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SHALLOW-DRAFT VESSELS ON SOVIET INLAND WATER WAYS

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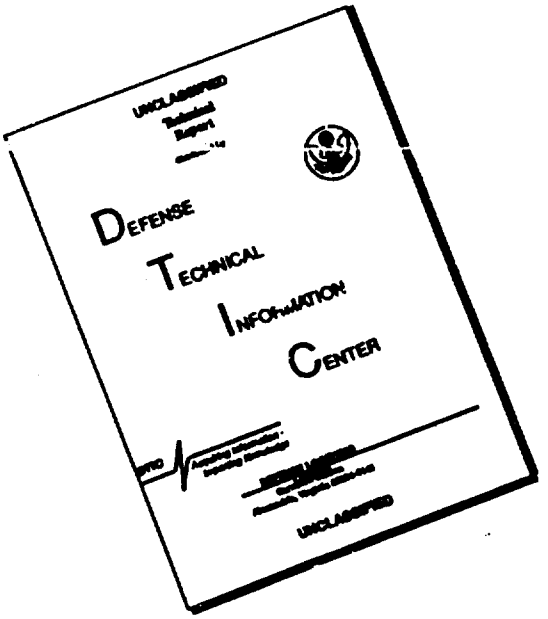

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SHALLOW-DRAFT VESSELS ON SOVIET INLAND WATER WAYS

by

Ing. A.P. Bogdanow and Ing. M.I. Tschernow, USSR

Translation of the article Flachgehende Schiffe der sowjetischen Binnenflotte. Schiffbautechnik 16 2/1966.

Shallow-Draft Vessels on Sowjet Inland Water Ways

by

Ing. A.P. Bogdanow and Ing. M.I. Tschernow, USSR

The total length of navigable inland water ways in the USSR /70
is presently already approximately 143 000 km long. This system consists of rivers, lakes, reservoirs, canals, and a large number of tributary waters.

In order to oversee the hydrotechnical construction plans and the ship-building the water ways were divided into four groups, for which the average designed draft was the main characteristic.

To the first group belong the main rivers with a draft of more than 3 m, to the second the rivers with a draft of 1.65 m to 3.0 m, to the third the local water ways with drafts of 1.0 to 1.65 m and to the fourth th so-called small rivers the drafts of which are approximately 0.75 to 1.00 m and sometimes even smaller.

Here we intend to discuss those vessels which, in essence, are operated on waterways of the third and fourth group of the classification given above. These are the waterways of the inner agricultural region of the country, mainly the upper courses of the rivers and their tributaries. Another very important characteristic of these waterways is the presence of a large number of sandbanks and extremely shallow spots which makes the choice of the type and the construction of the propellers and rudders difficult. Many of these rivers have, besides that, seasonally conditioned draft variations, thus reducing the navigability to the time when the river is in a swollen state.

These circumstances contribute to the difficulties of establishing a fleet and to provide permanent transportation within this river area. It is most difficult to decide the questions which drafts to select as the basis, since this decision determines radius of operation of a ship. It is also difficult to decide the overall length of the vessel which is limited by the prevailing radii of the curvatures of the ship channels and by the overall strength which is

associated with the demand for a bulk weight of the ship that is as low as possible. In this project the influence of the reduced depth of the water must also be taken into consideration since it, on the one hand, increases the resistance of the ship and, on the other hand, the efficiency of the propeller. This in turn has an influence on the operating condition of the main engine, increases fuel consumption and leads to stronger wear and tear. The influence of these factors reduces considerably the operating speed and the economy of these vessels.

During recent years the steamship and the wooden barge have been replaced more and more by motor boats and steel barges. The motor boat represents today 84% of the total number of self-powered vessels of the inland waterway fleet. Ships built of wood have lost all practical significance. Within the frame work of this article only those of the multitide of types of ships will be discussed which are built in mass production. Those ships which handle the traffic on rivers of the third group and visit the ports of these rivers will be discussed first. To this group belong the cargo vessels and tankers with a carrying capacity of 300 to 600 t. The main characteristics of these vessels are compiled in Table 1.

