

## Brief introduction of geological disaster risk management and control measures for oil pipelines

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### Abstract

Oil pipelines span a vast area, with complex and diverse topography, and are easily threatened by geological disasters. Frequent geological disasters lead to frequent occurrence of pipeline accidents, and the production activities of pipeline enterprises are seriously affected. The focus of safety protection for pipeline companies. After investigation and analysis, the main geological disasters that cause oil pipeline accidents include water damage, landslides, debris flows, earthquakes, subsidence, etc. According to different types of geological disasters, corresponding prevention and control measures for oil pipeline geological disasters are proposed to effectively ensure the safe operation of oil pipelines. Provide a solid theoretical foundation.

### Keywords

Oil pipeline; geological disaster; risk management.

### 1. Introduction

Chinese pipelines span a long area and the environment is complex. Most of the oil pipelines are located in geological disaster areas. The pipelines are extremely vulnerable to different geological disasters, such as water damage, collapse, land subsidence, debris flow, landslide geological disasters, earthquake disasters, and ground fissures. and permafrost hazards. These geological disasters lead to frequent occurrence of pipeline accidents. In mild cases, the production activities of enterprises are affected, and in serious cases, the safety of people's lives and properties is affected. Therefore, enterprises need to pay attention to the geological hazards of pipelines and use reasonable methods to prevent and control them safely.

### 2. Risk management and control measures for oil pipeline water damage disasters

Pipeline water damage can be mainly divided into slope water damage and river channel water damage according to the different topography and water damage parts. According to different types of disasters, corresponding hydraulic protection schemes are selected to improve the protection effect and ensure the safe operation of oil pipelines.

#### 2.1. Water damage on mountain slopes

The characteristics of slope water damage are large volume and long treatment period. The prevention and control of slope water damage is to prevent the slope surface from being damaged by water damage, which will result in the thinning of the covering soil of the pipeline,

and then induce the occurrence of exposed pipes and suspended pipes. The main measures taken are the construction of mortar masonry retaining wall, Panax notoginseng lime soil interception wall, straw bag fort, etc. [1]

## 2.2. Water damage to river channels

The characteristics of water damage in river channels are large in number and difficult to control. Different control measures can be taken according to different types of water damage in river channels [2].

(1) The following measures can be taken for scour river channel water damage:

- ① Ditch hardening work to avoid excessive water scouring the riverbed;
- ② The direction of the water flow is changed by building a diversion dam to reduce the erosion effect of the water flow on a certain river bank;
- ③ Using the box culvert to protect the pipeline to reduce the impact of the water flow on the riverbed.

(2) For the erosion and collapse of the embankment, masonry or concrete can be used to reinforce the embankment to improve the erosion resistance of the embankment [3].

## 3. Risk management and control measures of oil pipeline land subsidence

There are two kinds of hazards of collapse to the pipeline: one is that the collapsed body hits the pipeline, causing a sudden increase in the force above the pipeline, which causes the pipeline to deform or break; the other is that the collapsed body peels off the parent body, leaving the buried pipeline exposed or suspended. phenomenon, resulting in an increased risk of exposure. The characteristics of the collapse are:

- ① The occurrence rate is extremely fast, which makes it impossible for pipeline enterprises to prevent them in the first time;
- ② The consequences of the accident are serious, and the collapse is often in bad weather, which can easily lead to chain accidents, such as drifting pipes, long-distance pollution of crude oil, etc.;
- ③ Collapse accidents are highly random, and the laws of geological activities are complex, often specific randomness and contingency, which make it difficult for pipeline enterprises to grasp the laws of accidents and achieve early prevention and early treatment.

The following measures can be taken to deal with collapse disasters:

- (1) The slope is cut in a stepped manner to reduce the height of the slope, set up retaining walls and other works in front of the slope, and green the slope [4].
- (2) Set up supporting facilities around the pipeline, and set up cover plates on the surface of the pipeline to avoid damage to the pipeline caused by the loading of falling rocks.

## 4. Risk control measures for landslides and debris flows in oil pipelines

Rainfall-induced landslides and debris flows are serious and widespread disasters, which can easily lead to safety accidents in pipelines [5].

