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**RESEARCH AND APPLICATION OF NEW GROUTING  
MATERIALS IN CHINA COAL INDUSTRY**

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**ABSTRACT**

THIS PAPER DEALS WITH THE RESEARCH AND APPLICATION OF NEW GROUTING MATERIALS IN CHINA COAL INDUSTRY WITHIN THE RECENT TWO DECADES AND PRESENTS SOME TYPICAL NEW GROUTING MATERIALS IN CHINA. SOME NEW TECHNIQUES AND EQUIPMENTS RELATED TO CHEMICAL GROUTS ARE PRESENTED IN THE PAPER. IN THE END OF THE PAPER, IT STATES SOME VIEWS ON THE DEVELOPMENT OF GROUTING MATERIALS MAINLY BASED UPON THE TENDENCY IN CHINA. IT ALSO STATES A DEVELOPMENT TENDENCY FOR EXISTING DISADVANTAGES OF CHEMICAL GROUTS AND ESPECIALLY STATES THAT THE INDUCTION OF NEW TECHNIQUES AND EQUIPMENTS WILL GREATLY IMPROVE THE ACTUAL VALUE OF SOME CHEMICAL GROUTS.

**INTRODUCTION**

IT HAS A LONG HISTORY WITH THE APPLICATION OF GROUTING TECHNOLOGY IN CHINA COAL MINING INDUSTRY. THE MAIN APPLICATIONS ARE FOLLOWING:

- A. PREGROUTING FOR FISSURES IN BASE ROCK BEFORE A OPERATION OF A SHAFT SINKING SUCH AS SURFACE AND WORKING FACE PREGROUTING;
- B. WATER SEALING FOR CONCRETE STRUCTURES, SUCH AS BACK-GROUTING FOR COMPLETED MINE SHAFT LINING, OPENING AND TUNNEL LINING;
- C. GROUTING FOR LOOSENED SAND STRATA, INCLUDING PREGROUTING FOR A SHAFT SINKING THROUGH A FLOW SAND STRATE AND GROUTING FOR BUILDING FOUNDATION REINFORCEMENT;
- D. SEALING BLOCKING FOR A HEAVY WATER INRUSH IN A FLOODED MINE AND MINE RECOVERING.

IN ORDER TO WELL SOLVE ABOVE PROBLEMS, DURING RECENT TWO DECADES THE RESEARCH ON THE GROUTING MATERIALS HAS MADE A RAPID

PROGRESS IN CHINA COAL MINING INDUSTRY. WE HAVE DEVELOPED NOT ONLY CEMENT GROUTS BUT ALSO SEVERAL KINDS OF CHEMICAL GROUTS, WHICH ARE NEW ACHIEVEMENTS IN RESEARCH PROVIDING NEW MEANS AND METHODS FOR CONTROL AND TREATMENT GROUND WATER HAZARD.

1. PRESENT STATE OF GROUTING MATERIAL AND RESEARCH ACHIEVEMENTS IN RECENT YEARS

THE GROUTING MATERIALS, WHICH HAVE BEEN USED IN OUR COAL INDUSTRY, MAINLY CAN BE CLASSIFIED AS FOLLOWING:

|                   |                  |   |
|-------------------|------------------|---|
| GROUTING MATERIAL | INORGANIC SYSTEM | SINGLE LIQUID CEMENT GROUT<br>CEMENT CLAY GROUT<br>WATER-GLASS GROUT<br>CS DOUBLE LIQUID CEMENT GROUT |
|                   | ORGANIC SYSTEM   | ACRYLAMIDE GROUT<br>UREA RESIN GROUT<br>FURFURALDEHYDE GROUT<br>CHROME LIGNIN GROUT                   |

CONSIDERING THEIR APPLICATIONS, THE MATERIALS, WHICH ARE THE MAIN RESEARCH ACHIEVEMENTS IN RECENT YEARS AND HAVE BEEN FREQUENTLY USED IN COAL MINE, ARE AS FOLLOWING:

A. CS DOUBLE LIQUID CEMENT GROUT

THIS GROUT MAINLY CONSISTS OF TWO COMPONENTS. THESE TWO ARE INJECTED BY DOUBLE LIQUID SYSTEM WITH A PROPER RATIO. WHEN NECESSARY, WE ADD SOME SETTING ACCELERATOR OR RETARDER TO ADJUST THE GROUT GEL TIME.