All of these ships are single-deckers the engine and the deck house to accomodate the crew (Picture 1) are placed astern. The propellers of these vessels are of the screw type and operate in shrouded rudders. The two 600 t-ships (dry-cargo vessels and tankers) have the same hull and the same principal dimensions. The two dry-cargo vessels have spray water protected hatch ways with telescope-type movable hatch covers. In certain areas of operation of limited transportation requirements where there are no wharfs available the dry-cargo vessel of 600 and 300 t carrying capacity are equipped with cranes which are mounted on one of the hatch covers and which can be moved with it. The portative force of the crane is 1.0 to 2.5 Mp.

The 600 t-tanker has 5 vertical bunkers for the load, a cargo hold for packaged dry goods and a tank for 35 tons of water ballast for the stabilization of trim at low draft and upon incomplete loading of the bunkers. A system of pumps is installed aboard of the vessel for the purpose of unloading the tankers.

Table 1

Nr.	Type of Ship	Carrying Capacity	Principal Dimensions L_{oa}	B	H	T at a load of 300 t	400 t	500 t	Engine Output	Speed	Crew	Propeller
		t	m	m	m				PS	km/h	persons	
1	Dry-Cargo Vessel	600	65.6	9.6	2.4	-	1.41	1.82	2 x 150	15	10	screw propeller in shrouded rudder
2	Tanker	600	65.6	9.6	2.4	-	1.47	1.87	2 x 150	14.5	10	screw propeller in shrouded rudder
3	Dry-Cargo Vessel	300	52.3	7.7	2.2	1.37	-	-	150	13.0	6	screw propeller in shrouded rudder

Table 2

Nr.	Type of Ship	Carrying Capacity	Principal Dimensions L_{oa}	B	H	T at a load of 100t	150 t	Engine Output	Speed	Crew	Propeller
		t	m	m	m			PS	km/h	persons	
1	Dry-Cargo Vessel	150	43	7.4	2.2	-	1.07	150	14.5	6	screw propeller in shrouded rudder
2	Dry-Carfo Vessel	150	44	7.5	2.0	~0.8	1.0	225	15.1	7	jet propeller
3	Tanker	150	43.1	7.4	2.2	-	1.15	150	14.0	6	screw propeller in shrouded rudder
4	Tanker	100-150	50.1	8.84	1.8	0.7	0.9	225	14.6	7	jet propeller

For the hauling of freight on the rivers of the third and fourth group a large number of vessels with a carrying capacity of 100 to 250 t has been built. The characteristics of these vessels are compiled in Table 2. /71

The dry-cargo vessel (line 1 of the Table; Picture 2) and the tanker (line 3) have the same hull and the same main engine. The cargo vessel has 2 cargo holds with telescope hatch covers of the type that has been described already.

The tanker (Picture 3) has four vertical inserted containers and a cargo hold for packaged dry goods.

These vessels are intended for the transportation of common freight, fuel, and engine oil to remote agricultural areas.

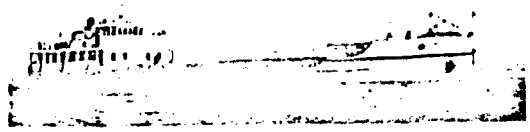
On the basis of the experience gained during operation, modernized ships have been built which show the following modification:
the cargo vessel in line 2 of the Table was equipped with:
a jet propeller instead of a screw propeller and a shrouded rudder,
a ballast tank for the stabilization of trim,
a large cargo hold without transverse bulkheads,
an electric crane with a range of 15 m and a lifting power of 3.5 Mp.

The tanker in line 4 of the Table was modified in the following way:
a jet propeller was installed instead of the screw propeller and the shrouded rudder,
the overall dimensions were somewhat larger,
a ballast tank was installed.