According to different geographical conditions and landform characteristics, the corresponding prevention and control measures are selected in a targeted manner.

- (1) For valley-type debris flows, measures such as refurbishment and reinforcement of river channels can be taken to effectively guide the flow direction of debris flows and prevent oil pipelines and ancillary facilities from being damaged by debris flows.
- (2) For hillside debris flow, interception measures can be taken to reduce debris flow collections to reduce the further development of debris flow. It is also possible to reduce the

destructive force of the debris flow by building a rock blocking dam to weaken the impact force of the debris flow.

(3) For active gullies and debris flow formation areas in clastic rock areas or areas with thick soil layers, plant trees and grass, restore vegetation, prevent soil erosion, and reduce the source of debris flow caused by soil erosion [6].

As a relatively common and common type of geological disasters, landslides mostly occur in mountainous and hilly areas, and occur more frequently than other types of geological disasters. In the process of landslide disaster prevention and control, different measures are selected according to different geographical environment conditions.

(1) Under some special terrain, there is the possibility of small landslides caused by the excavation and laying of pipelines. Due to the relatively small scale and potential energy of such landslides, measures are usually taken to build masonry retaining walls;

(2) For landslides with greater harm, due to the large scale and potential energy of the landslides, anti-slide piles are usually used for support.

## **5. Risk management and control measures for earthquake disasters in oil pipelines**

my country is located between the Pacific Rim seismic belt and the Eurasian seismic belt. In addition, there are many small seismic belts derived from it. As a result, earthquake disasters are one of the greatest threats to pipeline safety. Earthquakes are generally large in scale, and the disasters are more concealed. It is necessary to strengthen investigation, research and inspection [7]. In the face of earthquake disasters, first of all, the corresponding seismic standards and fortification measures should be formulated according to the actual situation of the local earthquake. At the same time, based on modern equipment and technology, we must do a good job of timely forecasting and early warning, improve the construction of emergency response systems, and be able to respond in a timely manner when an earthquake strikes, and carry out rescue and disaster relief activities accurately, efficiently and safely [7].

## **6. Risk management and control measures for oil pipeline cracking disasters**

The dominant factors for the formation of ground fissures are natural landform activities and human mining activities. The triggering factors for the formation of ground fissures include atmospheric precipitation, seismic activity and groundwater exploitation.

Preventive measures for ground fissures:

- ① According to the principle of avoidance, determine a reasonable avoidance distance;
- ② It is strictly forbidden to pump a large amount of groundwater in the ground fissure damage zone and nearby affected areas;
- ③ Strengthen the monitoring work [8], and increase the inspection frequency of the plumbers in the ground fissure damage zone and nearby affected areas.

## **7. Risk management and control measures for permafrost disasters in oil pipelines**

For frozen soil pipelines, the most common safety issue is freeze-thaw hazards. When laying long-distance pipelines in permafrost regions, frost heave and thaw settlement must be considered to prevent excessive stress or strain in the pipeline and ensure the safe operation of the pipeline [9].

The following protective measures can be taken according to the frost heave and thaw under different geographical features:

- (1) The contact between the oil pipeline and the frozen soil can be effectively avoided by setting the thermal insulation layer, and this measure can effectively reduce the influence of the oil pipeline on the temperature field of the surrounding frozen soil [10].
- (2) The frozen soil pipeline can also be cooled by heat pipes to adjust the temperature of the frozen soil around the pipeline.
- (3) For the frozen soil developed in saturated ice or swamp, the method of increasing the wall thickness can be used to increase the deformation resistance of the pipeline [11].

## 8. Conclusion

The oil pipeline spans a wide range, the pipeline passes through complex terrain, and there are many types of disasters, which add a lot of difficulties to the safety protection of my country's pipelines [12]. Therefore, it is necessary to take practical and effective protection and remediation measures according to different geographical locations and different types of disasters, so as to ensure the safe operation of my country's oil pipelines as much as possible. and the safety of the natural environment [13]. With the establishment of the National Pipeline Network Company, pipeline safety work will enter a new process. At that time, it will be more convenient and efficient to allocate resources to deal with various disasters.

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