THE CHARACTERISTICS OF THE GROUT ARE AS FOLLOWING:

- A. THE GROUT GEL TIME CAN BE ACCURATELY CONTROLLED FROM SEVERAL SECONDS TO SEVERAL TEN MINUTES.
- B. COMPRESSIVE STRENGTH OF SOLIDIFIED MATERIAL IS HIGH, WHICH CAN REACH 100-200KG/CM<sup>2</sup>.
- C. THE RATIO OF SOLIDIFICATION IS HIGH WHICH CAN REACH 100%.
- D. THE SOLIDIFIED MATERIAL HAS A GOOD IMPERMEABILITY WHICH COEFFICIENT IS 10<sup>-5</sup> CM/S.
- E. THE SOURCE OF THE MATERIAL IS RICH AND THE PRICE IS LOW.
- F. THERE IS NO POLLUTION TO GROUND WATER AND ENVIRONMENT.

THE BASIC PROPERTIES OF THE GROUT ARE SHOWN IN FIG.1 TO FIG.4. CS DOUBLE LIQUID CEMENT GROUT HAS BEEN WIDELY USED AND IS VERY EFFECTIVE. IN OUR COAL INDUSTRY HUNDREDS OF PROJECTS HAVE OBTAINED GOOD RESULTS BY THIS MATERIAL.

B. MG-646 CHEMICAL GROUT

MG-646 CHEMICAL GROUT IS SIMILAR TO AM-9 OR JAPAN-SS. IN OUR COUNTRY IT HAS BEEN USED AS LONG AS 20 YEARS AND SOLVED A LOT OF PROBLEMS THAT ARE DIFFICULT FOR CEMENT GROUT. ITS MARKED CHARACTERISTICS ARE AS FOLLOWING:

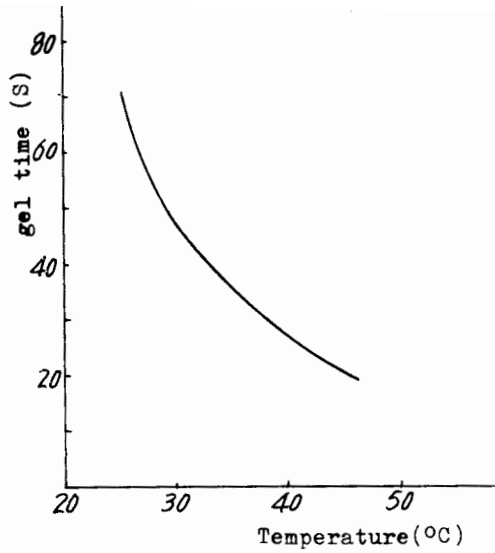


Fig. 1. The temperature influence on gel time.

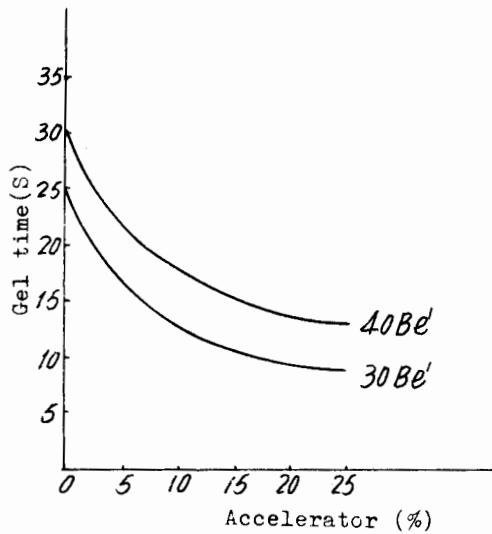


Fig. 2. The setting accelerator influence on gel time.

