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NUMERICAL SIMULATION AT THE BOTTOM OF DRILLING HOLES ABOUT HYDRAULIC MINING

Summary. In order to reveal the impact of flow-related parameters it shoud be computed the flow field velocity and pressure. It can get the influence of the variation of parameter of the hydraulic mining system from diameter nozzle, jet velocity, and pulp imports. The nozzle is changed by impact migration flow at the end of the hydraulic mining flow field of ore grain in the ore particles hole. It is used of calculating fluid of the bottom hole.

MODEL NUMERYCZNY DNA OTWORU W HYDRAULICZNEJ METODZIE URABIANIA

Streszczenie. W celu określenia wpływu parametrów związanych z przepływem istotne są obliczenia, pozwalające na uzyskanie modelu pola prędkości i ciśnień. Zbadano wpływ zróżnicowania parametrów systemu średnica dyszy, prędkość strugi, przypływ urobku. Stwierdzono, iż dysza jest poddana działaniu cząstek zawieszonych w dopływającym urobku. W rozpatrywanym przypadku, pomimo wysokich prędkości strugi, nie uzyskano oczekiwanych parametrów urabiania.

1. Introduction

At present all countries were faced with shallow underground Rich Ore increasingly depleted generally, the exploitation of deep and shallow depleted mineral ore will inevitably cause low productivity, high cost of mining, security and environmental protection, and other issues in the world. It often occur accidents due to explosions, flooding, landslides and others. Therefore, the research and development of high technology is urgently needed to alleviate contradictions of higher cost, lower efficiency and consumption. Bored hydraulic mining technology is such one of prospect exploitation technologies [1–4]. Carrying out research is in line with China's scientific and technological innovation demands long-term development strategy, in line with the state 863 plan "11th Five-Year" development planning, resource and environmental technology areas of new mining technology research requirements.

Bored hydraulic mining technology in the hydraulic system is the basic component of the system, including hydraulic cutting, hydraulic mining, mining field hole at the end of the ore particles hydraulic transmission, hydraulic lift lifting of the surface transportation and five sub-systems. Domestic and foreign-related industries such as petroleum, mining and other relevant units of the hydraulic broken rock, rock samples vertical lift, and so more research, Few studies the impact the hydraulic mining ore transportation and the flow. In fact bottom of the hydraulic mining field follow-up of vertical transmission of a conveyor system should not be underestimated the impact. Because it was to consider how fast the water of the ore would be transported to the vertical pipe, and then lift, the former were the source, in order to consider lifting effectively, only in the former in-depth study the system can more effectively enhance the efficiency of drilling hydraulic mining.

2. Research and Practice

2.1. Geometric modeling and meshing

Figure 1 shows the commercial use of fluid dynamics software to hydraulic mining drilling holes flow field at the end of the geometric modeling and mesh. In this paper, Cartesian coordinates the flow of axial symmetry of the equation form: (1) Continuous equation (2) Momentum equation (3) energy equation (4) the standardization of k-ε model.

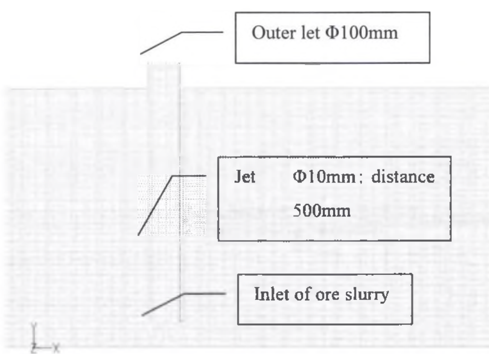


Fig. 1. Drilling holes at the end of hydraulic mining flow geometry model and mesh
Rys. 1. Model geometrii wraz z siatką dyskretyzacyjną dla analizowanego problemu

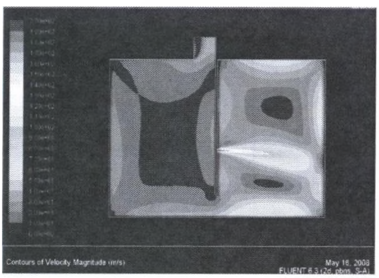
In this paper, oil shale in Jilin occurrence conditions, identified in the mining depth of about 700 m below the surface. Bored with the existing hydraulic mining technology proposed for the exploitation of oil shale in Jilin Province mode, that was, using high pressure water jet spray mining. In this process, taking into account the oil shale in Jilin physical and mechanical properties, the calculation method is used fluid dynamics simulation software to its analysis. At the end of the plane the hydraulic mining drilling holes to simulate the regional flow in the case of foreign-related projects carried out after analysis of data collected

2.2. Simulation and programme

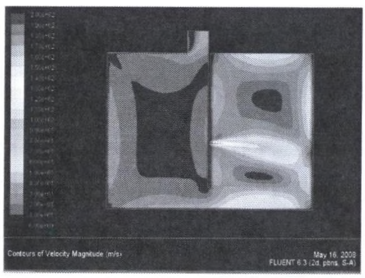
1. At different nozzle velocity, analysis of the impact of the jet and its lower part of the flow of liquid flow rate and pressure;

2. Unchanged the velocity and adjustment the conditions of the nozzle diameter, changes in diameter nozzle flow field velocity and pressure;

3. Adjustment and pulp imports from the nozzle changes its size between two convection velocity and pressure.



(a)



(b)

Fig. 2. Cloud figure of velocity; nozzles at: (a) 10 mm, (b) 8mm
Rys. 2. Mapa rozkładu prędkości; dysze: (a) 10 mm, (b) 8mm

Flow map shows the pressure nozzle pressure which below a first-class region, the need for greater pressure gradient of the movement of ore particles, is not satisfactory.

