**Engineering and Technology Journal e-ISSN: 2456-3358**
**Volume 05 Issue 07 July-2020, Page No.-720-725**
**DOI:10.47191/etj/v5i7.03, I.F. – 6.127**


# Study on Geological Environmental Impact Assessment and Control Measures for Pingdingshan Tianan Six Coal Mine

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**Abstract**: The geological environment problems in Pingdingshan Tianan six coal mine, such as cave-in and fissure, have a serious impact on the local ecological environment. Through the detailed investigation of this mine, combining with the main mine geological environment problems existing in this mine, the effective protection and control measures are put forward.By carrying out restoration and treatment projects such as subsidence area backfilling, ground crack filling and land reclamation, good results have been achieved, and the local ecological environment has been restored to the maximum extent.It can provide reference for the control of the same type of mine geological environment problems.

**Key words**: Pingdingshan Tianan six coal mine; Geological environmnet; Evaluation; Prevention and control measures.

## 1. Introductions

With the development of my country's society, the number of mining geological engineering projects continues to increase. Coal mining has a greater impact on the geological environment of the mine, which seriously threatens the lives and property safety of the residents in the mining area[1].Located in the central and western part of Pingdingshan mining area and in the northwest suburb of Pingdingshan city, The six Mine is one of the large backbone mines of Pingdingshan Tianan Coal Industry. The six mine has made important contributions to the economic development of Pingdingshan city in the long-term mining activities. Meanwhile, the associated geological environment problems in the mining process are prominent problems in the construction of ecological civilization functional area, so it is extremely urgent to solve the geological environment problems[2-3].

## 2. Analysis of Mine Geological Environment Problems

The six Mine is regularly mined every year, and mining activities have caused a series of geological and environmental problems. According to the analysis and prediction of the current status of mine geological disasters, the main problems of mine geological disasters are ground subsidence, ground fissures caused by mining activities, and water and soil resources pollution caused by mining activities and man-made daily life.

### 2.1 Ground collapse

Surface collapse and hidden dangers mainly exist above and around the goaf formed by underground mining, mainly in underground mining coal mines, and most of them are potential dangers that have not yet occurred. In case of earthquake and other strong geological effects, great harm may be caused[4].The six coal mine belongs to well mining. The top and bottom floor rocks of the coal seam are mainly sandy mudstone and mudstone. Due to continuous mining all the year round, the scope of goaf is constantly expanding. When the roof weight exceeds the tensile strength of the roof and the compressive strength of the coal pillar, the rock and soil layer of the roof will have displacement, fracture, caving and subsidence, causing surface collapse[5-7].

The ground collapse caused by mining in six mine has a certain time sequence[8].The period of Construction is given priority to with pressure accounted for and the local damage, during the mining goaf collapse on the land

damage would occur with the mining working face advancing gradually, over time is a dynamic process, has a certain influence on the space range, to predict the formation of subsidence time generally consistent with the working face in time as shown in Figure 1.The time sequence of land destruction is closely related to the mining of coal seams[9]

