

AZELKHANOV ASKHAT ZHENISOVICH

Development of efficient schemes of filling mixture's feeding at Suzdal mine of
"FIK "Alel" JSC

Specialty 06N0707 – Mining

ABSTRACT
from the master's dissertation degree
academ methods and technology

Republic of Kazakstan
Ust-Kamenogorsk, 2011

The dissertation is executed on Geology and mining chair East Kazakhstan state technical university of consumers' cooperative society.

The dissertation supervisor:	Academician of NANC RK, Professor, Doctor of Engineering Mr. Yuri Shaposhnik
The leading organization:	East Kazakhstan State Technical University. Serikbaev
The official opponent:	Ockasov D.T. Doctor of Science delegate director «NICTBCM»

Protection will take place on January, 24th, 2010 at 10.00 at session of dissertational council at the East Kazakhstan State Technical University. Serikbaev of consumers' cooperative society to the address: 071000, Ust-Kamenogorsk, street Serikbaev, 19, a boardroom of dissertational council.

The author's abstract is dispatched on December, 24th, 2010

Thesis work it is possible become acquainted bibliotheca care of Ust-Kamenogorsk, street Serikbaev, 19.

The scientific secretary
Dissertational council
doctor of Science

Bolatova A.B.

Number of illustrations, tables, used literature sources, in this dissertation shows 30 illustrations A4; given 39 of the table, and used 45 sources, consists of 120 pages.

Introduction

Relevance of the research.

Currently leaders of the “FIK “AleI” JSC have decided to mine gold-containing ore from the bottom horizons of the Suzdal deposit by the way of field development system with filling: slicing and sublevel and pillar mining.

Up to date 2 projects on the construction of the concrete-filling complex (CFC) at Suzdal mine, both surface and underground, have been completed:

- technological regulation for designing of the surface CFC with a grinding method of filling mixture production, and feeding of the filling mixture to interstices of worked areas by pipeline transport (“VNIITsvetmet” Affiliated Public Enterprise NC KPMC);

- a project of construction of the underground CFC with a grinding method of filling mixture production at the 160th horizon, components for mixing being delivered from the surface to the 160th horizon through the wells and filling mixture being delivered to interstices by pipeline transport (“BAISiK” Ltd.).

While conducting scientific research works at Suzdal mine, scientists of “VNIITsvetmet” Affiliated Public Enterprise NC KPMC also thoroughly studied basic properties and characteristics of filling mixture’s components. Efficient compositions of filling mixtures for the conditions of Suzdal mine were developed in the technological regulation: binding material (Portland cement of the Semey cement plant, M400-D20 sort) – 150 kg/m³, filling material (overburden of open pits and rhyolites from rock quarries) – 1430 kg/m³, water (industrial water of the pit №2 of the Suzdal deposit) – 365 kg/m³.

While preparing filling mix, “VNIITsvetmet” Affiliated Public Enterprise NC KPMC used the following inert materials as an inert aggregate: rhyolites from rock quarries; inequigranular sand from the pit №2; inequigranular limestones from the internal waste pile of the pit №1; carbonaceous-argillaceous siltstones from the pit №3.

Constructing the CFC, a composition of filling mixture in the project was taken as follows: cement of the Semey cement plant, 400 sort (GOST 10178-87) – 115 kg/m³; crushed heaped rock of the fraction of 5-25-40 mm– 1135 kg/m³, sand – 760 kg/m³, water – 240 l/m³.

To suit conditions of Suzdal mine the following technology was recommended as a main technology of filling operations: joint preparing of filling components and preparation of mixture, having set-up parameters for coarse and fine aggregates at the MShR 2.1x3.0; delivery of the mixture to the worked areas by pipeline transport in a self-flowing mode.

However these projects have not been implemented at Suzdal mine due to high capital expenditures for the purchase of a ball grinder, and additional expenditures for pumping of water drained during the formation of filling mass

while using pipeline transportation of filling mixture and conducting operations in small volumes – within 12 m³/h.

