail transport. The extra cost is ascribed to the truck-to-ship cargo handling while the contribution of the external costs to the total costs is not taken into account. All analyses of the costs indicate that, regardless of the traction, the external railway transport cost can be much higher than costs of this kind in inland waterway transport.

An analysis of the costs of external railway transport and combined transport in the OW transport corridor [4] showed that in the Polish conditions the external railway transport cost is almost twice higher than that of combined transport. For rail, regardless of the distance and the quantity of transported cargo, it amounts to 0.03 €/tkm. For combined transport it is in a range of 0.01-0.014 €/tkm. The higher value is for short distances (100 km) and the lower value is for longer distances (500 km). The algorithm was based on the demand for electricity generated by power plants at a given efficiency of its transmission to a receiver (a locomotive), the fuel consumption by a push train in given navigation conditions, the rates of emission of the components of the air polluting exhaust fumes causing the greenhouse effect as well as the external emission cost indices, the congestion, the cases of landscape transformation and other indices whose values were generated.

By and large, rail transport generates lower costs only in the case of large discounts (above 60%) relative to the officially binding tariffs. Figures 5 and 6 show exemplary costs of the combined transport of coal on the route: Silesia–receivers on OW.

If the external costs are excluded, rail transport on the mines–the Opole power plant route is more advantageous to combined transport with reloading in Gliwice. If the external costs are taken into account, combined transport on the whole (except for one case of a 60% discount on unit costs) generates significantly lower costs than rail transport. The advantage of combined transport increases with transport distance. The costs of external transport constitute (depending on the size of discount) from 12% to 18% of the total combined transport costs and from 21% to 40% of the rail transport costs. The costs of combined transport are mainly determined by the railway transport costs. In the case of transport to the Opole power plant the average railway transport distance amounts to 16.26% of the waterway. The unit cost of railway transport (without the external costs) constitutes from 63.48% (0% discount) to 41% (60% discount) of the total costs. For the route to Szczecin the shares are as follows:

- the share of the distance of railway transport to the waterway – 2.56%,
- the railway transport cost share at 0% discount – 45.2%,
- the railway transport cost share at 60% discount – 24.8%.

The above analysis of the costs of transporting coal for the selected routes showed that in some cases combined transport generates lower costs than rail transport.

