EXAMPLES OF COAL DUST EXPLOSIONS

By
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ABSTRACT

It is difficult with inadvertent explosions to establish fundamental data, especially of original dust, of pressure, temperature etc. and of ventilation oscillations, as exposed personnel rarely survive. Retrospective data from explosions must be derived from damage, from fatalities, from ventilation analyses, from analyses of dusts and other indications of temperature and duration of temperature.

The five disastrous explosions selected for analysis provide examples of what data can be established as to the cause and extent of explosions. Such information is required for legal etc., inquiries subsequent to explosions, but most importantly to give the best guidance for avoidance of possibility of further disasters.

INTRODUCTION

Methane and coal dust explosions have been the cause of the greatest disasters resulting in tremendous numbers of fatalities in the mining industry. Unfortunately there is no world statistic of those disasters available. Such statistical material would be of great value for a synthetic approach to the subject and as a consequence for drawing scientific and immediate practical conclusions for permanent, regular, improvement of the level of combating the explosion danger.

Despite the progress made in combating the hazard of explosions the potential danger exists as it is shown by the disasters which occur from time to time in different countries. The potential danger is also confirmed by the numerous ignitions of methane and coal dust occurring but which do not develop into disastrous explosions.

EXAMPLES OF COAL DUST EXPLOSIONS

IN MEMORIAM

These examples serve as reminders of the existence of the hazard and also heighten the memory of the miners who lost their lives in explosions such as the tragic disasters described in detail.

HONKEIKO COLLIERY

On April 26, 1942, in the Honkeiko Colliery in Manchuria there occurred the most tremendous, horrible disaster in the whole history of mining which caused the death of 1527 miners and injured over 250.

In 1941 the Honkeiko Colliery situated in the Penhsihfu Coalfield and operated by the Japanese produced 900,000 t of coking coal and employed 4400 men underground. The longwall system was used with caving. The coal was carried in sequence by chain conveyors, endless rope haulage and by conveyor belts to the surface. The colliery was regarded by its management as non-gassy and the coal as non-explosible even though the volatile matter content was 18% and despite the occurrence of other previous explosions.

A strong wind in the morning hours of April 26, 1942, had damaged the power lines. The management of the mine without giving notice to

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the underground staff ordered the disconnection of the power line until the repair was made. This interruption stopped the fans. The interruption of power lasted 1 hour. When the power was switched on again a violent explosion occurred. A man standing at the entrance of the incline on the surface was killed on the spot and the buildings near the entrance were completely demolished.

After the explosion the management ordered the fans to be stopped again for the purpose of extinguishing any fire which might have started. Thus the mine should be saved but perhaps at the cost of the lives of people. Shortly after the explosion a man came out by himself from the incline.

The subsequent Inquiry showed that a man who was responsible for electrical equipment thought when the power was cut off that the switch of the conveyor motor became faulty and he started to investigate it and to repair it. Then the ends of the power cables were close enough together for an arc to strike when the power was switched on again. This arc ignited the methane accumulation, which in turn initiated the coal dust explosion. The explosion also went through galleries in stone where evidently coal dust deposits were present sufficient for the propagation of the explosion. No means of protection against coal dust explosions had been used.

After 2.5 hours the rescue operation started, but soon had to be stopped because of the reported failure of the rescue apparatus. After some hours the fans were started again and the rescue operations were resumed. It was ten days before all of the bodies were recovered. Most of the miners were found to have been poisoned by CO. Only a few had died from the immediate explosion. Most of the dead were in the intake air roadways on the way to the surface. Probably if the fans had not been stopped most of them could have been saved. Thus the greatest mine disaster in the world can be blamed on two managerial mistakes, firstly not to use means of protection against explosions and secondly initiating this catastrophy by stopping the fans (Anon., 1942).

COURRIERES COLLIERY

In the French mine Courrieres on the 10th March, 1906 there occurred one of the greatest mine disasters in the world caused by a coal dust explosion. 1099 miners lost their lives.

The mine Courrieres is situated in the Pas de Calais Coal Basin. The mine employed 9258 people, 7594 of them underground. The explosion affected the entire southern part of the mine. The range of the disaster covered an area about 5 km long and 1.5 km wide. There is no figure about the total length of the roadways traversed by the flame, and probably it was in the order of 30,000 m. Several shafts and many workings and seams were affected by the explosion. Both longwall and pillar systems were used with shotfiring.