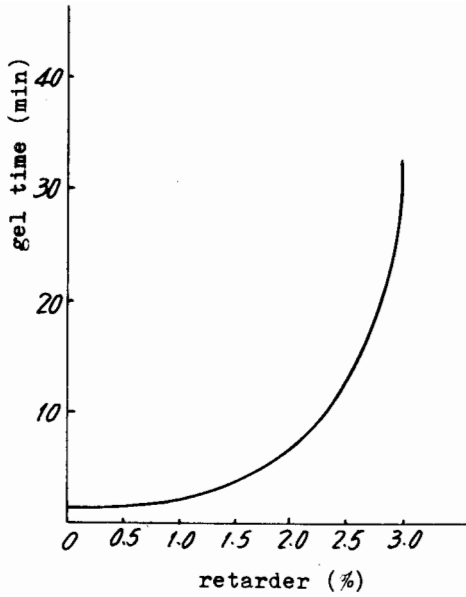


Fig.3. The setting retarder influence on gel time.

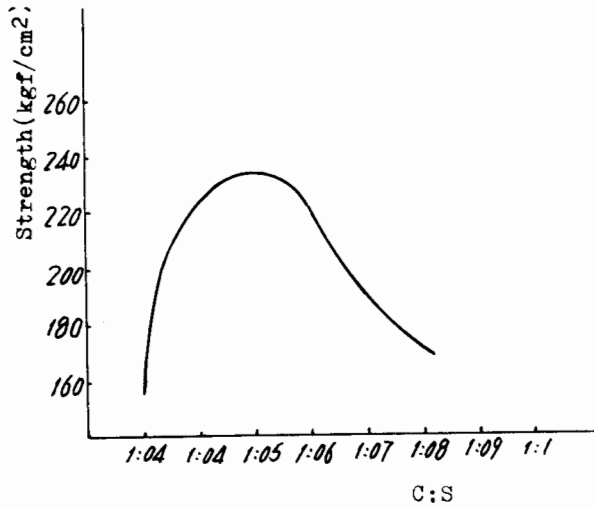


Fig. 4. The C:S influence on compressive strength.

- A. THE VISCOSITY IS LOW ABOUT 1.2 CENTIPOISES. THE VISCOSITY KEEPS CONSTANT BEFORE GELLING. SO THE GROUT HAS A GOOD PERMEABILITY.
- B. THE GEL TIME CAN BE ACCURATELY CONTROLLED FROM SEVERAL SECONDS TO SEVERAL TEN MINUTES. THE GELLING OCCURS AND COMPLETED INSTANTANEOUSLY.
- C. THE GEL BODY HAS A GOOD IMPERMEABILITY WHICH COEFFICIENT IS  $10^{-5}$ -- $10^{-6}$ CM/S.
- D. THE GEL COMPRESSIVE STRENGTH IS LOW ABOUT 4-6KGF/CM<sup>2</sup>.

C. PM AND SPM CHEMICAL GROUTS

PM AND SPM GROUTS ARE POLYURETHANE GROUTS. PM IS OIL-SOLUBLE GROUT AND SPM IS WATER-SOLUBLE GROUT. THESE TWO GROUTS GAVE A HIGH PRACTICAL VALUE, WHICH CAN SOLVE SOME ENGINEERING PROBLEMS. THE CHARACTERISTICS OF PM GROUT ARE AS FOLLOWING:

- A. GROUT IS WATER-INSOLUBLE. WHEN IT ENCOUNTES WATER. THE GROUT BEGINS TO REACT. SO IT IS NOT EASY TO BE DILUTED OR SCATTERED BY GROUND WATER.
- B. IN REACTION THE GROUT WILL FOAM, EXPAND AND HAVE A SECOND PENETRATION. THE PENETRATION IS EVEN AND THE GROUTING EFFECT IS GOOD.
- C. COMPRESSIVE STRENGTH OF SOLIDIFIED BODY IS HIGH WHICH CAN REACH 60-100KGF/CM<sup>2</sup>.
- D. AS FOR INJECTING BY SINGLE LIQUID SYSTEM. THE PROCESS AND EQUIPMENT ARE SIMPLE AND THE GEL TIME CAN BE ADJUSTED.
- E. THE STABILITY OF THE PREPOLYMER IS NOR GOOD. IT SHOULD BE SEALED HERMETICALLY FOR KEEPING AND STRICTLY FORBIDS TO GET IN TOUCH WITH WATER OR MOISTURE.
- F. EQUIPMENT, PIPE LINE AND ETC SHOULD BE CLEANED BY ACETONE.