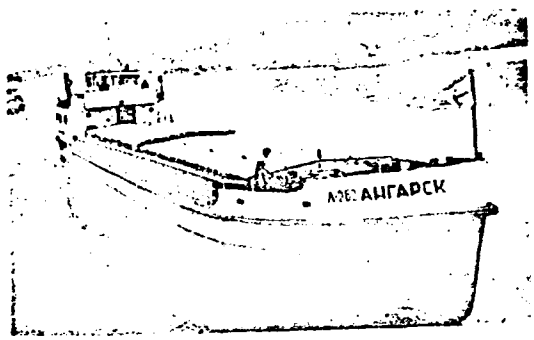
These changes made it possible to operate these vessels at a calculated draft of 0.9 to 1.0 m at full load (150 t) as well as at a reduced draft of 0.7 to 0.8 m without trim with a partial load of 100 t. The experiences gained during the operation of the modernized vessels confirm that it is possible to operate with full loads at the time of swollen state of the river and with somewhat reduced carrying capacity during the course of the summer months at low water levels.

For the smallest rivers, such as the tributaries in Sibiria, a motor cargo vessel with a carrying capacity of 25 t (Picture 4) was built.

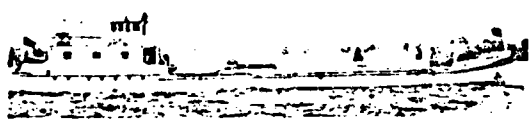
On the same basis a refrigerated vessel for the transport of perishable agricultural products is being built which has a



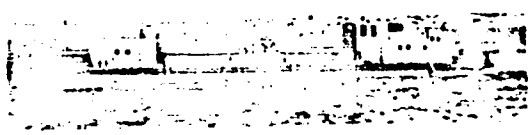
Picture 1. Dry-Cargo Vessel, Carrying Capacity 600 t



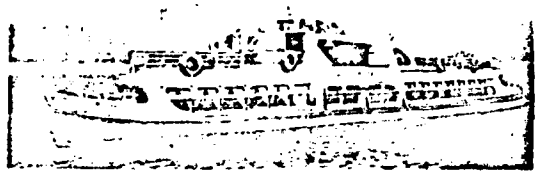
Picture 2. Dry-Cargo Vessel, Carrying Capacity 150 t



Picture 3. Tanker, Carrying Capacity 150 t



Picture 4. Dry-Cargo Vessel, Carrying Capacity 25 t



Picture 5. Passenger Boat "Moskwitsch"

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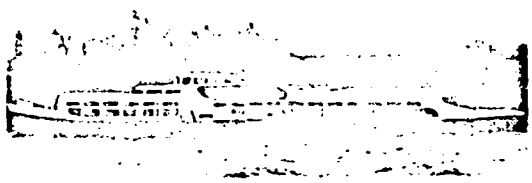
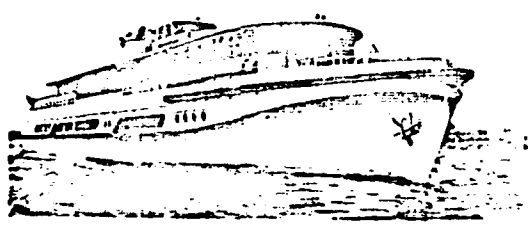
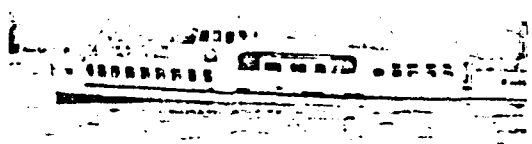


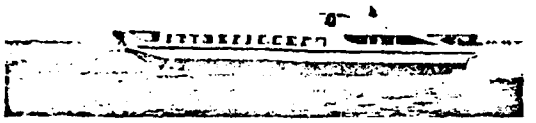
Picture 6. Passenger Boat "Leningradez"



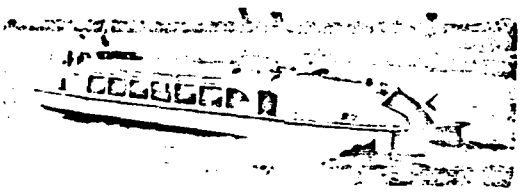
Picture 7. Passenger Motor Boat "Oserny Moskwitsch" ("Moskwitsch" for traffic on lakes)



Picture 8. Passenger Boat for Small Rivers



Picture 9. Hydrofoil "Raketa"



Picture 10. Passenger Step-Bottom Boat

carrying capacity of 10 t. The low dimension of the ship and the difficulties with the trim forced the accomodation of the crew quarters in the fore body.