On the first shift 1400 men were underground. The underground explosion occurred at 7 am and also demolished the buildings on the surface. Clouds of fumes came out from the shafts. The official statistics say that 1099 miners perished. A heading where the shotfiring was used is regarded as the point of initiation. The explosives initiated the coal dust explosion.

The violence of the explosion differed in individual workings. Methane could not have been the initiator of the explosion since at the time no methane was present in the mine. Open lights were used there. Also after the explosion no methane concentrations were found in the mine. There is no doubt that this terrible disaster was cuased by a coal dust explosion alone. In all parts of the mine affected by the explosion great deposits of dangerous coal dust were observed. The explosion did not affect non-dusty workings and also workings dusted with slate dust. Coke deposits were found along the entire path of the explosion. The explosives used in the Courrieres mine were non-permitted explosives which are able very easily to initiate a coal dust explosion.

No means for protection against and suppression of the coal dust hazard were practiced although at that time in other mines water spraying was used for this reason. Expecially in France at this time the view was generally taken that coal dust by itself without methane is not able to explode.

The rescue operations were no less dramatic than the explosion itself. The rescue activities were difficult because of roof falls and the mine fire which started after the explosion. Changes were made with ventilation air currents for the purpose of extinguishing the fire. No attention appears to have been given to the possibility of miners being still alive. 20 days after the explosion the public was deeply shocked by the news that 13 men had found their way out of the explosion area. They survived by staying in blind workings to which CO did not penetrate. To feed they used oats intended as food for horses and whatever they found to eat in the pockets of their dead companions. Five days later - that is 25 days after the explosion - still another man, named Berthon, worked himself out of the mine. It is worth emphasising that these people were not rescued; they saved themselves by themselves. It was attributed to the mining engineers of this mine, that they had not saved the miners still alive after the explosion and that they had affirmed that no man was alive underground (Cunyngham,1907, Kochenhaver,1906).

LUISENTHAL COLLIERY

In West Germany in the Luisenthal mine in the Saar Coal Basin a disastrous methane and coal dust explosion took place on 7th February, 1962. 299 miners were killed and 73 injured.

The Luisenthal mine has two exploitation areas: the Alsbach and the Southern fields. The explosion affected the Alsbach field. The longwall system with hydraulic stowing was used. The length of the longwall was 150-200 m and the seam thickness was 2-3 m. Shotfiring with undercut was used. At the time of this accident five longwalls were in operation: two in Seam 1 and three in Seam 3. The longwall 3E was stopped and being used as a ventilation roadway (Fig.1). The coal dust contained 35-39% volatiles and was of high explosibility. All exploited seams were very gassy seams. The possibility of methane accumulations was greater in Seam 1 and here methane drainage was used. Seam 1 was not the origin of the explosion.

In the workings of Seam 3 the possibility of dangerous methane accumulations was lower in conditions of normal, usual ventilation. The quantities and velocities of air were high - velocity not less than 1 to 1.5 m/s - and the methane emission was relatively low. But the situation was different for the galleries on Level 2, which were affected by the influence of the exploitation of other workings. A few days after the disaster methane layers were found in the galleries and in the development headings and also in other places of this area. Also long zones of methane accumulations over 5% CH_4 were found behind the lagging of the support. Before the disaster the mine was obliged to use:

- stonedusting to 50% of incombustibles of all workings with dangerous coal dust except exploitation workings, and
- barriers H with 400 kg/m^2 and barriers N with 100 kg/m^2.

The regulations did not define exactly the location of the barriers.

Officially it was recognised that the most probable point of initiation was the western part of Gallery 221. The reason for the ignition was not definitely established but it appears probable that the cause was contraband - cigarettes - or a damaged cap lamp. Electricity, shotfiring, mine fire and the safety lamp were excluded as possible causes. Probably in Gallery 221 a methane layer was ignited, which carried the flame to a methane accumulation, which exploded. This

