LANDSCAPE AND WATER BODY CONTAMINATION DUE TO PIPELINE ACCIDENTS: CASE STUDY OF OIL FIELDS IN WESTERN SIBERIA

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The oil producing industry has a significant impact on the environment. This effect is caused at all the stages of the "big travel" of oil - from a wellsite to a crude-oil refinery. Among the most dangerous factors that lead to environmental problems are emergency situations in the workplace.

Most accidents are caused by breakdowns in the technological process, equipment misuse, violation of labour discipline and technological process specifications, disregard of safety rules, lack of proper equipment condition monitoring. With respect to environmental impact pipeline accidents bring about the most harmful and large-scale after-effects. In this regard, the oil producers need to have an accurate idea of possible ruptures, methods of their elimination and subsequent surface reclamation of soil.

The purpose of the study is to assess pollution of landscape and water bodies caused by pipeline breaks and the analysis of the most efficient emergency procedures.

In order to prevent rupture it is necessary to identify possible factors contributing to oil and gas pipeline accident occurrence and development which may include the following:

1. Pipeline volatile flammable liquid (VFL) or gas run;
2. Considerable pipeline section length;
3. Periodic oil and gas pumping;
4. High-pressure pumping;
5. Pipeline crossings through water bodies, intersections of a pipeline with transport communications;
6. Anthropogenic impact on pipeline facilities;
7. Corrosive fluid.

Thereby, according to these factors the following causes of accidents may be determined.

1. Pipeline depreciation, mechanical damage, temperature deformations;
2. Water hammer effect caused by harsh closing of check valves;
3. Internal and external pipeline corrosion;
4. Disturbances of oil and gas transport process conditions;
5. Natural and manmade external effects;
6. Personnel delay errors or failure to act in standard and emergency situations;
7. Willful acts (a terrorist attack, illegal tapping of pipeline to steal a transported product).

Apart from the loss of products at hydrocarbon operating facilities, the immediate consequence of accidents is damage to the environment. Petroleum accumulations in the lower areas can lead to aerogen gas formation which may result in the subsequent fires and consequently, smoke occurrence in nearby settlements, loss of property and thermal injuries of people caught in the fire zone.

Thus, oil producer must produce cause-effect model of accident development for its prevention. This requirement is established by the Federal Law "Industrial Safety of Hazardous Production Facilities" on 21.07.1997 (№ 116-FL) and the regulations of the Government of the Russian Federation "The Development of Action Plans for Localization and Liquidation of the Consequences of Accidents at Hazardous Production

Facilities" on 8.26.2013 (№ 730), according to which the oil companies of West Siberia must have developed action plans for localization and elimination of accidents and the consequences of accidents [4,5].

Hazardous substances that may pollute the environment are divided into:

• Inflammable gases (IG) - oil-associated gas.

• Flammable liquids (FL) - oil, gas -condensate, methanol, demulsifier, corrosion prevention chemicals.

In practice the outlet zone and the spread of dangerous substances in the accident will depend not only on the volume of the dangerous substance, but also on the conditions of spreading, i.e. an accident scenario and external factors.

The adverse impact of emergency-poured oil under different scenarios of accidents at production facilities affects all the components of the environment. This results in:

• Soil contamination with absorbed oil;

• Pollution of surface and ground water;

• Air pollution with oil vapors, as well as their combustion products.

In accordance with the causes of an emergency situation, its type and the affected area a set of measures can be taken to eliminate the consequences. Oil spill of more than 15 tons is referred to as an emergency. Localization and elimination of the damage caused by minor accidents involving oil spills of less than 15 tons is self-performed. The oil spill response operations require immediate field work of all the committees involved, which is aimed at a maximum reduction of the affected area and decrease of the effects on the environment and the working staff.

To repair damage caused by accidents the following stages of reclamation are distinguished:

1. Accident damage control;
2. Environmental survey;
3. Determination of affected target characteristics including engineering-geological parameters, qualitative and quantitative contamination indicators, microbiological and agrochemical parameters of contaminated soil;
4. Contamination localization;
5. Clean-up operations;
6. Covering recultivated ground with potentially fertile rocks and topsoil;
7. Cleaning of recultivated area from industrial waste;
8. Seedling purchase and planting.

The main types of accidents which occur on pipelines and the most appropriate measures for their localization and removal actions can be considered by the example of Muravlenkovskoye oil field.

Muravlenkovskoye oil field is located in the northern part of the Surgut Swell in Purovsky District of Yamalo-Nenets Autonomous Okrug of Tyumen Oblast restricted to river Pyakupur and river Purpe interstream area. The field is confined to Surgut petroleum region of Nadym Pursky petroleum bearing area, West Siberian petroleum province. The commercial oil recovery is associated with the Pokurskoe suite. The extracted fluid is characterized by the following physical chemical properties: density of crude oil - 780-790 kg/m^3, viscosity - 1.2-1.38 mPa×s; there is sweet, paraffin-base, low-resinousness oil, gas ratio is 58-70 m^3/t.

