CONTROL OF THE LIMESTONE WATER NUISANCE FOR KUZHULIN COAL MINE

Yang Chunlai

China Coal Research Institute
District 13, Hepingli,
Beijing, China

ABSTRACT

There was a sudden flooding at the drain sump, suction well, slope and roadway during the construction in Kuzhulin Coal Mine of Liuzhi Coal Mining Bureau in Guizhou Province. The amount of mine inflow was up to 800m³/h. The flooding occurred on limestone ground of Carboniferous system.

In order to control the water flooding, grouting was carried out at the spots of water inflow. 800 tons of cement, 200 tons of waterglass and 150 tons of ashes were used.

After grouting, the actual water inflow was 10.98m³/h. During the rainy season in 1995, no unusual water outflow phenomenon occurred in the mine. The coefficient of grouting reached 98%.

INTRODUCTION

Kuzhulin Coal Mine belongs to Liuzgi Coal Mining Bureau and located in Guizhou Province. It has two inclined shafts and the dip of the main and the auxiliary is 28° and 25° respectively.

In the course of construction, there were many water outflow spots in the two incline shafts. In the rainy season, the water inflow increased and often turned turbid. With further development in the mine, more water outflow spots occurred. Finally, three main water outflow spots go in the way of further operations. One was on the roadway to the shaft station, where water inflowed at about 100m³/h; another at the inner water sump, inflowed at about 250³/h; and the third at the bottom of No. 1 suction well at about 200m³/h. The mentioned water issues had a steady flow rate and were only slightly affected by the seasons. In normal conditions, the total amount of water inflow ranged from 600 to 700m³/h, but in the rainy season, it is more that 800m³/h.

Because of the large amounts of mine inflow, 8 pumps were installed in the mine and had to run all day in the pump house, otherwise the shaft would risk flooding. In the course of construction, there were two incidents of shaft flooding due to the heavy rain and occasional shortage of power. It took a long time to drain away water from the shaft and seriously delayed the construction schedule,

Kuzhulin Coal Mine made an electrical survey of the shaft to locate the recharge source of the mine water but it failed because the geological and hydrological conditions were too complex.

In order to ensure that the coal mine could produce on schedule, stopping water inrush and avoiding shaft flooding became a main priority.

WATER CONTROL METHOD

Grouting outside the centralized water outflow spot

According to the feature of water outflow in the beginning the task was carried out on those spots where water outflow had occurred. At these locations, we drilled several boreholes 3 metres deep. Whenever we met a cavern at the location we had to grout using large amounts of coal ash. The weight ratio of ash to cement is 1:1, and the ratio of water to cement is the same. It took about 2 months to grout outside the centralized water outflow spots. After grouting at these locations, the water outflows were stopped, even when the underground water table rose sharply.

Grouting at the centralized water outflow spots

Following outside grouting of the aforesaid spots, the control work focused on two centralized water spots.

Construction of concrete plug

(1) Construction of concrete plug of No. 1 suction well

The No. 1 suction well was of 1.5m in diameter and 5.5m deep in which a big fracture about 200mm wide existed. Meanwhile the suction valve of the water pump was 200mm higher than the well bottom. All these made it difficult to construct a concrete plug to ensure the quality of the concrete plug and the normal pumping.

What measures should we take? Firstly, we installed 3 guiding water pipes of 108mm in diameter to drain water from the sump to No. 1 suction well, and built up two concrete walls on the roadway from the sump to the well (see Fig.1).

After finishing the concrete wall, a concrete plug for the No. 1 suction well should be made. First, in order to make the filter layer we constructed with No.8 steel wire 15 cages whose diameter was 250mm and height 400mm, Then put them down to the suction well near the suction valve. All the cages were full of broken bricks. Immediately after that, more crushed bricks were thrown upon the cages until it appeared above the water table. Second, we set a layer of whole bricks covering the crushed brick level, then a layer of asphalt on top of the whole bricks. Finally, the concrete was poured on the asphalt. The height of the concrete layer was 1.5m (see Fig.2). The pump was operating non-stop during the course of constructing the concrete plug and its curing.

After 10 days curing, the pump and the valve of the suction pipeline were closed to stop drainage. Then the water in the No.1 suction well was drained back to the sump through 3 guiding water pipelines. When the valve of 3 guiding pipelines were closed to check the

water flow and the pressure gauge installed in the suction pipe in No. 1 suction well showed that the pressure reached 0.6Mpa, the construction of the concrete plug was proved successful. The water outflow was stopped under the concrete plug.

