On issue of substantiating availability of main pipelines in Western Siberia

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Abstract. The urgency of providing year-round access to main pipelines (MP) constructed in wetlands is due to: the considerable length of MP strings in wetlands; ineffective and sometimes destructive use of the technology of operational and other enterprises due to the lack of year-round opportunities for carrying out preventive works; the impossibility of immediate response in the occurrence of accidents and failures in operating MPs and, as a result, material damage to operators and consumers of products; inevitable negative impact on the environment in case of emergency.

1. Introduction
The presence of a year-round operating road excludes many of the listed problems, the solution of which requires significant costs, usually unplanned, which negatively affects the financial well-being of the oil and gas industry and operational organizations. The road routes (RR) provide a high production culture, the ability to use the latest diagnostic technologies and equipment. It is very important to build such roads along the MP operating for more than 30 years, where, according to theory, the probability and the number of failures will only grow. Moreover, modern studies of the theory of the origin of oil (Larin V.N., 2005, 2016) show that oil reserves are inexhaustible, which should ensure the long life of MP.

2. Materials and methods
The purpose of the article is to show the constructive and technological solutions for the construction of RR with the use of a widespread local material - peat. Scientific novelty lies in the development of types of constructive solutions for RR with peat in the body of the mound for various territories.

The main feature that causes new problems of road construction in such conditions is a rigid binding of the route of the future road to the MP track passing through the wetlands. At the same time, it is necessary to build a road in the immediate vicinity of the operating MP.

The prerequisites for the use of peat in the body of roads along the operating MP are based on the historical experience of peat application in road construction. The normative document [1] allows the use of peat, with certain design constraints, in the lower part of the bodies of highways of the III - IV categories with a traffic intensity of 100 cars per day or more. Similarly, in Northern European countries, where the territories are covered by a multitude of marshes of different types, peat in the body of the roads is also allowed for public roads. The website [2] contains reports on solving problems of peat roads with low traffic intensity (LTI).
The oil and gas industry in the years of development of the pipeline network used peat actively and productively, located in the immediate vicinity of the pipeline route. A lot of works are devoted to studies of peat as a constructive local material and the rationale for its application [3-5]. The wide use of synthetic and rubber-fabric materials in the construction of temporary roads with peat in the body significantly increased the bearing capacity of structures [6, 7].

The technological schemes proposed in VSN 26-90 [1] are possible only in winter, and it is impossible to develop a reserve with peat from one side of the future RR because of the nearby MP.

Thus, the prerequisites for the wider use of peat for RR construction during the operational stage of the MP are:
- ultra-low traffic intensity (ULTI) of the RR technique (unlike public roads - units per day);
- proven ability of peat deposits to withstand significant loads (over 60 tons);
- the necessity of creating an all-year-round RR in wetland conditions growing due to the aging of the MP strings.

The basic design solution of the RR with the maximum replacement of mineral soil with peat is shown in Fig. 1.

**Figure 1.** The basic design of the roadbed in the marshes with the use of peat in the body of the banket for RR

a – on the marsh of type I; b - on the marsh of types II and III (B = banket width, S – final sediment of the base of the banket, Hp – working height of the banket, Hb – marsh depth, 1 – road surface, 2 – sand fill, 3 – peat layer)

Fig. 1 shows the possibility of replacing mineral soil with peat for marshes of Type I; for marshes of types II-III, let us fill the marshy thickness with preformed peat (PP) along the contour b. The basis for the replacement is the calculation of the construction of road topping by [1]. Calculations are made for the road structure shown in Fig.1. The road covering of the transitional type is a slag layer of 15-20 cm. Replacement of mineral soil, according to Fig. 1, is produced by preformed peat, aged in burts before reaching the necessary humidity. The depth of the marsh varied from 3 to 4.5 m. The elevation of the bottom of the mineral soil above the surface of the marsh is 0.3 m plus the reserve for the sediment of the peat banket, calculated from the "age-old" precipitation of 2 cm/year (M.P. Bolshtyansky, 1990, 1998). The selection of the thickness of the sand backfilling between the PP layer and the slag coating was made by calculations, depending on the intensity of the working motion.
along the RR. Fig. 2 shows the dependence of the layer of mineral soil on the intensity of the machinery traffic intensity during the operation of the MP.

![Figure 2](image)

**Figure 2.** The change in the layer of mineral soil, depending on the traffic intensity along the RR (the abscissa axis, standard trucks)

The height of the banket at the beginning of operation depends on the planned service life of the RR, so for a service life of 30 years, the height $H_p$ will be 1.1-1.2 m, while the "age-old" peat sediment with a low intensity of impact on the peat thickness is unknown.

The typification of organizational constructive and technological solutions for the construction of a RR is carried out, including the name of the structure (peat banket-TH), the type of marsh, lake (marsh of the 2nd type - B2, Oz) and the performance time ($L, Z$). Fig. 3 shows an example of the use of different design and technological solutions for the construction of RR.

![Figure 3](image)

**Figure 3.** An example of the implementation of organizational design and technological solutions of laying MP in the wetlands (rigid binding of the route of the future road to the highway MP)

Peat bankets (PB) are fairly peaty, 10-50 thousand $m^3$ are required for 1 km of RR, depending on the thickness of the marshy deposit. For the implementation of technological processes for the erection of a PB, preformed peat is required with a moisture content not exceeding the limit of its moisture capacity (300-900%). Fig. 4 shows a schematic diagram of the peat bulging. The formation of lakes at places of peat deposits is ecologically expedient, since in this case, according to biologists, biological diversity of wildlife is increasing.
The economic efficiency of peat application in the body of RR bankets is related to the elimination of problems arising in the absence of such roads. Moreover, the continued availability of MP leads to a range of economic benefits [8]:

- the elimination of peak seasonal resource requirements (machinery and people);
- maximum utilization of the production capacity of operational organizations;
- reduction in the share of contingent expenses as part of the annual program expenditure;
- an increase in the annual program of works, therefore, an increase in the volume of repair and restoration works in the MP system of Russia;
- increase in profit due to more efficient use of funds for depreciation of fixed assets.

![Figure 4. A schematic diagram of the peat deposit development](image)

![Figure 5. Comparative economic efficiency and payback period of roads with peat in the body of banket and traditional roads](image)

The calculation of the efficiency of investment in RR using peat soils is based on [9]. Fig. 5 shows the comparative data for the calculation of net present value for a section of MP of 100 km length laid.
in wetland conditions. Initial data: "the project" takes into account the costs of performing the work of the experimental stage, then within 3 years, it will be possible to construct a RR using peat; "without a project", the possible costs for the construction of levies, long-term products cutting-off, etc. were taken into account.

At the experimental stage, the following problems need to be solved:

- To work out new ways of erecting PBs on the basis of the construction of experimental sites in marshes of different types and lake-moss complexes.
- To work out the technology of preliminary peat formation.
- To check the stability of the PB with low traffic intensity and the impact of long-standing construction machines in the pilot areas.
- To assess the consequences of peat extraction for the needs of the RR.
- To conduct a study of the economic parameters of organizations that perform routine and emergency work on pipeline transport to obtain a more reliable assessment of the integrated economic effect.

3. Conclusions
1. Construction of permanent roads along the MP is technically feasible and cost-effective.
2. The use of peat in the body of the banket, which gives a multiple economy of investment, is the most effective one;
3. To develop recommendations for the construction of roads along the MP, it is necessary to carry out Scientific Research and Experimental Design Work, the tasks for which have already been set.

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