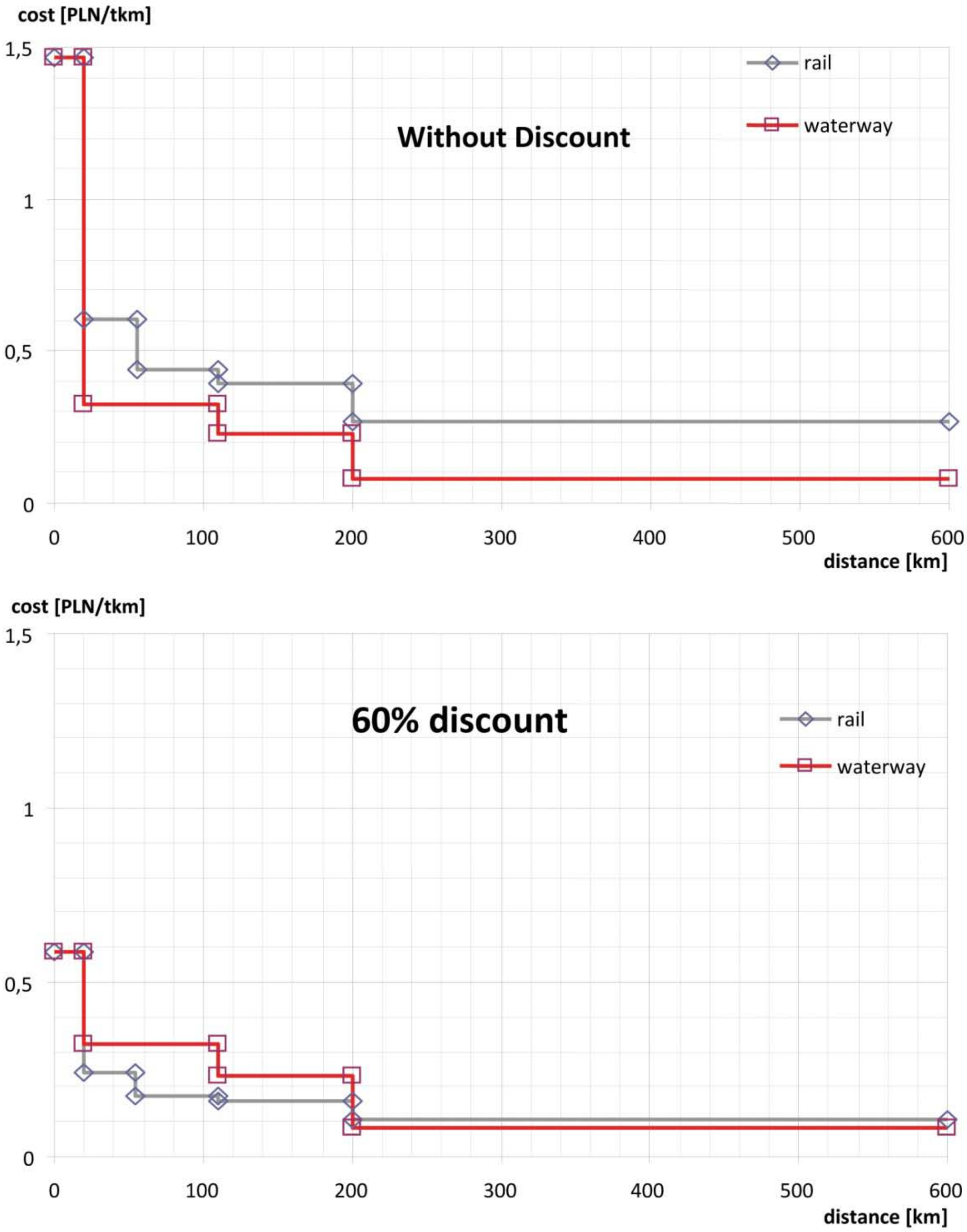

Fig. 5. Effect of distance and discount amount on unit costs of transport work for combined transport. (Without discount, cost, distance, rail, waterway transport, 60% discount)