The main characteristics of these vessels are as follows:

		Dry Cargo Vessel	Refrigerated Vessel
dw	(t)	25	10
Loa	(m)	24.2	23.6
Bmax	(m)	3.7	3.7
Hside	(m)	1.0	1.0
Hmax	(m)	3.4	3.8
Tm	(m)	0.65	0.56
N	(PS)	80	80
deep water	(km/h)	14.2	16.0
crew	persons	4	4

The dimensions of these ships make it possible to transport them by rail from one river system to the other.

The refrigerated vessel has a cargo hold of 34.5 m^3 which is cooled by a Freon-plant. The loading operations are handled by a permanently installed electric crane which is operated manually and has a lifting force of 0.3 Mp with a range of the spreader of 4 m.

After World War II a large number of small passenger boats has been built in the USSR which, in essence, are only equipped with seats. A large number of these ships handles commuter traffic between the areas of the tributaries and the large cities which are located on rivers and reservoirs. In Table 3 are compiled the main characteristics of these vessels. Pictures 5, 6, 7, and 8 show several of these vessels. All of these passenger boats are standardized to a high degree with regard to their main engines, installations, and equipment. Standardized equipment as has been developed for busses and trolley-busses, is used to a large extent for the construction of these vessels.

The superstructures of the vessels of the type "MD" and the vessels for the local traffic are constructed of aluminum alloys, the roof of the motorboat "MD" is made of glass fiber enforced plastic. Plastic is used extensively for the interior of the rooms.

The motorboat "Leningradez" and the motorboat for the small rivers have a height above the water level of approximately 4 m which enables them to also pass low bridges.

During recent years a series of high speed hydrofoils has been developed in the USSR which operate on passenger routes at speeds of 60 to 70 km/h. It was imminent to also try and build hydrofoils for the traffic on small rivers.

Presently a modification of the type "Raketa" is being built in series. The vessel has a low draft and differs otherwise from the already well known regular type "Raketa" (Picture 10) in the following way:

		"Raketa"	"Raketa" of lower draft
Loa	(m)	27.0	27.0
Bmax	(m)	5.0	5.0
$T_{still\ stand}$	(m)	1.8	1.2
$T_{on\ hydrofoil}$	(m)	1.1	0.5
N	(PS)	825	850
v	(km/h)	67	60
number of passenger		66	50

The modified vessel of the "Raketa"-type of lower draft can be operated successfully on waterways of the third group which have a guaranteed designed draft of at least 1.5 m. /73

For the passenger traffic on the smallest rivers with drafts of 0.7 to 1.0 m a type of a step-bottom boat has been developed in a special scientific research project which is well suited for these drafts and shows good maneuverability. The main data of this boat (Picture 10) are:

L	(m)	22.0
B	(m)	3.9
T	(m)	0.4
N	(PS)	850
v	(km/h)	43

The ship has a jet propeller which performed well under all operational conditions of the vessel.

Table 3

Nr.	Type of Ship	Passenger Seats	Sleeping Accomo-dations	Principal Dimensions L_{oa} (m)	B (m)	H (m)	TM (m)	Engine Output (PS)	Speed (km/h)	Propeller
1	"Moskwitsch"	143		27.2	4.85	1.4	0.9	150	19	screw propeller
2	"Leningradez"	100		27.2	4.85	1.4	0.84	150	10	screw propeller
3	"Oserny Moskwitsch"	242		42.6	7.12	2.5	1.47	2 x 150	20	screw propeller
4	"Oserny Moskwitsch"	165	16	42.6	7.12	2.5	1.50	2 x 150	20	screw propeller
5	"Typ MO"	138		29.5	5.2	2.4	1.20	150	20	screw propeller
6	"For Local Traffic"	153	18	49.3	8.3	2.6	0.68	150	18.5	jet propeller
7	"For Small Rivers"	60		24.0	4.0	1.0	0.55	150	16.8	jet propeller
8	"For Small Rivers"	22	24	24.0	4.0	1.0	0.55	150	16.8	jet propeller

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