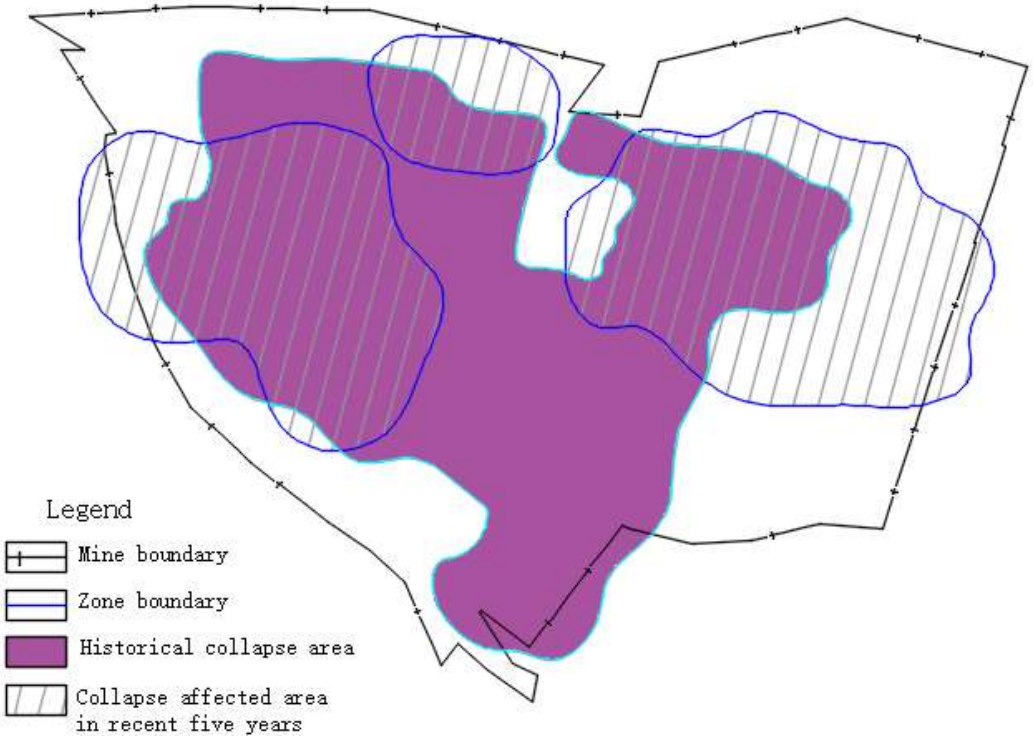


**Fig. 1** Present collapse distribution diagram of six mines1

**2.2 ground fissures**

Fractures in the interior of the mine area are the derivation and associated phenomena of surface collapse. Most of them appeared in groups, and most of them were parallel. The steps pointed to the same direction as the slope, and they were concentrated at the edge of the subsidence area. Most of the ground fractures are arc-shaped or broken lines developed in the mountaintops and slopes, and they are parallel or oblique to the slope strike, with lengths ranging from 100m ~ 150m. The width is generally 0.3m, and the widest can reach 1.1m. The visible depth is 0.4 ~ 3.5m.Nine ground fracture groups were investigated in the No.6 mine area, as shown in Fig. 2.

**2.3 Pollution of water and soil resources**

The main sources of water pollution are mine inrush, domestic sewage and coal gangue. Relatively serious soil and water pollution is the underground mine gushing water and coal gangue in the rainwater of the pollution, domestic sewage north one industrial site workers water consumption is small, the production of domestic sewage is small. With a long mining life and a large annual exploitation amount, solid wastes from mining will pollute the soil to varying degrees, resulting in the destruction of soil and water bodies, the reduction of agricultural and forestry crop yields and the damage to the health of the population.

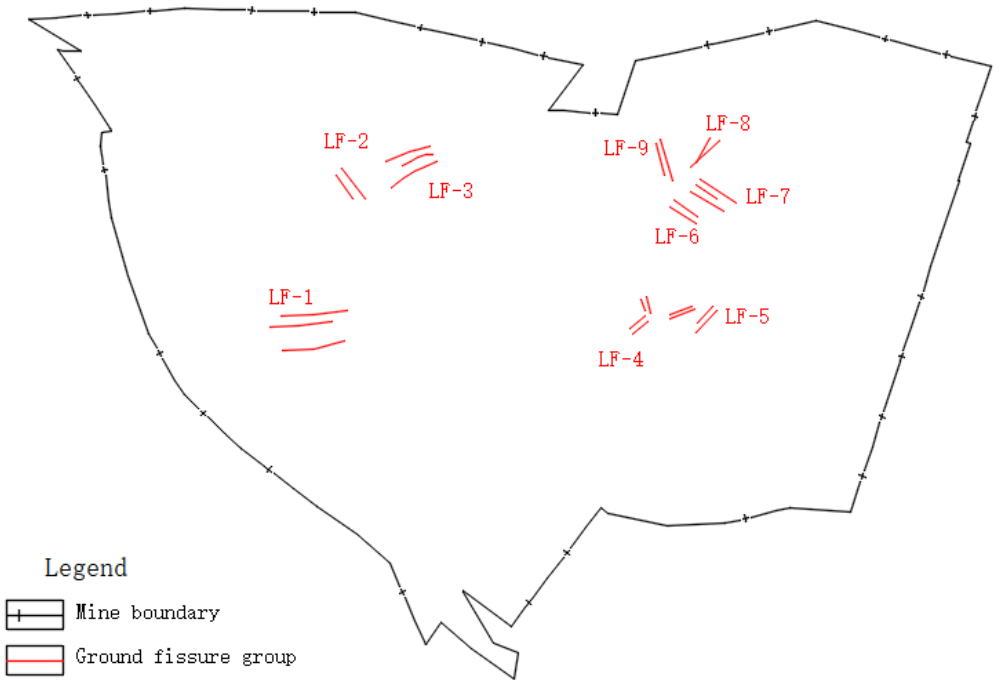


**Fig. 2** Distribution diagram of existing fracture group in No.6 mine

## 3. Prevention and Control Measures

### 3.1 Ground collapse prevention and control

For the surface collapse and leveling of the mining area, the pumping method with fast speed and high efficiency is adopted, and the specific technology is as follows: when the collapse and damaged area is leveled, the 30cm thick ripe soil is first turned on one side, and then the excess raw soil is dug out from the trench and transported to the filling site according to the construction design. At the filling site, the 30cm thick cooked soil should be turned to one side first. After the filling reaches a certain height, the cooked soil should be found and spread on the raw soil. After the filling of gangue, backfilling of raw soil or land leveling is completed, the original stripped topsoil is covered on top of the raw soil with a thickness of 30cm, which is compacted and leveled (artificially refined after mechanical leveling) to reach the design elevation. All layers are leveled at an average slope of 2 ~ 3° (in the reverse direction).The mining area added 42 monitoring points of land subsidence influence and 1 monitoring point of landform landscape.

