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# Study on Influencing Factors of Oil Spill Dispersion Behavior in Rivers Crossing the Pipeline

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## Abstract

**In order to summarize the relationship between pipeline oil spill accidents and emergency response, relying on the migration and spreading laws of oil spills across pipeline projects in torrent rivers, the influencing factors of oil spill diffusion behavior in rivers are expounded, and the properties of medium and leakage, external factors are analyzed. The influence mechanism of various influencing factors such as environment and emergency response intervention provides theoretical support for the study of oil spill diffusion in pipeline crossing projects.**

## Keywords

**Oil Spill Diffusion; Pipeline Crossing Engineering; Diffusion Impact; Emergency Response.**

## 1. Introduction

The pipeline spanning project has the characteristics of high pressure, high strength, high frequency of geological disasters, large diameter, and large throughput. In addition, the oil and gas medium itself is flammable, explosive, and toxic. Once the medium leaks, fire and explosion accidents are very likely to occur. [1]; In addition, the spilled oil generated by the leakage accident will not only pollute the water quality of the river, but also cause serious consequences such as loss of life and property safety, environmental damage and production impact. The mechanism of oil spill diffusion influencing factors [2] is an important theoretical basis for the study of oil spill diffusion laws in pipeline spanning projects. Therefore, this paper will study the three influencing factors of medium properties and leakage, external environment and emergency response intervention. [3], which provides a strong theoretical basis for the study of oil spill diffusion across pipeline projects.

## 2. Influencing Factors of River Oil Spill Spreading Behavior

Oil spill diffusion behavior refers to the physical and chemical behavior of oil spilled during the process of oil spill floating up to the cross-section expansion under the action of the oil boom, and its influencing factors can be divided into medium factors (media properties and leakage), external environmental factors and emergency response to intervention factors [4].

### 2.1 Media Properties and Leakage

(1) Components

The components that affect the behavior of oil spills are mainly colloidal and asphaltene components in crude oil. The composition determines the properties of the oil itself, as well as its behavior and

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fate once spilled into the environment. First, the degree of oil evaporation, dispersion, and dissolution affects the amount of oil that can be cleaned up by means of mechanical sealing and recovery, dispersant application, manual cleaning, or in-situ burning [5]. The degree of weathering and the properties of the oil, such as viscosity, density, and stickiness, can affect the effectiveness of these cleaning techniques.

(2) Physical and chemical properties of oil

Crude oil spill behavior is related to properties, including viscosity, density, specific gravity, distillation, and interfacial tension. In fact, these property indicators also influence each other [6]. The meanings of various physical and chemical property indicators of oil products and their role in the spread of oil spills are shown in Table 1.

In the analysis of oil spill behavior, combined with the existing research, it can provide a theoretical basis for the future simplified model, and the more important parameters such as composition, density and viscosity are selected for numerical simulation work.

**Table 1.** Physical and chemical properties of crude oil and their role in the spread of oil spills

| Index | Meaning | Function and Features |
|---|---|---|
| Viscosity | measure of the resistance of crude oil to flow | The lower the viscosity, the better the fluid flow, and as the oil weathers, the evaporation of lighter components causes the viscosity to increase. |
| Density | Affects the rate of natural dispersion and the likelihood of settling Thicker | oils disperse more easily form emulsions more easily, and settle more easily. |
| The interfacial tension | characterizes the shrinkage force on the liquid interface | The lower the oil-water interfacial tension, the greater the degree of spreading and the thinner the oil film thickness. Interfacial tension is generally not used to analyze diffusion behavior because environmental and other factors dominate as the oil film diffuses |
| Solubility | An indicator of the solubility of oil molecules in water | Affects dissolution behavior |
| Distillation fractions of oil | Combinations of petroleum products distilled out at a given temperature | Affects the evaporative behavior of oil spills |

(3) Crude oil spill scenario and spill volume

The amount of leakage is related to the distribution of oil spills on the river surface, as well as the plan for intercepting and collecting oil, while the crude oil leakage scenario directly determines the instantaneous speed of the leakage [7], the method of crude oil injection, the amount of leakage per unit time, the total leakage Time, which indirectly affects the time of leak detection, maintenance time, total leakage and the level of emergency response to leakage. It can be seen that the impact of leakage amount and leakage method (scenario) on oil spill behavior is crucial, and the two are interrelated, and the impact is more worthy of attention.

