# River Transport

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Despite the fact that it operates seasonally in many countries, river transport has numerous advantages in comparison with other types of transportation. Initial expenditures to organize navigation on large rivers are eight to ten times less than corresponding expenditures to establish railroads. The prime cost of shipping on mainline rivers is 35 percent lower than rail shipping and 67 to 80 percent less than shipping by motor vehicle.

This natural process is caused by the dynamic activity of erosive agents, that is, water, ice (glaciers), snow, air (wind), plants, animals, and humans. In accordance with these agents, erosion is sometimes divided into water erosion, glacial erosion, snow erosion, wind (aeolic) erosion, zoogenic erosion, and anthropogenic erosion.[2] The particulate breakdown of rock or soil into clastic sediment is referred to as *physical* or *mechanical* erosion; this contrasts with *chemical* erosion, where soil or rock material is removed from an area by its

dissolving into a solvent (typically water), followed by the flow away of that solution. Eroded sediment or solutes may be transported just a few millimetres, or for thousands of kilometres.

*An actively eroding rill on an intensively-farmed field in eastern Germany.*

Natural rates of erosion are controlled by the action of geological weathering geomorphic drivers, such as rainfall;[3] bedrock wear in rivers; coastal erosion by the sea and waves; glacial plucking, abrasion, and scour; areal flooding; wind abrasion; groundwater processes; and mass movement processes in steep landscapes like landslides and debris flows. The rates at which such processes act control how fast a surface is eroded. Typically, physical erosion proceeds fastest on steeply sloping surfaces, and

rates may also be sensitive to some climatically-controlled properties including amounts of water supplied (e.g., by rain), storminess, wind speed, wave fetch, or atmospheric temperature (especially for some ice-related processes). Feedbacks are also possible between rates of erosion and the amount of eroded material that is already carried by, for example, a river or glacier.[4][5] Processes of erosion that produce sediment or solutes from a place contrast with those of deposition, which control the arrival and emplacement of material at a new location.[1]

While erosion is a natural process, human activities have increased by 10-40 times the rate at which erosion is occurring globally.[6] At well-known agriculture sites such as the Appalachian Mountains, intensive farming practices have caused erosion up to 100x the speed of the natural rate of erosion in the region.[7] Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems. On-site impacts include decreases in agricultural productivity and (on natural landscapes) ecological collapse, both because of loss of the nutrient-rich upper soil layers. In

River-transport vessels are subdivided by purpose into transport, technical, and auxiliary vessels. Transport vessels include passenger ships, dry-cargo ships, tankers, push boats, and tugboats. The passenger fleet has local and transit vessels. Dry-cargo vessels with cargo holds have large openings in their decks that facilitate loading and unloading. Dry-cargo vessels on which cargo is shipped directly on deck (flat barges) are designed for transporting any cargo that does not have to be kept dry, primarily mineral construction materials, such as sand, crushed stone, and gravel. Tankers carry liquid cargoes, such as petroleum and petroleum products, in bulk in the holds and in tanks located on deck. Since 1968, combination petroleum-ore vessels have been used, which are loaded with petroleum in one direction and bulk cargo in the other.

The technical fleet includes dredging equipment and vessels for performing various types of channel work. Auxiliary vessels include landing stages, quarter boats, storeships, repair vessels, ferries, floating cranes, sand and gravel dredges, and harbor, service, and auxiliary vessels. Icebreakers facilitate the operation of vessels in ice conditions and are especially important in river transport.

River vessels may be self-propelled or not. Self-propelled ships are divided by engine type into those powered by steam, diesel, and diesel-electric engines. They are divided by the type of propulsion device used into screw-propeller,

connected the seas surrounding the European part of the USSR with a network of internal, deep-water river mainlines.

River transport in the USSR is a part of the country's integrated transportation system (*see* INTEGRATED TRANSPORT NETWORK OF THE USSR). It is very important for the development of industry and agriculture in the eastern regions. It serves industry in Western Siberia, particularly the development of petroleum and natural gas regions. River transport carries cargo for the Noril'sk Mining and Metallurgical Combine, timber for export to Igarka, and cargo for the Yakut mining industry. In the 1950's and 1960's, hydroengineering work began on the eastern rivers. Several hydroengineering complexes were built—Irkutsk and Bratsk on the Angara River, Novosibirsk on the Ob' River, and Bukhtarma and Ust'-Kamenogorsk on the Irtysh River. In 1972 construction was finished on the first stage of the Kras-noiarsk hydroengineering complex, largest in the world, on the Enisei River. The mighty rivers of Siberia have been changed from communication routes of local importance into main transit lines that link up with the ports of the European part of the USSR along the northern sea route. In 1973 shipping on rivers of the eastern basins accounted for 24.5 percent of the total volume of shipping by river transport.