#### 3.1.1 Governance of plain areas

The construction technology of field surface leveling (deep turning) in the mildly damaged subsidence area in the plain area: construction preparation → construction pavement layout → deep turning, bulldozing, leveling and sprinkling → survey and inspection → acceptance of work. For the cultivated land with collapse depth greater than 1.5m, coal gangue was used for filling. In the construction, it is necessary to adopt the soil reconstruction method of "layered stripping and staggered backfilling", so that the thickness of soil layer after reclamation will increase and be better than the original land. The topsoil is taken out by mechanical excavation, and then the gangue is filled. According to the designed elevation and slope, backfill leveling is carried out to keep the surface slope of each block within the prescribed standards. After that, small fields are leveled out into large ones to expand the field area and improve the mechanical tillage conditions. At the same time, through roads, afforestation, irrigation and water conservancy projects, improve the conditions of farmland infrastructure, improve the comprehensive land production capacity and land utilization.

#### 3.1.2 Hilly area governance

For mild and moderate subsidence areas of hilly workers, cultivation can be done by leveling the field (ploughing) or not leveling; For severe subsidence areas in hilly areas, terrains can be trimmed along the topographic contour line, and slightly inwards to retain water and conserve moisture. In land use, they can be arranged into alternate agroforestry (fruit). Contour tillage can be adopted for soil and water conservation.

As shown in Fig. 3, the triangulation network method is adopted to calculate the amount of work. This method is suitable for the characteristics of uniform change of ground slope in the mining area and the boundary between excavation and filling can be found.

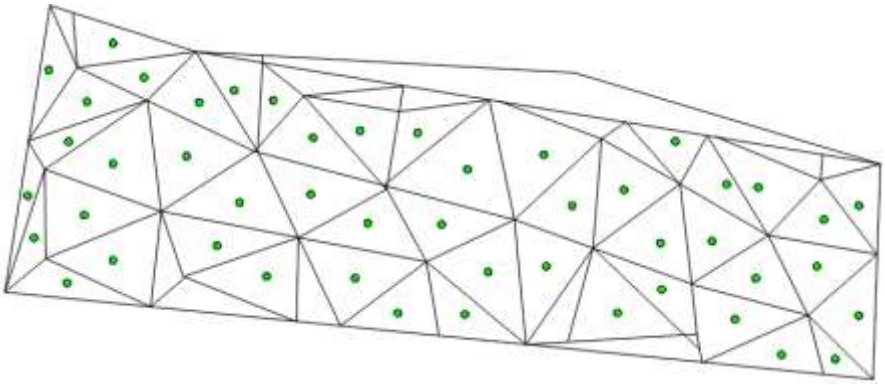

**Fig. 3** Calculation chart of earth volume for land leveling

For the severely damaged cultivated land, it is proposed to change the slope cultivated land formed by collapse into gentle slope terrace through site leveling project, and at the same time to rebuild irrigation facilities. On sloping farmland below 25°C, terraced fields are designed to provide abundant labor force and deep soil in the reclamation area. Therefore, horizontal terraced fields are built. See Fig. 4 for the relations among the elements of the horizontal terrace section and see the following formula for the calculation expressions.

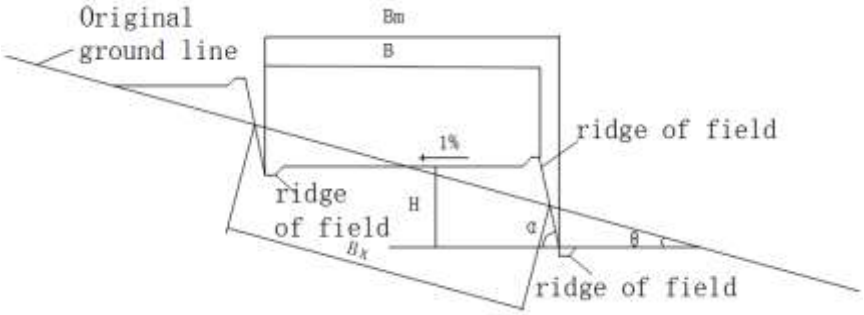


**Fig. 4** Schematic diagram of terrace cross-section design

$$\begin{cases} H = B_x \sin\theta \\ B_x = H\cos\theta \\ b = Hctg\alpha \\ B_\alpha = Hctg\theta \\ B = Bm - b = H(ctg\theta - ctg\alpha) \end{cases}$$

In the formula:H is the height of tian Kan, m;$B_m$-- Field wool width, m;$B_x$--Original slope width, m;θ--The original ground slope;b--Width of tian Kan, m;α-- Gradient of terraces;B--Clear width of field, m.

