

Oil Slick Movement upon the Lena River on the Section of the Underwater Crossing of the ESPO Pipeline System.

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Study of oil slick movement in case of oil spill is rather urgent for a prediction of environmental impact of the ESPO pipeline system. Data on river flow velocity and its direction provide significant information for investigation of the oil slick behavior after emergency or nonemergency oil spill. In connection with it, a full-scale experiment was conducted in October 2009, which allowed detecting the trajectory and velocity of the oil slick movement on the underwater crossing of the PS ESPO. Two river stations were chosen near the underwater crossing. During the experiment hydrometric floats and handheld GPS-units were applied. Results of the experiment for the first time showed trajectory and velocity of the oil slick movement in an autumnal low water period on the area of the underwater crossing of the pipeline. Information on hydrological regime of the Lena River is provided in the paper as well.

Key words: pipeline, ESPO, oil slick, oil spill.

1. INTRODUCTION

In October 2009 employees of the institute conducted natural experiments for the purpose of the new features detection of the object, particularly the trajectory and velocity of the water stream on the surface of the Lena River downstream the ESPO pipeline in case of possible oil spillage at the site of its underwater crossing. The experiment finding provides a scientific idea about the stream flow on the water surface at the reach of river, being the general factor of the oil slick movement on river during a windless climate.

The ESPO pipeline approaches the Lena River on the 1751 km of its right-of-way from Tayshet. The river length from its mouth up to the crossing is 2238,4 km. The width of river during the low water is 1328 m. Average depth during the low water is 6,83 m. Average flow velocity during low water is 1,12 m/sec. The width of water protection zone is 200 m. Water discharge by 1% flood probability is 51800 m³/sec, and by 10% flood probability is 42200

m³/sec. Water level by 1% probability is 135,53 m BS, by 10% probability is 132,93 m.

2. WORKING PROCEDURE

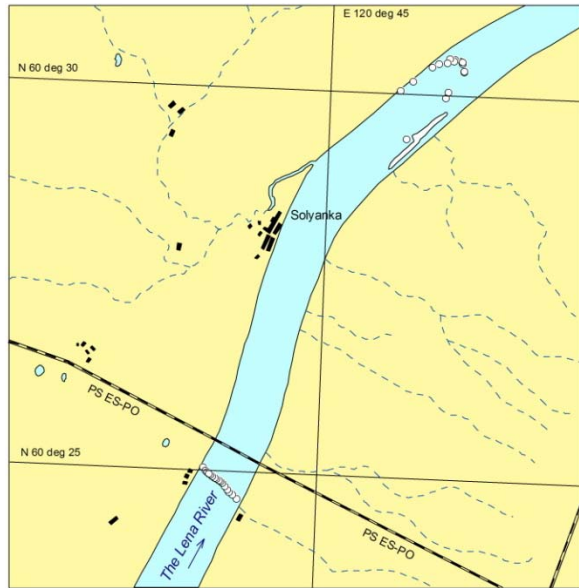
During preparatory stage of the field work, we stated the surface floats method, using floats for distances about 10 000 m for the purpose of detection of the flow direction on the river surface and measuring of average velocity of the floats, released in different distances from a bank.

Field work included 2 similar experiments with a difference in location of float release start-points. The floats correspond white painted studs (18*16*6). Each float had its serial number, drawn upon a side. In the first experiment the river station approximately in 1000 m upstream from the underwater crossing of the ESPO was chosen. The width of the water level at the river station was about 1350 m. By reading of a standard handheld GPS-unit geographical coordinates of the right bank were recorded, where the movement to the over bank by the river station had started from. The floats release and fixing of their initial position by GPS were applied; the coordinates and release time were recorded in the survey notes at the same time. The floats were situated approximately in 100 m from each other, and the last had number 16. During the experiment the floats drifted through the underwater crossing and the Solyanka settlement.

Next, the floats were caught one after another 2 hours later with recordings of coordinates of location and precise time of a catch.