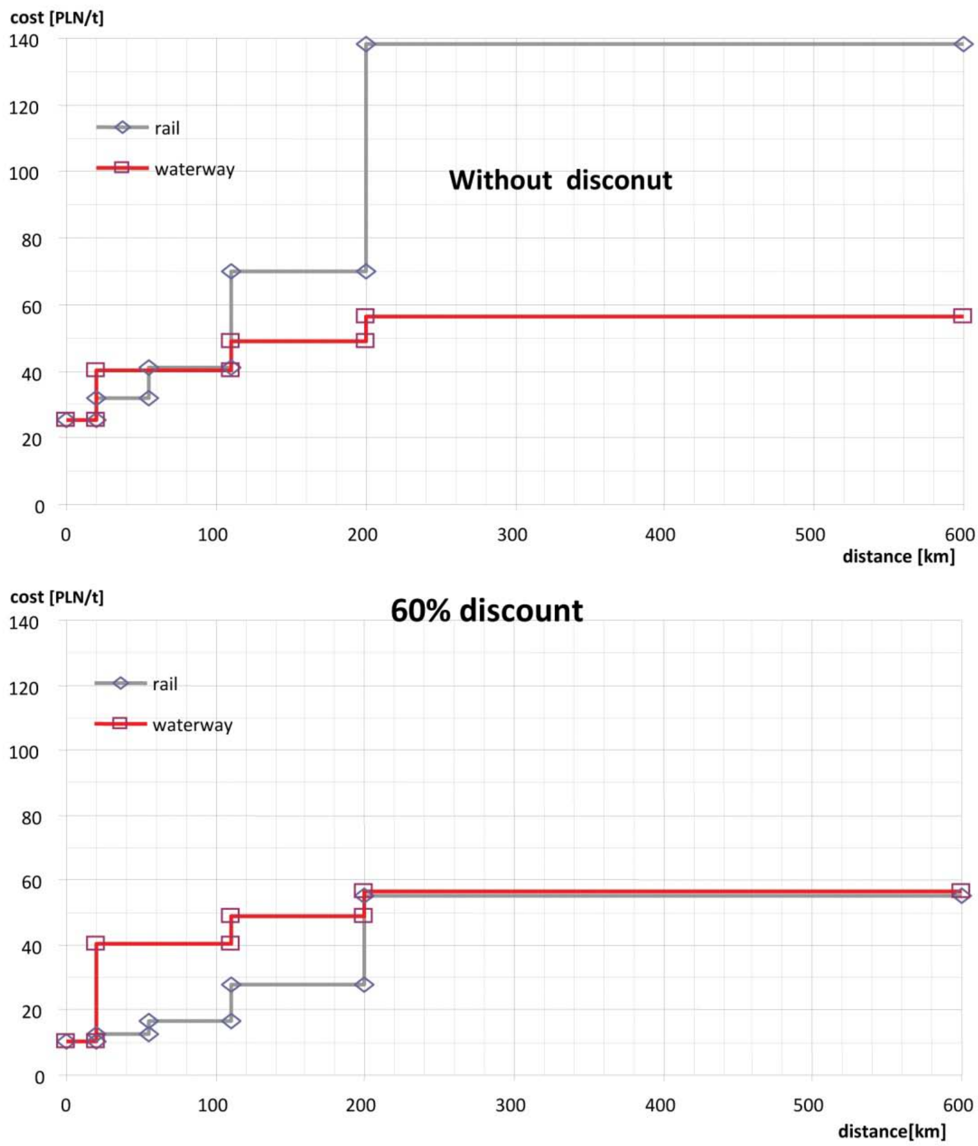

Fig. 6. Effect of distance and discount amount on unit costs of combined transport.

3. FLEET

Push-type fleet predominates in Poland. This is because this system was preferred in the 1960s and 70s and also due to the dominant position of one large carrier (formerly Żegluga na Odrze, now ODRATRANS). After 1990 the number of small private ship-owners increased. Today about 35% of the fleet tonnage is privately owned. The private carriers operate on local routes and also handle special (atypical) cargos.

The main pusher-tug operated on the Oder by the largest carrier, i.e. ODRATRANS, is pusher BIZON III. It was designed in the 1960s and became an inspiration for later pushers (KOZIOROŻEC, MUFLON, KARIBU) which, however, did not find wider use because of the crisis and the progressing degradation of OW. The barges operated on the Oder are of the universal push-type. Initially they had a single sideboard. The cargo holds were divided by cross partitions. Currently the barges are being upgraded. In order to facilitate their loading and unloading they are being converted into partitionless barges with double sideboards. The basic specifications of the push-barges operated on the Oder are presented in table 4.

Table. 3. Push-barges operated on Oder.

Type of barge	Principal dimensions [m]			Dimension of cargo hold		Draught [m] / load capacity [t]											
	L_c	B_c	H	Length [m]	Width [m]	0.70	1.0	1.1	1.2	1.3	1.4	1.5	1.55	1.6	1.8	2.0	2.19
BP-800	60.05	8.96	2.30	50.0	6.90	135	285	336	387	437	488	539	565	591	695	799	-
BP-800	59.00	8.99	2.30	49.40	6.90	115	257	306	354	4-3	453	5-3	528	553	651	756	853
BP-750	58.90	8.24	2.30	49.40	5.18	103	233	278	323	368	413	459	482	504	597	691	780
BP-650	58.73	8.98	1.70	51.70	7.00	181	328	378	428	478	528	579	604	630	-	-	-
OBP-500	45.13	8.98	1.70	38.00	7.0	138	248	286	322	360	399	437	456	475	-	-	-
BP-500	45.00	8.98	1.70	38.00	7.00	151	260	298	336	374	412	450	469	488	-	-	-
BPC-500	45.20	9.00	1.80	38.00	6.97	144	255	294	332	371	409	448	469	486	-	-	-
BPP-500	47.00	8.70	1.70	-	-	175	290	329	367	405	444	483	502	-	-	-	-
BPP-400	35.00	8.70	1.70	-	-	134	219	247	275	304	332	360	374	-	-	-	-

Deck barges are more widely used to transport bulk cargos such as aggregates, stones and coal. Barges of this type have no traditional cargo holds – the cargo is carried on the deck. The loading space is delimited by the coaming structures. The coamings prevent the cargo from shifting. Barges of this kind were primarily designed to transport bulk cargos resistant to weather conditions. Barges BPP400 and BPP500 (fig. 7) operated on the Oder belong to this type of barges.

Fig. 7. Push train of deck barges on the Oder.

Considering the transport tasks to be handled, there is a surplus of fleet. This applies to the totality of the EU countries. Figure 8 shows the degree of use of the fleet in the particular EU countries [3].