Now leaders of “FIK “Alel” JSC are planning not to use the grinding method of filling mixture preparing because of its high cost. They are going to develop a technology of filling mixture’s preparation at the surface complex and transportation of the mixture to worked areas by mobile mixers. Mixture placing to the worked areas is to be conducted by concrete placers with an inert aggregate of the size up to 20 mm, having a possibility to feed mixture to the worked area of 80 m in depth.

In this regard, it is necessary to develop and conduct experimental-industrial test of technology of filling mixtures’ preparation at the surface concrete mixing unit for the conditions of Suzdal mine. The unit should perform the following technological processes:

Crushing and storing of crushed overburden at the site of crushing and sorting plant;

Shipping, receiving and storing of cement and chemical additives;

Loading of crushed rock to the feed bins, feeding of the bins into the mixer of the concrete mixing unit;

Feeding of cement, chemical additives and water to the repulpator, preparing of cement wash and feeding it into the mixer;

Mixing and preparing of filling mixture in the mixer;

Transporting of filling mixture by the mixers to the site in the mine, where mixture will be placed to the worked areas;

Placing of filling mixture to the worked areas by concrete placers.

For the practical implementation of the technology of filling mixtures preparing at the surface concrete mixing unit, it is necessary to select filling mixture with a minimum amount of sealing components while preserving necessary strength characteristics of the filling mass, to develop a technological scheme of a filling mixture’s preparation and transportation, to select main processing equipment, to calculate an operating procedure of filling operations.

The research objective:

Selection of efficient compositions of filling mixture for the conditions of Suzdal mine, development of technological schemes of a filling mixture’s preparation and transportation with substantiation of a selection of the main processing equipment for the achievement of high technical and economical indexes of filling operations.

The object of the research:

The technology of filling operations at Suzdal mine.

The subject of the research:

Hardening filling mixtures and technological process of mixtures’ preparation and transportation.

The method of the research:

A complex method that includes an analysis and generalization of scientific and technical information, an analysis of technical and economical indexes of CFC of mining enterprises, laboratory researches aimed to study rheological and strength properties of filling mixture, methods of mathematical statistics, technical and economical analysis, experimental-industrial test, implementation of recommendations.

Results:

– As a result of laboratory tests in the laboratory of construction and filling operations of Ridder ore dressing and processing enterprise of “Kazzinc” Ltd., rheological and strength properties of filling mixture were found out. Basing on them, efficient compositions of filling mixtures for the conditions of Suzdal mine were substantiated.

– Technological schemes of preparation and transportation of filling mixture in Suzdal mine were developed;

– Technological processes of filling works for the conditions of Suzdal mine were calculated;

– Main processing equipment for filling operations at Suzdal mine was selected.

The novelty of the dissertation:

The most efficient granulometric composition of filling mixture, that meets the requirements of mixture’s transportability through pipelines and standard strength for the conditions of Suzdal mine, because of system under –storeyed chamber’s ore excavation (raise mining):

- mounting cased layer (rated rigidity 2,5-2,8 MPa fixed period curing 14 day): cement M 400 -175 kg/m³; inert aggregate 1695 kg/m³ (limestone 425 kg/m³, sand 1270 kg/m³); colliery water -310 kg/m³;

- massif bord (rated rigidity 1,5 MPa ; fixed period curing 28 day): cement M- 400 -125 kg/m³; inert aggregate -1695 kg/m³ (limestone 424 kg/m³, sand 1271 kg/m³) colliery water -320 kg/m³;

- frame layer (rated rigidity 4- 4,5 MPa; fixed period curing 90 day); cement M-400 – 200 kg/m³; inert aggregate 1642 kg/m³ (limestone 411 kg/m³, sand 1232 kg/m³) colliery water 315 kg/m³.