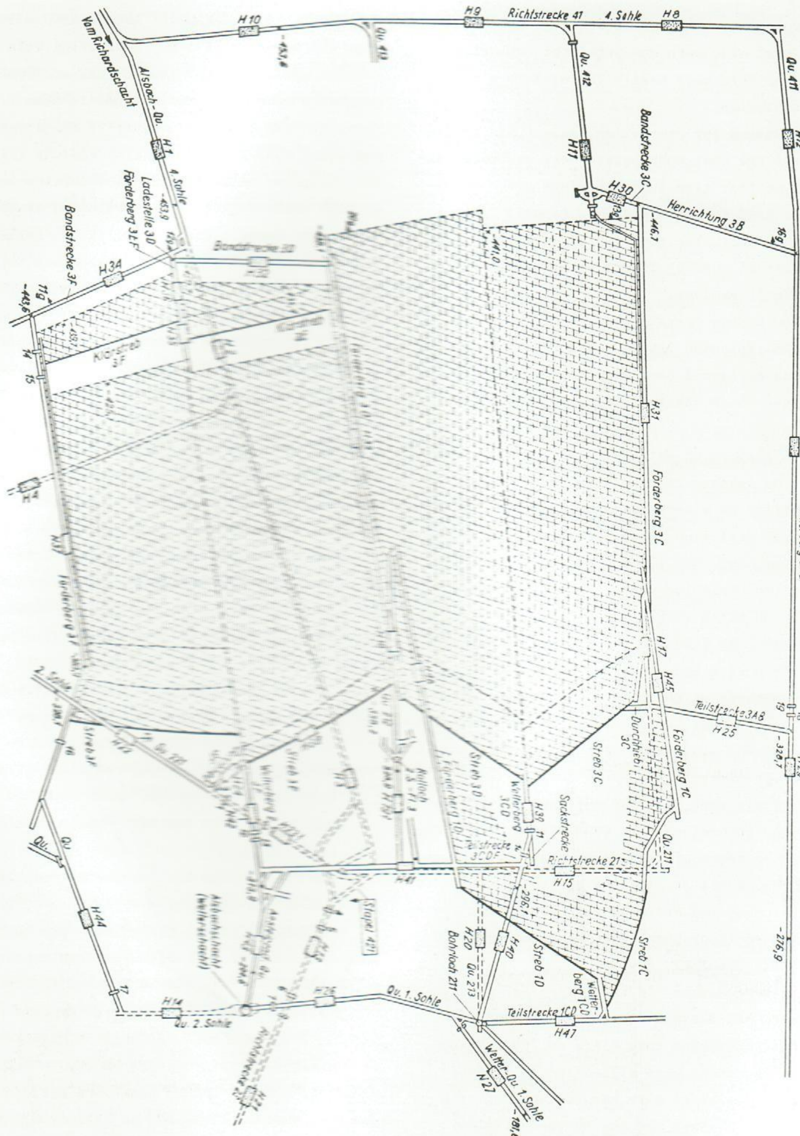

Fig. 1. Plan of part of Luisenthal Colliery

explosion reached the coal workings and started the coal dust explosion. The methane explosion was intensified by other methane accumulations present on the way. The explosion affected all workings of Level 2 in the Alsbach field, exploitation workings in Seam 3 and also all dip headings in Seam 3 to Level 4.

The great range of the explosion is explained by the fact that it passed through other workings which contained pure coal dust and also through other workings in which, even if they were in compliance with the regulations, this sort of stonedusting was not sufficient to stop the propagation of the explosion. In the description stonedusting is not mentioned. Another reason why this explosion was so widespread was the shortage of proper regulations dealing with location of barriers (Fritsche,1965).

MIKAWA COLLIERY

In Japan in the Mikawa mine on 9th November, 1963 a coal dust explosion occurred and 458 miners lost their lives.

The Mikawa mine, whch belongs to the group of Miike collieries produced 187,000 t/month and employed 3923 miners.

The exploitation was conducted at two levels, 350 m and 450 m.

The Inclines 1 and 2 were the intake airways and the Shinko Shaft was the return (Fig.2).

The coal was carried to the surface by belt conveyors installed in Incline 1. Incline 1 was 2,000 m long at a slope of 12°. It was 6.38 m wide and 4.55 m high and was divided by a partition into two parts. In the first part was the belt conveyor and in the second the track for material haulage. Electrical cables were installed there also.

The explosion happended in the time between shifts, when 1388 miners of the first shift and 692 miners of the second shift were underground. Some miners from the first shift were waiting for cars to take them out, some others were ascending in cars in Incline 2.

At the time of the explosion the conveyor in Incline 1 was stopped, but in the other partition eleven cars were being lowered. At 1180 m from the surface the coupling between the third and fourth car was broken and the eight uncoupled cars ran violently down and reached a speed of 120 km/h. Then the cars were derailed and ran another 54 m to stop 1630 m from the surface. The derailed cars cut the electrical cables in the raised dust cloud and initiated the coal dust explosion.

The Mikawa mine was a non-gassy mine. It was a pure coal dust explosion of a very explosible and dangerous coal containing 40% volatile matter.