(2) Construction of concrete plug in the water sump

There was a cave at the bottom of the inner water sump, from which water outflowed at about 250m³/h, and the diameter of the cave was approximately 800mm. First, 2 guiding pipelines (dia. 150mm and 50mm) were fixed at the location where water outflowed. Second, two concrete walls of 1.0m wide were separately made on two sides of the water outflow spots. Each side of every concrete wall, we also built brick walls to strengthen it. Then we filled broken bricks as a filter layer between the two concrete walls and poured concrete on to the filter. The total height of the filter and concrete was 1.5m.

After 10 days curing of the concrete plug, the valve of the guiding pipeline was closed, and no water leaked or penetrated through the concrete plug. 205m³/h water inflow at this centralized spots was compressed under the concrete plug.

Closing Valve Test

After constructing the two concrete plugs and curing for more than 10 days, we turned off the values of the above plugs at the same time. Following that, we investigated the water inflow at other outflow locations in the shaft and found a water inrush which was up to 40m³/h at the intersection of the main inclined shaft at the first closed valve. It the valve of the concrete plug was opened, the water inrush would disappear. Then grouting was carried out with long and short boreholes at the water inrush spot and nearby. After the curing of the cement grout, we tested the closed valve again and found two more spots from which water flowed up to 20m³/h and 10m³/h separately at the intersection between the auxiliary shaft and the pipe compartment, so we had to open the valve of the concrete plug and grouted once more. This time, we did not stop grouting until the water inrush was prevented.

Grouting Method

Based in careful analysis of water flow direction, we employed the method of relieving grouting. First, the valve of two concrete plugs were closed and the pumps stopped working, 30 minutes later, the valve of the concrete plug in the inner sump was opened, the grouting was carried out by means of guiding water pipelines of No.1 suction well. TBW-250/50 grout pump was used and the ratio of water to cement was 1:1. The water lass (33-35Be') was injected under pressure by 2TGZ-60/120 grout pump. Two types of grout were combined at the borehole mouth. The grouting lasted 6 hours. When the cement grout flowed out of the valve of inner sump and the pressure at No.1 suction well climbed to 1Mpa, we stopped grouting. Re-grouting was carried out through the guiding pipe of the inner sump.

The total amount of materials consumed for all grouting work was cement 510 tons, water glass 45 tons and coal ash 47 tons.

CONCLUSION

The residual amount of water inflow was 10.98m³/h after 4 months construction. The grouting coefficient was up to 98%. After grouting, there was only one pump left and at no point was it operating continuously. Even in the conditions of heavy rain and non-power supply, the residual water inflow did not cause any trouble. The coal mine survived the water flooding and coal production continues unabated.

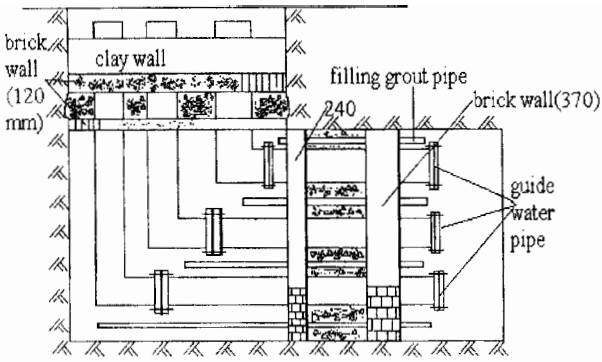

Fig 1.The diagram of construction of guide water pipe and concrete wall for No.1 suction well

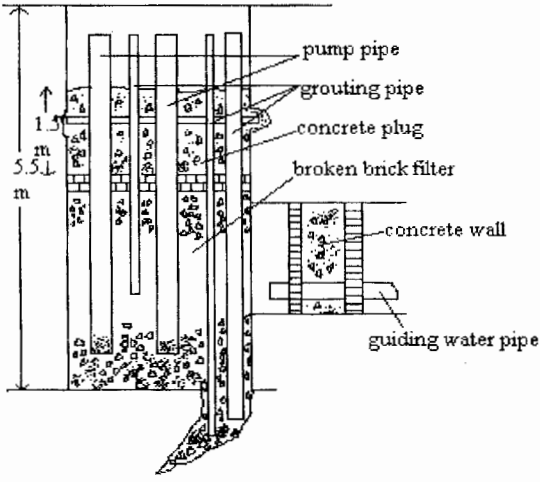

Fig 2.The diagram of construction of concrete plug of No.1 suction well