Efficient compositions of filling mixture for the conditions of the Suzdal mine were substantiated for slice and sublevel and pillar field development systems, taking into account the normative strength of the filling mass;

Efficient technological schemes of filling mixture’s preparation and transportation in Suzdal mine were substantiated using main processing equipment: MB-30WS concrete mortar-mixing unit, produced by MEKA, having production capacity of 30 m³/h; UNI 50-3 mining machine of PAUS firm production; P 715 Putzmeister mixer and compact trailed pump for fine concrete feeding;

Technological processes of filling operations for the conditions of Suzdal mine were calculated basing on planned production capacity of the CFC at the rate of 12m³/h.

The scientific significance of the research:

Complex theoretical and experimental studies were conducted to find most efficient compositions of filling mixtures for the conditions of Suzdal mine;

Efficient technological schemes of filling mixture's preparation and transportation in Suzdal mine were substantiated using main processing equipment: MB-30WS concrete mortar-mixing unit, produced by MEKA, having production capacity of 30 m³/h; UNI 50-3 mining machine of PAUS firm production; P 715 Putzmeister mixer and compact trailed pump for fine concrete feeding.

The practical significance of the research consists in:

Development of the technology of filling mixture's preparation and transportation in Suzdal mine;

Given recommendations for experimental-industrial test of the developed technology of filling mixture's preparation and transportation, author's control of processes such as designing, constructing, testing and adopting of technique and technology of filling operations at Suzdal mine.

Information about publications:

1. Yu.N. Shaposhnik, S.N. Shaposhnik, U.B. Aknazarov, A.Zh. Azelkhanov Contribution of "Altay" Techno Park in innovative development of the university // Branch of the Russian State Social University, Ivanteevka, 2010

2. Yu.N. Shaposhnik, S.N. Shaposhnik, E.G. Kolmakov, A.Zh. Azelkhanov Improvement of filling operations at mining enterprises of East Kazakhstan // Materials of the 7th All-Russian scientific and practical conference "Quality management of education, production and environment", Biysk, the Biysk Institute of Technology, 2010

3. A.Zh. Azlekhanov Technology option feeding leaned mixture on subareal captive mine East Kazakhstan Choice of filling mixture feeding technology at underground mines of East Kazakhstan // Materials of the 10th Republican scientific and technical conference of students, undergraduates, post-graduates and young professors "Creativity of young people to innovative development of Kazakhstan": the East Kazakhstan State Technical University, Ust-Kamenogorsk, 2010.

4. A.Zh. Azlekhanov Технология закладочных работ на руднике «Суздальский» АО «ФИК «АЛЕЛ» // Журнал «Вестник the East Kazakhstan State Technical University, Ust-Kamenogorsk, 2010.

Bulk

As it is known, mining and smelting industry provides about a quarter of a total country's industrial output. Its share in the total volume of export is about 20%. The Head of the State and the Government of the Republic of Kazakhstan set a task before mining and smelting industry to double a volume of output and export of production by 2015, to extend processing and to create higher production area.

Because of increase in capacity of Suzdal mine of "FIK "Alei" JSC of "Severstal" company from 300 to 500-600 thousand ton a year and because of deepening of mining works, it is planned to use sublevel and pillar ore mining method with filling and to use mobile equipment.

Currently leaders of the "FIK "Alei" JSC have decided to mine gold-containing ore from the bottom horizons of the Suzdal deposit by the way of field development system with filling: slicing and sublevel and pillar mining.

To suit conditions of Suzdal mine the following technology was recommended by "VNIITsvetmet" Affiliated State Enterprise NC KPMC as the main technology of filling operations: joint preparing of filling components and preparation of mixture, having set-up parameters for coarse and fine aggregates at the MShR 2.1x3.0; delivery of the mixture to the worked areas by pipeline transport in a self-flowing mode.

However these projects have not been implemented at Suzdal mine due to high capital expenditures for the purchase of a ball grinder, and additional expenditures for pumping of water drained during the formation of filling mass while using pipeline transportation of filling mixture and conducting operations in small volumes – within 12 m³/h.