THE CHARACTERISTICS OF SPM GROUT ARE AS FOLLOWING:

- A. IT CAN BE SPREADED EVENLY AND DISSOLVED IN A GREAT DEAL OF WATER. AFTER GELLING AN ELASTOMER CONTAINING A LOT OF WATER IS FORMED
- B. THE RATIO OF GROUT AND WATER CAN BE VRIED IN A LARGE RANGE, SO THE REQUIREMENT FOR A ADJUSTING FLOW OF PREPORTIONING PUMP IS NOT HIGH.
- C. THE GEL TIME IS GENERALLY ABOUT 2 MINUTES.

II.THE BSIC DATA AND EXPERIENCE FOR APPLICATION AND SELECTION OF A GROUTING MATERIAL

FIRST OF ALL, WATER SEALING IN BASE ROCK FISSURES IS THE MAIN ISSUE IN THE COAL INDUSTRY. SO CEMENT GROUT HAS BEEN WIDELY USED IN MOST CASES. IN SOME CASES CHEMICAL GROUT MUST BE USED. THERE IS A QUESTION AT WHAT A KIND OF CONDITION TO USE A WHAT KIND OF GROUT.

FIRST, THE SELECTION OF GROUTING MATERIAL SHOULD BE DEPENDENT ON THE FOLLOWING FACTORS, SUCH AS GEOLOGICAL AND HYDROGEOLOGICAL CONDITIONS, THE PUPOSE AND REQUIREMENT OF A CONSTRUCTION,

MATERIAL SUPPLY, ECONOMIC BENEFIT AND ETC.

AS FOR CEMENT AND CHEMICAL GROUTS, GENERALLY SPEAKING, IF CEMENT GROUT CAN SOLVE THE PROBLEM, CHEMICAL GROUT SHOULD NOT BE USED. CHEMICAL GROUT MAY USE WHEN THE CEMENT GROUT COULD NOT HANDLE SOME PROBLEM.

BASED ON OUR EXPERIENCE, HOW TO SELECTE A GROUTING MATERIAL IS GIVEN IN TABLE 1.

III.THE APPLICATION AND RESULT OF  
GROUTING MATERIAL IN COAL MINE

THE APPLICATION OF GROUTING MATERIAL IS PRECENTED BY FO'RR TYPICAL ENGINEERING PRACTICE, AND CERTAIN CONDITIONS, THE WAY CHOO-SING DIFFERENT KIND OF GROUTING MATERIALS REASONABLY TO SOLVE PRACTICAL PROBLEMS TO GET GOOD RESULT IS EXPLAINED FURTHER.

A. SURFACE PREGROUTING INTO BASE ROCK FISSURES USING SINGLE LIQUID CEMENT GROUT. IN BASE ROCK FISSURES, IF THE VELOCITY OF GROUND WATER IS NOT TOO HIGH, IT IS MORE CONVENIENT TO USE SINGLE LIQUID CEMENT GROUT. AND DESIRED RESULTS CAN BE ACHIEVED SATISFACTORILY. THE GEOLOGIC COLUMN AND INFLOW OF HEBEI MAIN AND AUXILIARY SHAFTS AT JIXI COAL MINE BUREAU ARE SHOWN IN FIG. 5.

ACCORDING TO THIS CONDITION THE GROUTING DEPTH WAS DECIDED AS 140 METRES USING SINGLE LIQUID CEMENT GROUT AND INJECTING DOWNWARDS. THE TOTAL AMOUNT OF CEMENT INJECTED IN THE TWO SHAFTS WAS 1816.46 TONS. MEASURED SURPLUS INFLOW IN LATER SHAFT SINKING WERE  $1.5\text{M}^3/\text{H}$  FOR MAIN SHAFT AND  $2.5\text{M}^3/\text{H}$  FOR AUXILIARY SHAFT WITH GOOD RESULTS. IN ADDITION, FILLING GROUTING AND WORKING-FACE PREGROUTING ALSO CAN USE SINGLE LIQUID CEMENT GROUT.