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### 2.2 External Environment

The influencing factors of the external environment can be divided into two categories: meteorological and hydrological conditions. Meteorological conditions include rainfall, strong wind, and low temperature. On the one hand, these harsh climatic conditions will increase the difficulty in the delivery of emergency rescue materials, and will also affect the deployment and recovery of oil spill interception facilities [8]. The effects of rainfall and strong winds are similar to water currents, which will rapidly spread oil spills, and may also bring danger to personnel operations and increase the difficulty of emergency rescue. Of course, although the reverse wind has a blocking effect on the oil flow on a certain section, when the water flow speed is large, the wind speed will increase the degree of turbulent mixing, but in a long time, the effect on longitudinal diffusion is minimal; hydrological conditions include water quality conditions, Water velocity, eddies, river bends, large drops, etc. When water contains microorganisms that may react with oil spills. The greater the water flow speed, the faster the longitudinal drift of the oil spill. Curved channels can alter the lateral distribution of oil spills on the river surface and may collect in some inlets. Vortexes and large drops increase the vertical mixing of oil spills and promote the formation of more emulsions, making recovery more difficult.

In general, environmental factors will have a greater impact on oil spills, so many aspects need to be considered when predicting the spread of oil spills.

### 2.3 Emergency Response Interventions

The emergency response intervention factor is actually the interference and blocking of the spread behavior of the oil spill under the natural conditions of the measures taken by the outside world (people) after the oil spill occurs. Most of the time, multi-level oil booms are used to intercept oil spills, and the spreading behavior of oil spills will change when they flow through each level of oil booms; emergency personnel will also lay some substances on the water surface to change or guide the flow direction of oil spills. Or use adsorbent materials to absorb oil slicks, etc. [9].

Emergency factors also include the availability of oil spill contingency plans and the adequacy of emergency supplies. After an oil spill occurs, the corresponding emergency plan should be activated in accordance with the pre-set emergency response procedures as soon as possible[10]. Generally speaking, the quicker the emergency response, the more scientific the emergency decision-making, the greater the emergency response capability[11], and the smaller the consequences of the oil spill accident. In view of the difficulties in the transportation of oil spilled materials from the pipeline and the oil spill disposal site, fortifications should be pre-built in suitable locations according to the severity of the accident, natural conditions, and the allocation of emergency materials, and materials should be reserved so that the oil blocking facilities can be quickly deployed. lay out.

## 3. Conclusion

In this paper, relying on the migration and spreading laws of oil spills from cross-pipeline engineering in torrent rivers, the influencing factors of the spreading behavior of oil spills in rivers are expounded, and the following conclusions are obtained:

(1) The lower the viscosity of the crude oil medium, the better the fluidity of the liquid. As the oil weathers, the evaporation of lighter components causes the viscosity to increase. Thicker oils disperse more easily, form emulsions more easily, and settle more easily. The lower the oil-water interfacial tension, the greater the spreading degree and the thinner the oil film thickness.

(2) External environmental factors include microorganisms in water quality that may react with oil spills; the greater the water flow speed, the faster the vertical drift speed of oil spills; the curved shape of the river channel will change the horizontal distribution of oil spills on the river surface; The drop increases vertical mixing of the oil and encourages the formation of more emulsion.

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(3) The quicker the emergency response is obtained, the more scientific the emergency decision-making, the greater the emergency response capability, and the smaller the consequences of the oil spill accident.

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