Now leaders of "FIK "Alei" JSC are planning not to use the grinding method of filling mixture preparing because of its high cost. They are going to develop a technology of filling mixture's preparation at the surface complex and transportation of the mixture to worked areas by mobile mixers. Mixture placing to the worked areas is to be conducted by concrete placers with an inert aggregate of the size up to 20 mm, having a possibility to feed mixture to the worked area of 80 m in depth.

In this regard, it is necessary to develop and conduct experimental-industrial test of technology of filling mixtures' preparation at the surface concrete mixing unit for the conditions of Suzdal mine. The unit should perform the following technological processes:

Crushing and storing of crushed overburden at the site of crushing and sorting plant;

Shipping, receiving and storing of cement and chemical additives;

Loading of crushed rock to the feed bins, feeding of the bins into the mixer of the concrete mixing unit;

Feeding of cement, chemical additives and water to the repulpator, preparing of cement wash and feeding it into the mixer;

Mixing and preparing of filling mixture in the mixer;

Transporting of filling mixture by the mixers to the site in the mine, where mixture will be placed to the worked areas;

Placing of filling mixture to the worked areas by concrete placers.

For the practical implementation of the technology of filling mixtures preparing at the surface concrete mixing unit, it is necessary to select filling mixture with a minimum amount of sealing components while preserving necessary strength characteristics of the filling mass, to develop a technological scheme of a filling mixture's preparation and transportation, to select main processing equipment, to calculate an operating procedure of filling operations.

On the basis of mentioned points, the research objective is selection of efficient compositions of filling mixture for the conditions of adopted technology of filling operations at Suzdal mine, development of technological schemes of a filling mixture's preparation and transportation with substantiation of a selection of the main processing equipment for the achievement of high technical and economical indexes of filling operations.

The technology of filling operations at Suzdal mine was chosen as the object the research.

Hardening filling mixtures and the technology of their preparation and transportation are the subject of the research.

Research tasks are:

To select rheological and strength properties of the filling mixture for the conditions of Suzdal mine;

To prove efficient compositions of filling mixtures for slice and sublevel and pillar field development systems taking into account standard strength of the filling mass;

To develop technological schemes of filling mixture's preparation and transportation in Suzdal mine;

To calculate technological processes of filling operations for the conditions of Suzdal mine;

To select main processing equipment for filling operations at Suzdal mine, CFC productivity being 12 m³/h.

Scientific theses that will be defended:

The most efficient granulometric composition of filling mixture, that meets the requirements of mixture's transportability through pipelines and standard strength for the conditions of Suzdal mine, because of system under –storeyed chamber's ore excavation (raise mining):

- mounting cased layer (rated rigidity 2,5-2,8 MPa fixed period curing 14 day): cement M 400 -175 kg/m³; inert aggregate 1695 kg/m³ (limestone 425 kg/m³, sand 1270 kg/m³); colliery water -310 kg/m³;

- massif bord (rated rigidity 1,5 MPa ; fixed period curing 28 day): cement M- 400 -125 kg/m³; inert aggregate -1695 kg/m³ (limestone 424 kg/m³, sand 1271 kg/m³) colliery water -320 kg/m³;

- frame layer (rated rigidity 4- 4,5 MPa; fixed period curing 90 day); cement M-400 – 200 kg/m³; inert aggregate 1642 kg/m³ (limestone 411 kg/m³, sand 1232 kg/m³) colliery water 315 kg/m³.

The most efficient technological scheme of filling mixture's preparation and transportation in Suzdal mine at the production rate of 12 m³/h was defined to be a scheme of filling mixture's preparation in the surface concrete mixing unit, mixture's transportation to the mine by mobile mixers with mixture's feeding to the worked areas by concrete pumps;

The most efficient processing equipment for the conditions of Suzdal mine is MB-30WS concrete mortar-mixing unit, produced by MEKA, having production capacity of 30 m³/h; UNI 50-3 mining machine of PAUS firm production; P 715 Putzmeister mixer and compact trailed pump for fine concrete feeding.