B. UNDER A PASSING WATER CONDITION BLOCKING HEAVY WATER FLOW BY USING CS DOUBLE LIQUID CEMENT GROUT. XIEZHUANG COAL MINE IS LOCATED IN THE WEST OF XINGTAI COAL BASIN. XIAOWEN RIVER FLOWS FROM THE EAST TO THE WEST ON THE MINE FEILD. OVER 90% OUTCROP OF COAL MEASURE STRATUM IS COVERED BY STREAM-LAID DIPOSIT, WHICH IS WIDELY DISTRIBUTED AND CONTAINS PLENTY OF WATER. SURFACE WATER IS EASILY CONDUCTED TO UNDERGROUND THROUGH SAND STRATUM IN COAL MEASURES. ONCE AN ACCIDENT OF WATER INRUSH HAPPENED IN NO. 311042 WORKING-FACE AT THE EAST PART OF THE MINE AND THE INFLOW AT MOST REACHEDD  $1960\text{M}^3/\text{H}$ .

AFTER WATER INRUSH THROUGH A GREAT DEAL OF INVESTIGATION IT WAS FOUND OUT THAT THE SOURCE OF WATER INRUSH WAS IN A LIMESTONE STRATA. THE GROUTING WAS CARRIED OUT BY DRILLING HOLES AT THE SURFACE. THE ARRANGEMENT OF THE GROUTING HOLES ARE SHOWN IN FIG. 6.

IN ORDER TO GUARANTEE NORMAL PPRODUCTION THE UNDERGROUND DRAIN-

Table 1

TABLE FOR CHOOSING GROUTING MATERIALS

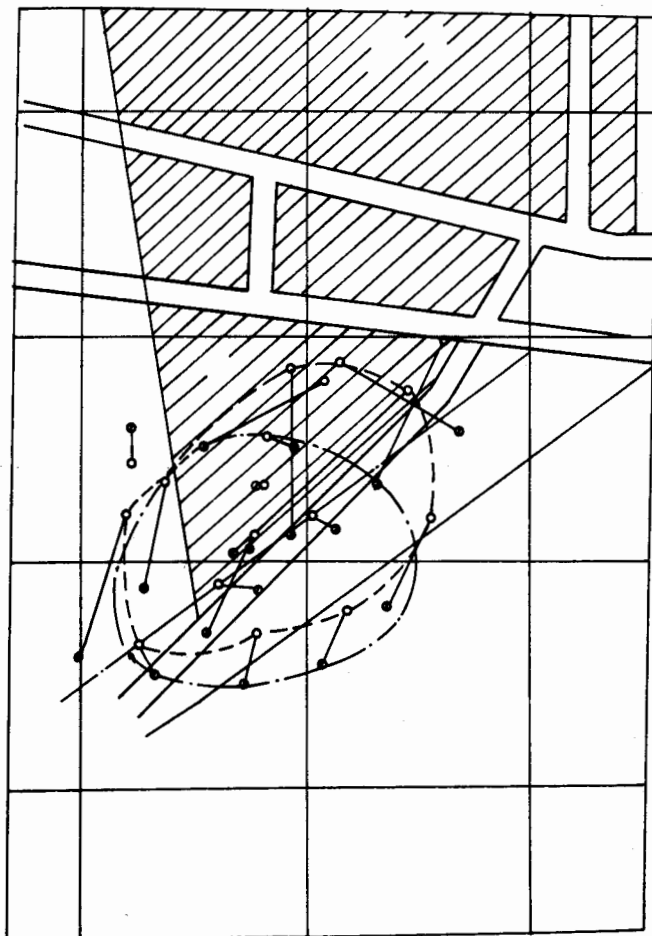
| Geological condition                            |                  | Construction purpose | Suppressing water   | Consolidation fill | Remarks   |
|---|------------------|----------------------|---|--------------------|---|
| Rock strata                                     | Fractured        | Porous               | Single liquid cement<br>CS double liquid cement   |                    | Chemical grout for fine fracture  |
|   |                  |                      | Acrylamide<br>Chrome lignin   |                    | Also blasting grouting injecting cement grout                           |
| Loosened sand strata                            |                  |                      | Acrylamide, Water-glass<br>Urea resin, Polyurethane<br>Furfuraldehyde, Chrome lignin                    |                    | Also cement grout for gravels and cobbles                               |
| Special strata<br>(Crush zone, faults, caverns) |                  |                      | Aggregates + Single liquid cement<br>Aggregates + CS double liquid cement<br>Aggregates + Cement - clay |                    | Grading and other qualities of aggregates depend on relevant conditions |
| Concrete construction                           | Inside of lining |                      | Acrylamide, Chrome lignin,<br>Polyurethane  |                    | Cement grout for large fracture   |
|   | sand strata      |                      | Acrylamide, Chrome lignin<br>Polyurethane   |                    | Drilling grouting holes can not penetrate shaft lining                  |
|   | Behind lining    | Rock strata          | Single liquid cement<br>CS double liquid cement   | cement-clay        | Also aggregates if possible   |

Notes: Grouting for shafting off seepage is used a little in coal mine, so we do not consider it.