In 1973 river transport accounted for 4.2 percent of total freight traffic in the USSR. The main cargoes in river transport freight traffic are mineral construction materials, lumber, petroleum, and hard coal. Table 1 gives statistics on the volume of river shipping in the USSR, and Table 2 shows productivity in river transport operations.

approximately 200 million tons of cargo for the front and the rear. River workers worked at the military crossings at Stalingrad and on Lake Ladoga, across which the Road of Life led to the besieged Leningrad. The war caused enormous damage to river transport. The fascist occupying troops sank and seized more than 8,300 river vessels and destroyed hundreds of ports, wharves, dams, dikes, and locks. River transport was rebuilt during the Fourth Five-Year Plan (1946–50).

In 1952 construction was completed on the V. I. Lenin Volga-Don Ship Canal, which connected the most important economic regions of the European part of the USSR—the Ural and Volga regions and the Central Zone—with the Donbas and the south. In 1955 two major hydroengineering complexes, Gorky and Kuibyshev, went into operation on the Volga, increasing the guaranteed depth of the Volga and Kama rivers by 0.9 m. In 1967 the Volga was dammed near Saratov, and a new reservoir was created whose waters extended to Kuibyshev.

The opening of the first hydroengineering complex on the Kama River above Perm' in 1957 marked the beginning of navigation improvements on that river. In 1964 the Votkinsk Reservoir came into use. In the same year, construction was completed on the V. I. Lenin Volga-Baltic Waterway, which ensured a reliable transportation link between the economic regions of the Central Zone and the Northwest European Russia. Construction of the navigation canals of the Baltic-White Sea, Volga-Don, and Volga-Baltic waterways connected the seas surrounding the European part of the USSR with a network of internal, deep-water river mainlines.

| Table 1. Cargo shipping in the USSR by river transport | | | | |
|---|---|---|---|---|
| | *1940* | *1965* | *1970* | *1974* |
| Length of navigable internal waterways (km)[1] ..... | 107,300 | 142,700 | 144,500 | 146,100 |
| Cargo shipped, millions of tons..... | 73.1 | 269.0 | 357.8 | 452.0 |
| Freight traffic (billion tons-km) ..... | 36.1 | 133.9 | 174.0 | 212.3 |
| [1] As used by all organizations | | | | |

The high-head dam of the V. I. Lenin Dneproges hydroelectric power plant raised the water level at the Dnieper rapids, and the river became navigable over its entire length. The first hydro-engineering complex on the Svir' River (1933) deepened the river's lower course. In 1933 the Baltic-White Sea Canal, which connected the White Sea with the Baltic Sea, also went into operation.

A great deal of work was done in the mid-1930's to establish a uniform, deep-water network in the European part of the USSR. The construction of a series of hydroengineering complexes and reservoirs on the Volga was enormously important; the first of them, Ivan'kovo, went into operation in conjunction with the Moscow Canal. During the prewar five-year plans (1929–40), the self-propelled river fleet was enlarged by 120 percent; the

began in St. Petersburg in 1815, and then in Pozhva on the Kama River in 1817. A number of steamship companies were formed on the Volga: the Obshchestvo po Volge (1843), the Kavkaz i Merkurii (1850–59), and the Samolet (1853) steamship companies and the Pol'za Kama-Volga Steamship Company (1854). In 1913 the number of steamships in Russian river transport had reached 5,467, and there were more than 23,000 river vessels that were not self-propelled.

Since the early 20th century, the steam engine has been supplanted on river vessels by the internal-combustion engine. The latter was first used by shipbuilders in Sormovo, who installed a diesel engine on the self-propelled tanker *Vandal* in 1903. In 1913, Russia led the world in number and quality of river vessels. Large-capacity metal tanker-barges were built for shipping petroleum. Russia had 64,600 km of navigable internal waterways. Cargo shipping by river transport reached 49.1 million tons—35.1 million tons using mechanical propulsion and the remainder using river current. More than 11 million passengers were carried. This shipping took place primarily on the rivers in the European part of the country. In prerevolutionary Russia, the rivers of Siberia and the Far East were hardly used for navigation; only rarely did ships travel the Ob', Irtysh, Enisei, and Amur rivers. Shipping on the rivers of the eastern basins accounted for roughly 6 percent of the total freight traffic in river transport. Grain, lumber, petroleum, and bulk materials were carried. River wharves were not mechanized, and loading was done manually.

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