Conclusion

The dissertation provides new evidence-based results. The usage of them will help to solve a big problem of development of an efficient technology of filling operations for the conditions of Suzdal mine of "FIK "Alel" JSC. This fact makes a significant contribution to the theory and practice of ore deposits development with the subsequent filling of worked areas.

The following main scientific results, practical conclusions and recommendations were drawn during the theoretical and experimental researches:

The most efficient granulometric composition of filling mixture, that meets the requirements of mixture's transportability through pipelines and standard strength for the conditions of Suzdal mine, because of system under –storeyed chamber's ore excavation (raise mining):

- mounting cased layer (rated rigidity 2,5-2,8 MPa fixed period curing 14 day): cement M 400 -175 kg/m³; inert aggregate 1695 kg/m³ (limestone 425 kg/m³, sand 1270 kg/m³); colliery water -310 kg/m³;

- massif bord (rated rigidity 1,5 MPa ; fixed period curing 28 day): cement M- 400 -125 kg/m³; inert aggregate -1695 kg/m³ (limestone 424 kg/m³, sand 1271 kg/m³) colliery water -320 kg/m³;

- frame layer (rated rigidity 4- 4,5 MPa; fixed period curing 90 day); cement M-400 – 200 kg/m³; inert aggregate 1642 kg/m³ (limestone 411 kg/m³, sand 1232 kg/m³) colliery water 315 kg/m³.

The most efficient technological scheme of filling mixture's preparation and transportation in Suzdal mine was substantiated, CFC productivity being 12 m³, filling mixture being prepared at the surface concrete mixing unit, transported to the mine by mobile mixers, fed to the worked areas by concrete pumps;

The most efficient main processing equipment was proved for the conditions of Suzdal mine as follows: MB-30WS concrete mortar-mixing unit, produced by MEKA, having production capacity of 30 m³/h; UNI 50-3 mining machine of PAUS firm production; P 715 Putzmeister mixer and compact trailed pump for fine concrete feeding.

Tasks, set in the dissertation, were successfully solved, the efficient technology of filling operations in Suzdal mine of "FIK "Alel" JSC was developed.

Recommendations about use of results of the research are being designed and implemented at Suzdal mine of "FIK "Alel" JSC.

Technical and economical indexes, calculated in the dissertation, indicate a high efficiency of the technology of filling operations at Suzdal mine.

A scientific level of the research is high enough as compared with the best achievements in this field.

List of reference

1. Смолдырев А. Е., Технология и механизация закладочных работ, М., 1974; Кравченко В. П., Куликов В. В., Применение твердеющей закладки при разработке рудных месторождений, М., 1974; Гидравлическая закладка выработанного пространства на угольных шахтах, М., 1975.

2. Корректировка технологической части (подземный рудник) проекта "Суздальский горно-перерабатывающий комплекс" Часть: Технологическая (подземный рудник): отчет о НИР: 6-07-40 /ВНИИцветмет; рук. Егорочкин А.А. – Усть-Каменогорск, 2007.-112 с.;

3. Проект «Суздальский горно-перерабатывающий комплекс», Часть: Технологическая (подземный рудник), «Казгипроцветмет», 2003г.

4. Лабораторные исследования и выбор составов закладочных смесей для условий подземного рудника Суздальского месторождения: отчет о НИР: 6-07-40, ВНИИцветмет; рук. Гамулка В.И. – Усть-Каменогорск, 2007.-30 с.;

5. Разработка технологии утилизации отходов горнометаллургического производства для закладочных работ при подземной добыче руд. Этап Разработка типового технологического регламента мельничной технологии утилизации отходов производства для закладочных работ: отчет о НИР: №23/ ВНИИцветмет; рук. Гамулка В.И. – Усть-Каменогорск, 2006. 60 с.

6. ВНТП-37-86. Нормы технологического проектирования рудников цветной металлургии с подземным способом разработки: Утв. Техн. упр. Минцветмета СССР –М.: 1986.-130 с.