Fig.5 Geologic column and inflow of Hebei shaft

| geologic time                     | accumulative depth (metre) | geologic Column | Main description of rock characteristics  | Water intrush |  |
|-----------------------------------|----------------------------|-----------------|---|---------------|--|
|                                   |                            |                 |   | Depth (m)     | Inflow (m <sup>3</sup> /h)                             |
| Quarterary period<br>Cenozoic Era | 6.50                       |                 | Mainly consisting of arenaceous clay  |               |  |
|                                   | 35.00                      |                 | Consisting of medium-grained sandstone, fine-grained siltstone & tuff, highly fractured, highly developed fissures width 10-40 cm | 60.00         | 248.00   |
|                                   | 56.00                      |                 | Consisting of fine & medium grained sandstone, fractured, highly developed fissures width 10-20 cm                                | 90.00         | 104.00   |
|                                   | 75.00                      |                 | Consisting of fine, medium & coarse-grained sandstone & shale, partly fractured, little developed fissures width 5-10 mm          |               |  |
|                                   | 140.                       |                 | Mainly consisting of fine-grained siltstone & arenaceous shale, partly fractured, little developed fissures width 2-5 mm          | 140.00        | 18.50  |
|                                   | 300.00                     |                 | Mainly consisting of fine-grained sandstone, arenaceous shale & fine, medium and coarse-grained sandstone                         |               | Below 140 m inflow is smaller than 1 m <sup>3</sup> /h |





**Fig. 6. Arrangement of grouting holes.**

- ----- underground position of water inrush,
- ----- underground position of grouting holes,
- ----- surface position of grouting holes.

AGE AND SURFACE GROUTING WERE CONDUCTED SIMULTANEOUSLY. IT WAS GROUTING UNDER PASSING WATER, USING CS DOUBLE LIQUID CEMENT GROUT. FIRST, AGGREGATES CONSISTING OF SAND AND GRAVELS WERE INJED  $776.72\text{M}^3$  THEN CS GROUT WAS INJECTED 1356.59 TONS. INRUSH WAS B-LOCKED COMPLETELY.

C. THE GROUTING INSIDE OF THE SHAFT LINING USING MG-646 CHEMICAL GROUT.

THE MAIN SHAFT LINING OF XINGTAI COAL MINE IS MONOLITHIC REINFORCED CONCRETE STRUCTURE WITH TWO LAYERS. BECAUSE OF THE EARTHQUAKE INFLUENCE IN THE SHAFT DEPTH OF 120 TO 160M, WHICH WAS IN THE ALLUVION, THERE WERE SEVERAL SPRAY WATER. THE SHAFT INFLOW WAS  $30\text{m}^3/\text{H}$ . IN ORDER TO PREVENT SHAFT LINING PENETRATED BY THE GROUTING HOLE AND INRUSH OF WATER AND QUICK SAND, GROUTING INSIDE THE SHAFT LINING, WITH USING MG-646 CHEMICAL GROUT, WAS ADOPTED. THE GROUTING PERFORMANCE LASTED FOR 20 DAYS, 35 GROUTING PIPES WERE PUT. THE NUMBER OF GROUTING WAS 25 TIMES. THE CONSUMPTION OF MG-646 CHEMICAL GROUT WAS 565.15KG. THE INFLOW WAS REDUCED TO  $6.3\text{m}^3/\text{H}$ , WHICH FLOWED MAINLY FROM UNHANDLED SECTION OF SHAFT.