### 3.2 Ground fracture treatment

During treatment, the topsoil was first stripped along the surface cracks with a width of 0.5m around the cracks, and the stripped soil was stacked nearby on both sides of the cracks with a thickness of 0.4m.Then according to the principle of filter filling wall cracks, holes, first with coarse slag or gravel filling pore, secondly with coarse gravel, filled with sand, and finally the wall, push trolley or trolley from dumping, crack when filling height from the peel of

the surface 1 m or so, start with a wooden packed for the first time, and then once every pack 0.4 m tamping, until after stripping of basic level surface.

According to the different types of strength of the cracks in the period of filling earth is different, each mu of subsidence ground fill crack earth quantity can be calculated according to the following empirical formula:

$$V = \frac{1}{2} aU \frac{666.7}{c} \mathrm{n150}\sqrt{\mathrm{a}}(m^3/\mathrm{hm}^2)$$

Note: The width of collapse crack is A (m);The spacing of collapse cracks is C; Length U of collapse crack; The number of cracks per Hectare is n.

Data such as crack width, crack spacing and number of cracks corresponding to different damage degrees can be referred to Table 2. By substituting the above formula, the earthwork required for filling collapsed cracks per mu with different damage degrees can be calculated.

**Table 1.** Calculation of soil volume (V) for filling cracks in each Hectar of subsidence area

| The degree of damage | Crack width A (m) | Fracture spacing C (m) | Cracks in the article number N (a) | The length of the crack U (m) | Topsoil stripping amount ($m^3$) | Fill the cracks per Hectar of earth volume V ($m^3$) |
|---|---|---|---|---|---|---|
| mild | 0.10 | 50 | 12.50 | 20 | 120 | 48 |
| moderate | 0.20 | 40 | 30 | 33.30 | 199.8 | 225 |

### 3.3 Prevention and control of soil and water resource pollution

The average normal inflow of mine water is 142m/h. The mine water discharged from underground enters the mine water treatment station through the drainage pipe. The treatment station has a designed processing capacity of 10000t/d.[3]The comprehensive utilization of mine drainage should be optimized step by step so that mine drainage has less pollution to soil and water.

Two kinds of measures were taken for the treatment of gangue: on the one hand, the comprehensive utilization agreement of gangue was signed with the gangue treatment company; On the other hand, the coal gangue which has not been recovered can be covered with soil to reduce the production of leachate.

After classified collection of domestic sewage, the workers' bathing waste water is precipitated in the sedimentation tank and used for sprinkling water and dust suppression in the gangue dump yard. The toilet sewage is treated with matching septic tank and used for fertilization in the surrounding farmland with comprehensive utilization and no discharge.

Eight monitoring points for water inflow, 160 monitoring groundwater level, 10 monitoring groundwater quality and 10 monitoring soil pollution have been set up.

## 4. Conclusions and Recommendations

### 4.1 Conclusions

Coal mining activities break the original equilibrium state of coal-bearing strata and cause irreversible geological environment problems. In line with the concept of sustainable development, the geological environment of the mine should be reasonably controlled and protected from the perspective of long-term development. In the mining of mine resources, the advanced mining technology is constantly improved, so as to better reduce the impact on the mine geological environment and better protect the ecological environment. In practice, afforestation and agro-ecological parks have been adopted to effectively harness and restore the geological environment of mines, reduce the losses caused by soil erosion, and further reduce the pollution of goaf caused by three industrial wastes. After effective treatment, the mine drainage utilization rate of No.6 mine reaches 75%.The comprehensive utilization rate of gangue is 80%, the treatment rate is 100%, and the treatment rate of ground cracks in the reclamation area is 95%.

### 4.2 Recommendations

Make full use of the concept of recycling and disaster reduction, develop recycling economy and implement green mining technology. By using the things that are currently

considered useless for disaster management and waste for disaster management, we can minimize resource exploitation, minimize environmental impact, fully utilize resources and minimize the occurrence of disasters. Referring to the principle of "mining one piece and restoring green one piece", the mining in blocks shall be carried out, and land reclamation shall be given priority, so as to meet the requirements of green mine construction.

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