7. НИР «Опытно-промышленные работы по породной и бутобетонной закладке отработанной камеры Малеевского рудника», 2005

8. Шапошник С.Н., Морозов А.Н., Шапошник Ю.Н. Основные результаты НИР «Совершенствование схем выемки запасов руд Родниковой рудной зоны Малеевского месторождения камер IV очереди при двухстороннем контакте с закладкой» // Материалы международной научной конференции «Роль вузов в формировании инновационной экономики», Усть-Каменогорск: ВКГТУ, 2008.

9. Шапошник С.Н., Морозов А.Н., Шапошник Ю.Н. Экономическая эффективность технологии выемки запасов руд на контакте с закладкой // Materily IV mezinarodni vedecko-prakticka conference «Vedecke myslene inflacniho století - 2008». - Dil. 10. Technicke vedy: Praha. Publishing House «Education and Science» s.r.o., 2008. - s. 85-87.

10. Рогов А.Е. Имитационное математическое моделирование, Алматы, 2007. - 96 с.

The list of keywords:

Captive mine
Laying
Analysis
Suzdal minefield
Mixer
Mixture
BLK
Pump
in-pit
perspective

Summary

Development of efficient schemes of filling mixture's feeding at Suzdal mine of "FIK "Alel" JSC.

The object of the research the technology of filling operations at Suzdal mine.

The subject of the research hardening filling mixtures and technological process of mixtures' preparation and transportation.

The research objective selection of efficient compositions of filling mixture for the conditions of Suzdal mine, development of technological schemes of a filling mixture's preparation and transportation with substantiation of a selection of the main processing equipment for the achievement of high technical and economical indexes of filling operations.

The method of the research a complex method that includes an analysis and generalization of scientific and technical information, an analysis of technical and economical indexes of CFC of mining enterprises, laboratory researches aimed to study rheological and strength properties of filling mixture, methods of mathematical statistics, technical and economical analysis, experimental-industrial test, implementation of recommendations.

Results:

– As a result of laboratory tests in the laboratory of construction and filling operations of Ridder ore dressing and processing enterprise of "Kazzinc" Ltd., rheological and strength properties of filling mixture were found out. Basing on them, efficient compositions of filling mixtures for the conditions of Suzdal mine were substantiated.

– Technological schemes of preparation and transportation of filling mixture in Suzdal mine were developed;

– Technological processes of filling works for the conditions of Suzdal mine were calculated;

– Main processing equipment for filling operations at Suzdal mine was selected.

The novelty of the dissertation, most efficient granulometric composition of filling mixture, that meets the requirements of mixture's transportability through

pipelines and standard strength for the conditions of Suzdal mine, because of system under –storeyed chamber’s ore excavation (raise mining):

- mounting cased layer (rated rigidity 2,5-2,8 MPa fixed period curing 14 day): cement M 400 -175 kg/m³; inert aggregate 1695 kg/m³ (limestone 425 kg/m³, sand 1270 kg/m³); colliery water -310 kg/m³;

- massif bord (rated rigidity 1,5 MPa ; fixed period curing 28 day): cement M- 400 -125 kg/m³; inert aggregate -1695 kg/m³ (limestone 424 kg/m³, sand 1271 kg/m³) colliery water -320 kg/m³;

- frame layer (rated rigidity 4- 4,5 MPa; fixed period curing 90 day); cement M-400 – 200 kg/m³; inert aggregate 1642 kg/m³ (limestone 411 kg/m³, sand 1232 kg/m³) colliery water 315 kg/m³.

Efficient compositions of filling mixture for the conditions of the Suzdal mine were substantiated for slice and sublevel and pillar field development systems, taking into account the normative strength of the filling mass;

Efficient technological schemes of filling mixture’s preparation and transportation in Suzdal mine were substantiated using main processing equipment: MB-30WS concrete mortar-mixing unit, produced by MEKA, having production capacity of 30 m³/h; UNI 50-3 mining machine of PAUS firm production; P 715 Putzmeister mixer and compact trailed pump for fine concrete feeding;

Technological processes of filling operations for the conditions of Suzdal mine were calculated basing on planned production capacity of the CFC at the rate of 12m³/h.