D. CUTTING OFF WATER INRUSH USING PM GROUT

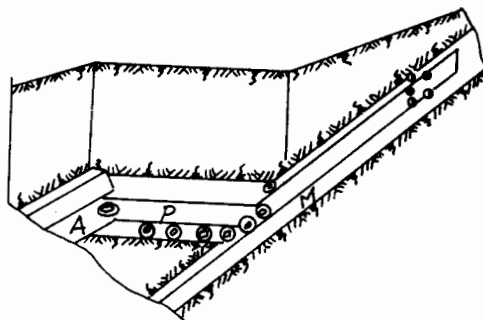
THE LENGTH OF THE MAIN AND AUXILIARY INCLINED SHAFT AT SHAJING COAL MINE NANNING GUANGXI PROVINCE IS 160M. ITS DIP IS  $25^\circ$ . THE LENGTH OF THE SECTION PASSING THROUGH SAND STRATUM IS 34.5M. IN THE SHAFT SINKING HEAVY INRUSH OF WATER AND QUICK SAND HAPPENED. AFTER LINING THE INFLOWS OF MAIN AND AUXILIARY SHAFT WERE  $74.67\text{M}^3/\text{H}$  AND  $67.83\text{M}^3/\text{H}$  RESPECTIVELY. FIRST CS DOUBLE LIQUID CEMENT GROUT WAS USED TO SOLVE THE AUXILIARY SHAFT PROBLEM AND ITS INFLOW WAS REDUCED TO  $1.94\text{m}^3/\text{H}$ . WHEN THE MAIN SHAFT WAS DEALED WITH SOMETHING HAPPENED, BECAUSE OF A PUMPING ROOM, WHICH LINKS UP THE TWO SHAFTS AND ITS DISTANCE TO THE SHAFT TOP IS 100M ALONG THE SHAFT LENGTH. THE PUMPING ROOM IS IN A CLAY STRATA AND THERE WAS NO WATER ORIGINALLY. WHEN A PART OF WATER INRUSH IN THE MAIN SHAFT WAS SHUT OFF, THERE WAS A HEAVY WATER INRUSH IN THE PUMPING ROOM. THE WATER FLOWED FROM THE UPPER SAND STRATA ALONG THE BACK OF THE LINING. SEE FIG. 7.

FIG.7 SCHEMATIC DIAGRM OF CUTTING OFF WATER INRUSH USING PM GROUT BECAUSE OF THE FAILURE IN UPPER GROUTING, GROUTING FOR CUTTING OFF WATER INRUSH WAS USED. AT THE EXIT OF PUMPING ROOM LEADING TO THE MAIN SHAFT THREE GROUTING HOLES WAS DRILLED. ONLY 100 LQF PM GROUT WERE INJECTED AND THE WATER INRUSH IN THE PUMPING ROOM WAS CUT OFF. THEN THE UPPER GROUTING WAS SUCCESSFUL AND THE FINAL INFLOW IN MAIN SHAFT WAS  $2.19\text{M}^3/\text{H}$

FROM ABOVE EXAMPLES WE CAN SEE THAT FOR SPECICAL NEEDS OF DIFFERENT ENGINEERING WE MUST USE DIFFERENT GROUT. THIS IS AN IMPORTANT PRINCIPLE AND A BASIC WAS TO SOLVE PROBLEM SATISFACTORILY.

IIII THE DEVELOPING TENDENCY OF GROUTING MATERIAL

WITH THE DEVELOPMENT OF MINE CONSTRUCTION THE GEOLOGICAL AND HYDROGEOLOGICAL CONDITIONS WILL BECAME MORE COMPLICATED AND BRING MORE AND MORE PROBLEMS TO TECHNOLOGY OF GROUTING MATERIAL.



- CS grouting hole
- ⊙ PM grouting hole,
- ⊙ CS grout with no gelation due to dilution,

M: main shaft,

A: Auxiliary shaft

P: pumping room.

Fig. 7.