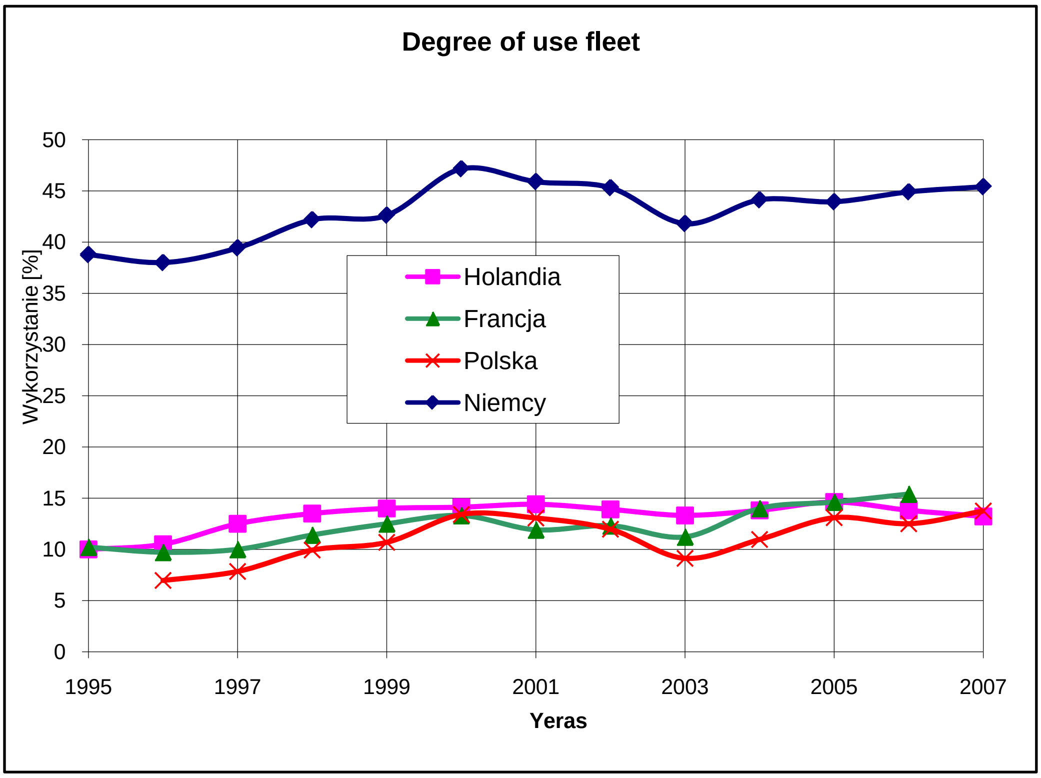

Fig. 8. Degree of use of fleet in selected EU countries.

The above analysis shows that there is a surplus of fleet. The capacity of the fleet is not fully used. This is partly due to the fact that the fleet is not operated at the full allowable draught.

Aggregates from the bottom of waterways or water bodies are extracted by dredgers. Usually they are bucket-ladder dredgers. There are nine dredgers on the official register of the Inland Navigation Inspectorate in Wrocław. The dredgers were designed in the 1960s and 70s. The latest dredger of the PK300 type was designed in 1980. The theoretical yield of this dredger is Q = 300 m3/h and its maximum extraction depth is 15 m. Figure 9 shows a bucket-ladder dredger made by the well know Dutch firm IHC.

Fig. 9. Bucket-ladder dredger.

4. NAVIGATION CONDITIONS

In the case of aggregate extraction from the bottom of waterways, the problem of navigation conditions is of less importance. The extracted aggregates are carried for short distances. The extraction of aggregates may directly contribute to an improvement in navigation conditions on a given stretch of a waterway. But there is no correlation between the demand for aggregates and the period of extraction. Aggregate extraction would have to be harmonized with the planned dredging work and the removal of sandbars and silts after periods of bankfull stages. Navigation conditions can be of major importance for transport over long distances. The constraints imposed by insufficient transit depths may result in stoppages in aggregate supplies and in increased water transport costs. The draught of the operated fleet has a major bearing on the costs.

Historically the Oder Waterway has been a major transport route in Poland and it will continue to be such in the nearest future. OW is characterized by varied infrastructural development, varying technical parameters and generally, a considerable degree of degradation of its facilities. Considering:

- the varying technical parameters of the waterway along its particular stretches,
- the varied hydrological conditions,
- the functions of the waterway,
- the needs and possibilities of improving the navigations conditions on selected stretches of the waterway,

the whole Oder Waterway is divided into:

1. the Gliwice Canal: six double lines of 72x12 m canal locks,
2. the canalized Oder from Koźle to Brzeg Dolny: 23 stages of fall, twenty 187x9.6 m locks, three 225x12 m locks,
3. the free flowing Oder from Brzeg Dolny to the estuary of the Lusatian Neisse,
4. the free flowing Oder from the Lusatian Neisse estuary to the Warta estuary,
5. the free flowing Oder from the Warta estuary to Szczecin.