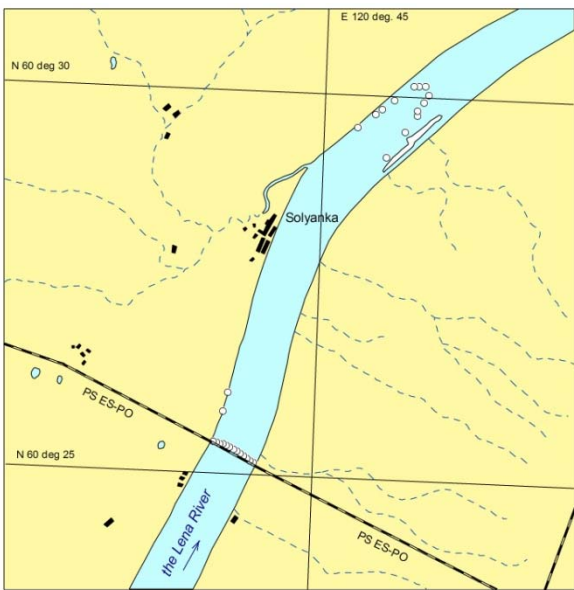
The second experiment for release of 15 floats was started from the river station of the underwater crossing of the ESPO by similar scheme. The experiment lasted 1,5 hour.

The floats 14 and 15 were found put in the left bank in 1210 m and 743 m from their release point, respectively. The points of the release and catch during the both experiments are shown on fig. 1 and 2.



PS ES-PO
 Temporary streams
 Buildings
 Points of floats release and catch

Fig. 1. Scheme of the experiment #1



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Fig. 2. Scheme of the experiment #2

3. WORKING DATA

During the laboratory work, path lengths for each float were calculated by means of using electronic instrumentation. Average floats velocities for the travelled distances were

specified. Data on floats velocity are shown on the figure 3.

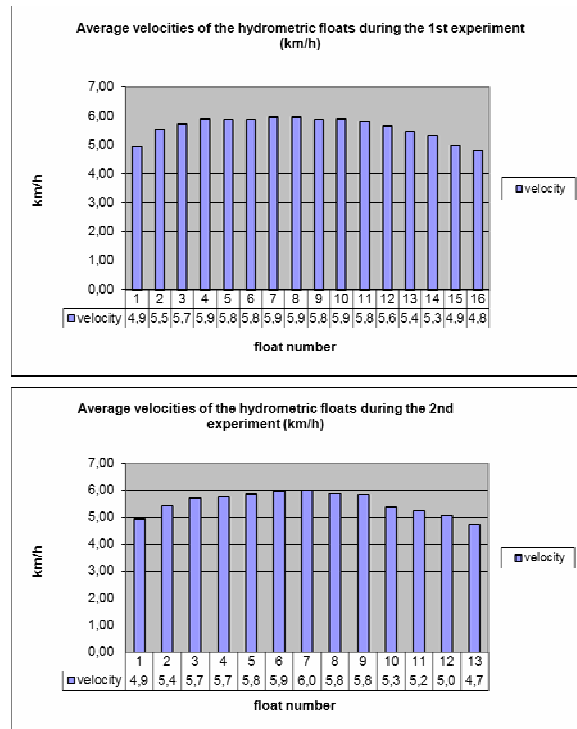


Fig. 3. Average velocity of floats movement during both experiments.

As a result, the maximum flow velocity of surface streams occurred over the deep stream. In general calculated average velocities of the floats ranged 4,7 – 6,0 km/h (1,31 – 1,67 m/sec).

The hydrometric floats having number 1 during the both experiments at the moment of the catch were in 380 and 285 m from the right bank respectively, instead of 151 and 79 m in the time of the release. The rest of the floats had been approached to the left bank as well. No one of the floats put in the coast of an isle near the site of the catch.

4. CONCLUSION

Data obtained during the field work might occur useful while calculation of thread of stream, as one of the main element of the oil outflow GIS-modeling of polygonal water bodies. The result of this one is calculation of the most important pollution features, as well as oil patch area, its length along the river fairway, and concentration of pollutant in the

center of the patch in case of emergency spill
[1].

5. LITERATURE

- [1] Atnabaev A.F., Bakhtizin R.N., Nagaev R.Z., Efremova O.A., Pavlov S.V., Sayfutdinova G.M. GIS-models for analysis of oil outflow consequences. // ArcReview #1 (32), DATA +, Moscow, 2005. – p. 15-16.

6. BIOGRAPHICAL INFORMATION

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