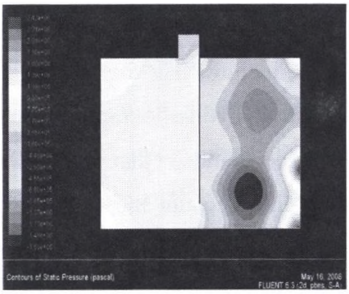
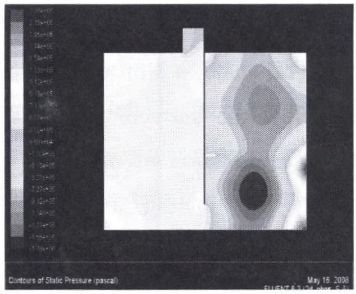
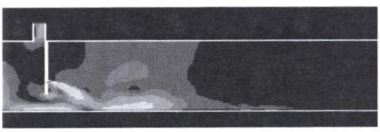
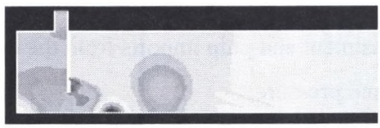

(a)

(b)

Fig. 3. Cloud figure of pressure; nozzles at: (a) 10 mm, (b) 8 mm
Rys. 3. Mapa rozkładu ciśnień; dysze (a) 10 mm, (b) 8 mm

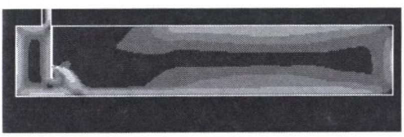
2.3. The results

Changes in diameter nozzle flow field velocity and pressure. At different conditions nozzle velocity the flow rate of flow and pressure changes.

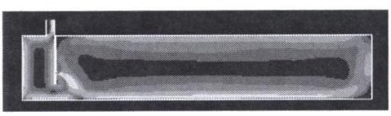
Selection of the nozzle exit velocity were 170 m/s, 200 m/s, 300 m/s, 40 0m/s to study flow velocity and pressure changes.

(a) (b)




(c) (d)




(e) (f)

Fig. 4. Numerical fluent simulation map about velocity: (a) cloud map at the velocity of 170 m/s, (b) pressure cloud at the velocity of 170 m/s, (c) cloud map at the velocity of 200 m/s, (d) pressure cloud at the velocity of 200 m/s, (e) cloud map at the velocity of 300 m/s, (f) pressure cloud at the velocity of 300 m/s.

Rys. 4. Mapy dynamiki przepływów na podstawie wykonanej symulacji: (a) mapa przepływów dla prędkości 170 m/s, (b) mapa ciśnień dla prędkości 170 m/s, (c) mapa przepływów dla prędkości 200 m/s, (d) mapa ciśnień dla prędkości 200 m/s, (e) mapa przepływów dla prędkości 300 m/s, (f) mapa ciśnień dla prędkości 300 m/s

Jet velocity increases, its exports had marked change velocity. When the import velocity of 170 m/s , maximum flow rate of exports was 3.1 m/s; entrance when the velocity was 200 m/s, the export rate was up to 3.41 m/s; When the entrance rate of 300 m/s, the export rate of up to 4.5 m/s. At the same time pressure also was changed, the nozzle from the pressure of 0.188 MPa to 1.09 MPa.

Great distinction was discovered by three jet velocity into the slurry around the mouth. When the jet velocity is low, the lower part of the flow is less than the impact of jet at high velocity. However, these hydraulic parameters were set up to ensure the effective delivery of the ore particles to the surface. From all over the map can be integrated back to see the maximum velocity could reach 4.5 m/s, the velocity would be enough transported to the surface, it could achieve good results mineral recovery. Export setting to 100 mm could be ensure sufficient space for the output of large-diameter rock particles. Cloud can be seen by the velocity of the jet nozzle of a broader, more regional impact of the mining results would be better, and the nozzle could be achieved Ring Jet.

3. Conclusion

(1) In this simulation, the adjustment of the nozzle diameter convection market impact was not very clear, so the actual diameter nozzle should also consider other factors identified.

(2) Spray velocity was a little impact on the flow field to transport ore particles.

(3) Nozzle and pulp imports should have a certain distance from each other to avoid the impact;

(4) From the simulation results of it was known that jet velocity was high but access to the mining region was still small. Therefore improve the flow jet velocity to improve mining region was undesirable.

BIBLIOGRAPHY

1. Chen C., Zhang Z. P., Wang M.: Jilin oil shale exploitation of the new model [J]. China Mining (5), 2007, p. 55-58.
2. Chen C., Zhang Z P, Huang X J.: Study on the methods of oil shale mining in Jilin Province [C]. Fourth sector Russian Far East and the Asia-Pacific region geological resources development issues collection. Changchun: Jilin University , 2006, p. 10-13.

3. Dimitrijevic B., Pinka J., Mitrovic V.: Selection of technological parameters in borehole mining production by technical deep drilling and hydroexploitation, Acta Montanistica Slovaca [J]. (9), 2004, p. 160-167.
4. Chen C., Zhang Z P.: Bored hydraulic mining technology [J]. China Mining (6), 1998, p. 40-43.
5. Chen C., Lu Club.: Reverse circulation drilling bottom purification of [J]. Prospecting works (geotechnical drilling and excavation works) No. 1, 2000, p. 60-62.
6. Кондырев Б.И., Ивановский И. Г., Приеменко С.Б.: Нетрадиционное осваение угольных месторождений, 2003 [M]. Владивосток: ДВГТУ , с. 108-128.
7. Аренс В.Ж.:.Физико-химическая геотехнология, 2001 [M]. Москва: МГГУ, 2001, с. 457-505.

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