The stretch of OW which limits the transit depths along the whole waterway is the stretch makes it possible to make a planned voyage at a given draught. In the case of the free flowing Oder the voyages are:

- Wrocław-Szczecin – duration three days,
- Szczecin-Wrocław duration six days,
- round voyage Wrocław-Szczecin-Wrocław – duration nine days.

Figure 10 shows the durations of the particular transit depths. The stoppages caused by route closures on the free flowing Oder were taken into account in the calculations. The closures were due to the icing over of the route or to a too high water level (flood hazard). An analysis of the water levels in the free flowing Oder in the period from 1.01.1980 to 31.12.2007 indicated that over 9860 days the route was closed for the total of 888 days, including 722 days (7.3%) because of icing over and 166 days (1.7%) because of high water levels.

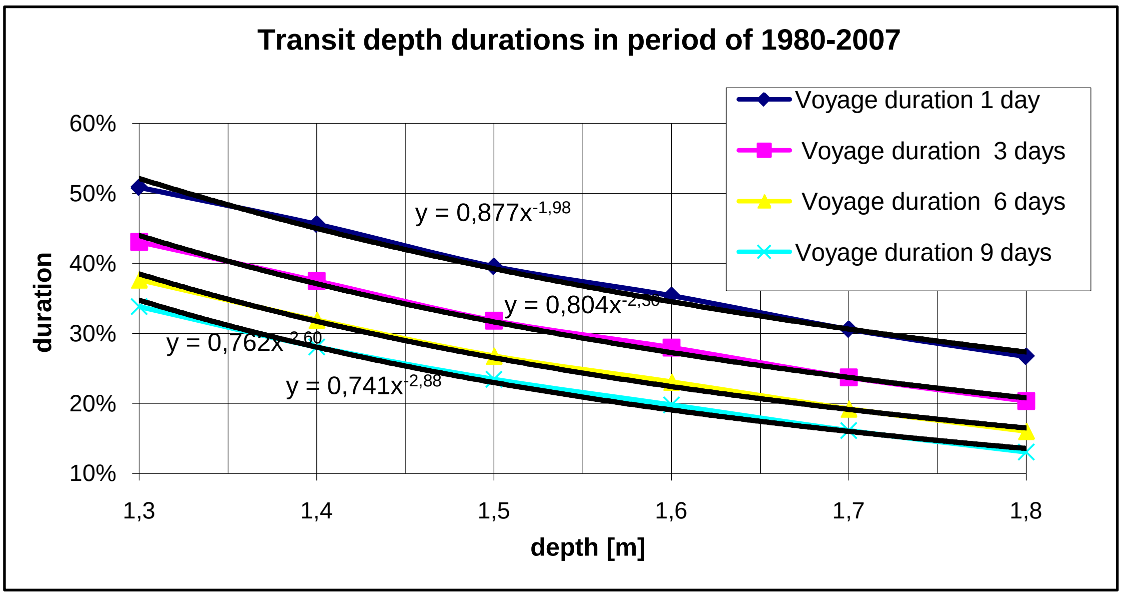

Fig. 10. Transit depth durations for selected routes *(source: in-house study based on Regional Water Management Board in Wrocław data*

from Brzeg Dolny (the 282.65 km) to the Kaczawa estuary (the 316.8 km). This limitation is due to:

- the erosion of the bottom downstream from the Brzeg Dolny stage,
- the neglect of maintenance – the degradation of the river regulation structures,
- the lack of planned dredging work on the shipping lane.

From the carrier's point of view the duration of a particular transit depth is important. The duration

The navigation conditions on the Oder downstream from BrzegDolny will improve when the Malczyce stage of fall (currently under construction) is put into operation. The construction began in 1997. According to the latest unofficial information, the construction of the Malczyce stage is planned to end in 2015. This will be an unbreakable world record.

5. CONCLUSION

The neglect of the waterways and the lack of investments into them have led to the marginalization of this transport system in Poland. This is in conflict with the general trends in the transport development strategies in the neighbouring countries. Inland waterway transport generates the lowest costs relative to the transport work done. Despite the existing advantageous system of waterways, this transport system plays a minimal role in Poland. The waterway transport share does not exceed 0.1%. In comparison with the previous years, this amounts to an almost tenfold fall. The surviving Polish carriers operate on the waterways of Western Europe.

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