The greatest damages were in Incline 1. The conveyor was broken and demolished and the supports were damaged. Other workings were slightly damaged. In this explosion 458 miners perished and 742 were injured, including 675 slightly, 42 moderately and 25 seriously injured. Only 20 miners were the direct victims of the blast of the explosion; all the rest were fatally poisoned by carbon monoxide (Cybulski, 1970).

The reasons for the great extent of this disaster were:

- the great dustiness of workings,
- the absence of means for prevention and suppression of coal dust explosions,
- the lack of self rescuers, and
- the initiation of the explosion at the time of changing shifts.

SALCIA COLLIERY

In 1974 in the Salcia Mine in Silesia, there occurred a methane and coal dust explosion which caused the death of 34 miners.

This explosion subjected 104 miners to danger, 34 of them were killed, 48 were injured and 22 went out without receiving injuries.

The Salcia Mine exploits gassy seams prone to spontaneous combustion. The longwall system with caving was used. The plan of the workings and the ventilation system is shown in Fig. 3.

Shotfiring with undercut was used. The

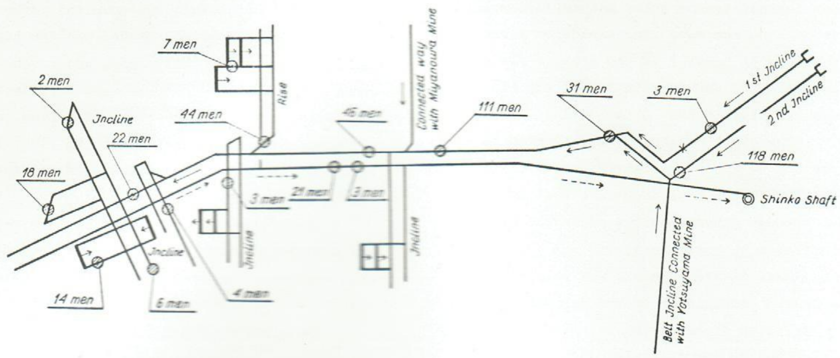

Fig. 2. Plan of part of Mikawa Colliery

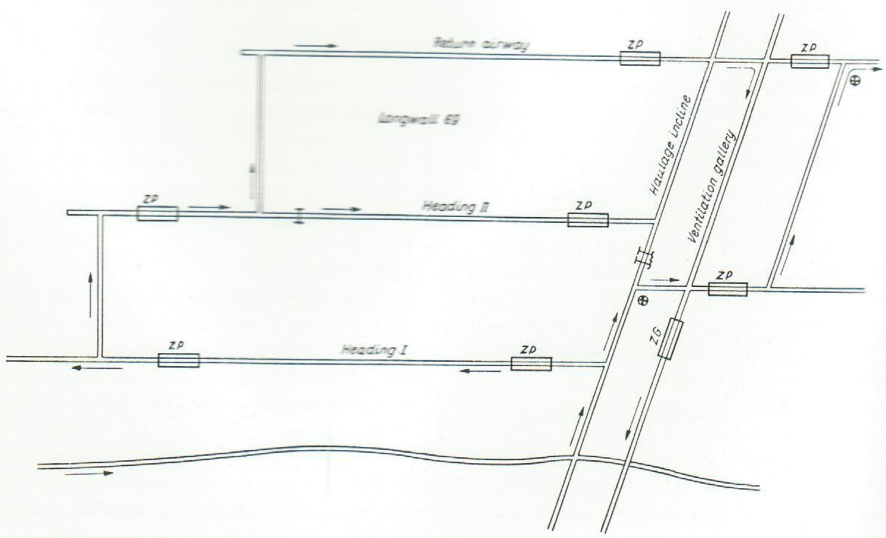

Fig. 3. Plan of part of Salcia Colliery

longwall where the explosion started was 108 m long and 2.5 m high.

The reason of this accident was a methane explosion in the upper part of the longwall and the methane explosion initiated the coal dust explosion. The explosion affected the longwall and roadways over a length of about 800 m.

The explosion was stopped perfectly by stone dust barriers.

The methane accumulation in the upper part of the longwall occurred as a result of:

- simultaneous drawing of the support, undercutting the longwall and lowering the air quantity by a short circuit of air in the inclined haulage roadway, and
- starting the fan again after a period of stoppage. The fan ventilated the blind end of Heading 1. This caused the increase of methane concentration in the intake air current flowing and ventilating the longwall.

