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NUMERICAL AND ANALYTICAL MODELING OF SPILLED OIL PENETRATION IN SOILS FOR RISK ASSESSMENT

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The Druzhba pipeline is the world's longest oil pipeline (about 4,000 km). It transports oil from central Russia to the energy-hungry western regions of Russia, Belarus, Ukraine, Slovakia, the Czech Republic, Hungary. The northern branch crosses the remainder of Belarus to reach Poland and Germany. There have recently been proposals to extend this branch to the German North Sea port of Wilhelmshaven, which would reduce oil tanker traffic in the Baltic Sea and make it easier to transport Russian oil to the United States. Today, the Druzhba pipeline is one of the principal arteries for the transportation of hydrocarbons across Europe to western Europe.

The next longest is the Baku-Tbilisi-Ceyhan oil pipeline (BTC) transporting crude oil (1,760 km) from the Caspian to the Mediterranean Sea. It passes through: Baku, (Azerbaijan); Tbilisi, (Georgia); and Ceyhan (Turkey).

According to the experience of European transit countries the transit of oil and gas causes great losses regarding the ecological situation thus counteracting the intended political and economical benefits. In addition to ordinary pollution of the environment it is possible that non-ordinary situations like pipeline and railway accidents arise. As foreign experience with pipelines shows, the main reasons of crashes and spillages (and fires as a consequence) are the destruction of pipes as a result of corrosion, defects of welding and natural phenomena. Also terrorist attacks and sabotage may occur. The probability of crashes for oil pipeline transport rises with the age of the pipelines in service, and with the extent of their network. For example, 250 ruptures, which were accompanied by spillages of the transferred products, occurred every year from 1973 to 1983 in the US pipeline network with a total length of about 250,000 km. In West Europe it has been found that 10 – 15 leakages happen every year in a pipeline network of around 16,000 km length, resulting in a loss of 0.001% of transferred products

It is obvious that safety of the neighbourhood of oil and gas pipelines is an urgent problem for Russia, many other east and west European countries and for the Caucasus. The application of models to the investigation of the impact of pollution on the environment and on the population caused by pipelines and rail road transport offers a chance to design sensible economical, social and political abatement strategies. Models

can efficiently support the development of prognostic and management methods for environmental protection. With this goal in mind we have applied mathematical models describing oil penetration into soils in case of pipeline damage in the general case and for special conditions taking into account the specific properties of several types of soils found along pipeline routs.

In this paper some environmental problems resulting from oil spillage along oil pipeline routes are discussed. Oil penetration into soil with flat surface containing pits is studied by numerical modeling. Some analytical and numerical solutions of the diffusion and filtration equations are given and analyzed. Results of numerical calculations of spilled oil penetration into soil with slopping surface are discussed. Results of numerical calculations of oil propagation in soil under high pressure also are presented.