The equipment used for hydrocarbon transport in the field includes oil gathering pipelines 514 km long with working diameter 114 mm and operating pressure 1.6 MPa; pressure pipeline 74 km long with working diameter 273 mm and operating pressure 1.6 MPa; gas pipeline 15 km long with a working diameter 219 mm and operating pressure

1.6 MPa. The amount of harmful substances present in the field pipeline equipment comprises 2333 tons of crude oil, 18.2 tons of methanol, 129.3 tons of associated gas [2].

In terms of environmental damage the most dangerous accidents in the target field can result in the contamination of water bodies. This effect arises as a result of pipeline integrity loss in the area of its crossing through the river Purpe and river Pyakupur, where oil is released directly into the water bodies, and permanent oil contamination of the water body is caused. The area of water pollution is about 800 thousand m^2.

Due to the large area of hydrocarbon contamination of water bodies one of the most reliable methods for the elimination of pollution is usage of absorbent developed from modified sphagnum moss peat. Being subjected to high temperature, the peat changes its properties from hydrophilic to hydrophobic and oleophilic ones. Humic component acts as a catalyst for native biocenosis activity; which in its turn, increases this activity significantly and accelerates its interaction with the hydrocarbons. This method is environmentally safe for hydrosphere in comparison with similar methods used to collect contaminants. After the elimination of pollution damage peat remains at the accident site, gradually turns into its hydrophilic state and starts to absorb the water in the way it does in natural environments, thus becoming a useful component of both water and soil [1].

However, the most likely accident outcome is soil contamination which takes place on land. The oil release caused by microfractures formed in pipes leads to extensive landscape pollution. The contaminated area exceeds 1.5 thousand m^2.

The analysis of main methods for hydrocarbon contamination elimination allows us to conclude that physical and chemical methods are the most cost-effective and productive ones to preserve ecosystems. One of them involves soil cleanup in technical tanks by heated water solutions in the presence of surface-acting agents, and the subsequent vacuum extraction of the remaining mixture. The second method implies lime treatment of soil in an amount of 0.5-5% by weight of the oil spilled. This is followed by collecting the obtained solid which retains oil as a complex compound.

Accidents at pipeline facilities are accompanied by release of significant amounts of gas. The elimination of this kind of accident after-effects is carried out in several stages: 1) gas pipeline shutdown; 2) damaged section outgassing; 3) line rupture security cordon; 4) reducing gas concentration to the maximum permissible concentration rate [3].

The degree of landscape and water body pollution caused by pipeline accidents depends on the speed and integrity of removal and remedial actions. Only in this case it is possible to minimize the harmful impact on the environment.

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ANALYSIS OF ROAD TRANSPORT LOAD OF THE ADJOINING AREAS IN A LARGE INDUSTRIAL CITY NOVOKUZNETSK

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With the increasing number of owners of vehicles and lack of available garages, there is a problem of congestion of yards with private vehicles. This, in turn, creates air pollution problems, increasing the area of asphalt concrete pavement, as well as an increase in the number of accidents involving children and the elderly.

The aim of this study is to analyze the trucking congestion in the areas of the town.

To accomplish this goal we studied the requirements of urban planning documentation and investigated domestic territories of the Central and Kuznetsk districts. In the yards a record of standing and moving traffic from 5.00 to 8.00 p.m. was carried out. We took into account the type of the building, the area of the territory, the presence of organized parking lots, the estimated number of resident population. The observation results are shown in Table 1.

It is noted that the number of vehicles standing is about 81, passing vehicles - 75, the distance to the facades of houses on the average - 5 to 10 meters, the average area of the paved yard area - 2560 m^2.

Table 1

Observations of road congestion in researched yard areas in spring and autumn

Yard playground	The area of the yard territory with asphalt	Number of standing cars		The number of passing vehicles			
				Arrived		Left	
		Spring	Autumn	Spring	Autumn	Spring	Autumns
№1	1900 м^2	34	50	75	81	59	63
№2	2300 м^2	29	46	57	43	41	29
№3	3350 м^2	101	99	47	54	25	35
№4	3600 м^2	80	156	204	210	168	144
№5	1650 м^2	51	54	84	59	36	32

The basis of town planning legislation for a truck load adjoining areas is as follows:

I. Gap between facilities for the storage of cars and building facilities: distance from public car parks and parking lots to the facades of houses with windows with the capacity of parking spaces less than 10 is 10 m., 11-50 parking spaces - 15 m. 51 -100 parking spaces - 25 m., 101-300 parking spaces - 35, more than 300 parking spaces - 50 m (Sanitary Regulations and Norms 2.2.1 / 2.1.1.1200-03, Article 7.1.12).