THE RESEARCH DEVELOPMENT OF GROUTING MATERIALS ARE AN IMPORTANT FIELD TO SOLVE THESE PROBLRMS. FOR THE DEVELOPMENT TENDENCY OF GROUTING MATREIAL SOME PERSONAL VIEWS ARE PRESENTED AS FOLLOWING:

A. USING CEMENT FOR GROUTING MATERIAL HAS SOME INCOMPARABLE ADVANTAGES. IT HAS RICH SOURCE, LOW PRICE, NO POLLUTION AND HIGH STRENGTH. NOT ONLY IN THE PAST IT WAS, BUT ALSO IN THE FUTURE IT WILL BE WIDELY USED FOR GROUTING MATERIAL. SO DEVOTING MAJOR EFFORTS TO DEVELOPING CEMENT GROUTING MATERIAL TALLIES WITH THE ACTUAL SITUATION. THE KEY TO THE PROBLEM IS HOW TO IMPROVE THE PERFORMANCES OF THE CEMENT GROUT.

RESEARCH IN CEMENT GROUT MAINLY MEANS RESEARCH IN SINGLE LIQUID CEMENT GROUT INCLUDING CEMENT-CLAY GROUT. THE CONTENT OF RESEARCH WOKE MAINLY IS TO IMPROVE THE PERFORMANCE OF THE SINGLE LIQUID CEMENT GROUT. ACCORDING TO OUR EXPERIENCE OF GROUTING IN COAL MINE FOR MANY YEARS THE FOLLOWING QUESTIONS MUST BE PAYED ATTENTION TO:

1. THE GROUT GELS IN A RANGE FROM SEVERAL TENS MINUTES TO SEVERAL HOURS AND THE GEL TIME CAN BE CONTROLLED AND ADJUSTED ARTIFICIALLY.

2. BEFORE THE GELLING OF THE GROUT MAKING NO FREE WATER OR FREE WATER AS LESS AS POSSIBLE THE RATIO OF SOLIDIFICATION REACH OR NEARS 100%.

3. THE STRENGTH MUST MEET THE NEEDS OF THE ENGINEERING. BUT IT IS NOT NECESSARY TO CONCENTRATE ON HIGH STRENGTH ALONE NO MATTER WHAT SITUATION AND WHAT CONDITION IS, BECAUSE IT WILL HINDER THE USE OF SOME NEW ADDITIVES AND SUBSTITUTES.

4. THE GRAIN CHARACTER OF CEMENT IS REALISTIC PROBLE. GRINDING CEMENT GRAINS WILL GREATLY RAISE PRODUCTION COST.

5. IN RECENT 20 YEARS THE CHEMICAL GROUT WAS DEVELOPED RAPIDLY IN OUT COUNTRY, BUT THE DISADVANTAGES OF ITS HIGH COST, POLLUTION AND ETC MAKE THE LIMITATION OF CHEMICAL GROUT FOR A WIDE APPLICATION. EVEN THOUGH, THE RESEARCH OF CHEMICAL GROUT STILL HAS AN IMPORTANT SIGNIFICANCE. BECAUSE IT REPRESENTS THE DEVELOPING LEVEL OF GROUTING TECHNOLOGY AND IT CAN SOLVE SOME VERY DIFFICULT PROBLEMS IN GROUTING ENGINEERING. WE HAVE DEVELOPED MANY NEW KINDS OF CHEMICAL GROUTS AND SUPPLIED THE MARKET. IMPROVING THE PERFORMANCES AND DISADVANTAGES OF CHEMICAL GROUT FURTHER, DEVELOPING NEW RESEARCH FIELD, REDUCING THE COST PROGRESSIVELY, REMOVING THE POLLUTION AND SERVING THE PRODUCTION BETTER ARE THE AIM OF DEVELOPING CHEMICAL GROUT.

C. THE RESEARCH WORK OF THE GROUTING MATERIAL AT PRESENT IS ROUGH AND LACKS INDEPENDENCY AND THEORTICS. IT HAS NOT FORMED ITS OWN COMPLETE SYSTEM. THE EQUIPMENTS AND INSTRUMENTS ARE NOT SPECIALIZED AND TEST STANDARDS ARE NOT UNIFIED. THE NAMES OF GROUTING MATERIAL ARE CONFUSED. THESE SITUATION HINDER THE DEVELOPMENT OF THE GROUTING MATERIAL SERIOUSLY. I HOPE THE TEST OF GROUTING MATERIAL PERFORMANCE WILL HAVE UNIFIED STANDARD ALL OVER THE WORLD AND THE RESEARCH WORK OF GROUTING MATERIAL WILL BE MORE THEORETICAL AND STANDARDIZED.