The Inquiry did not establish definitely the reason of the ignition. The possibility of initiation by shotfiring, open light and safety lamp was excluded. Probably the ignition was caused by frictional sparking.

FINAL REMARKS

The number of fatalities caused by an explosion is usually taken as a measure of the magnitude of the explosion. This treatment is of course right with reference to the terms of the disaster, but it is not strict for the terms of the explosion. The number of victims depends of course on the number of people affected by the explosion. This depends on the system of exploitation, on its organisation and also in a great part on chance. The chance factor plays a great role in the extent of the disaster. There are explosions of a relatively small extent which cause a great number of victims and conversely in a great explosion a relatively low number of people may be killed.

The most appropriate measure of the magnitude of an explosion is the range of the explosion - taking into account the range of the flame and its velocity - the range of the blast and also the extent of the poisonous effect of post-explosion fumes, which means poisoning from CO.

Considering statistically methane explosions, methane and coal dust explosions, coal dust explosions and mine fires in relation to their ranges and to the number of victims resulting, the coal dust explosion is of greatest seriousness. Methane explosions or ignitions have local character only. In the present state of science and knowledge of ventilation and with the present means of methane control, great and undetected methane accumulations should only occur rarely. Coal dust deposits can be found in every roadway. Therefore the explosion is able to propagate for very long distances and affects a lot of workings and of course a lot of men. Practically coal dust cannot be removed from the roadways as can be done with methane by means of ventilation. This is the reason why coal dust explosions are responsible for such great numbers of victims in a single disaster.

But it would be wrong to draw conclusions from the fact of a smaller number of victims in a methane explosion, that methane explosions are not dangerous. It is worth emphasising here the great easiness of ignition of methane mixtures in contrast to dust clouds.

The introduction of stonedusting into coal mines in the year 1920 diminished the number of explosions and also the number of victims of explosions which occurred. The magnitude of the disasters was reduced. But, unfortunately, from time to time great disasters still occur. The analysis of explosions and ignitions in mines indicates an important role of the human factor in this problem. Very often great disasters are caused by typical mistakes, by negligence and by relaxation of safety against accidents. Every accident is a dramatic event, which brings sorrows to the families. Mine accidents have a special character. Every accident creates despondency not only among the workers of the mines who are directly affected but also in the mining circles at large and as well in the whole society.

Disasters and their consequences affect the psychology of miners, introducing disinclination to work in mines and to impair miners' confidence in the effectiveness of the means of suppressing explosions.

If the frequency of explosions in one mining area is low, there may be a desregard about this hazard building up. This frame of mind may propagate in all levels of the mining industry and with it a reducing regard to the safety regulations of mines. Regulations and rules are a basic help in combating the hazards of mining. On the conscientousness and the level of work quality in carrying out the regulations depends on the effectiveness of suppressing explosions.

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DISCUSSIONS

R.S. FERGUSON (Department of Mines, Western Australia): In the Collie Coalfield in Western Australia the coal has a high hygroscopic moisture content, around about 26 per cent. The coal is also high in volatiles: the volatile matter content of some samples is up to 45 per cent on a dry ash free basis. Coal has been mined from the coalfield for the past 80 years, during which time about 37 million tonnes have been mined by underground methods. Some workers on the coalfield feel rather unhappy that coal dust is used for stemming with non-permitted explosives. It is felt that the situation needs proper investigation. One of the things which has been done is a laboratory test on the explosibility of a sample of coal dust. This was carried out by the Department of Mineral Resouces in New South Wales. There is a shortage of testing galleries in Australia for this type of work. A proximate analysis of the coal which was tested for explosibility was:-

Hygroscopic Moisture	23.5%
Volatile Matter	31.0%
Ash	7.6%
Fixed Carbon	37.9%
Volatile Matter Dry Ash Free	45.0%
Specific Energy Dry Ash Free	27.3 MJ/kg
Total Sulphur	3.1%

No explosion was observed using the crushed and air dried portions. The oven dried sample did not explode but when screened through a 75 um sieve, the -75 micrometer portion gave a positive result. It was found that the minimum explosive concentration of a -75 micrometer oven dried dust cloud is 0.41 kg/m^3.

There is still some opposition to the thought that rather more care should be taken in using non-permitted explosives and coal dust. The basis of opposition is that there is a high hygroscopic moisture content and an apparent absence of methane in the coal. The other thing is that people say that coal has been mined for about 80 years, without incident. There have probably been coal dust explosions as a result of blasting but these explosions have not been propagated throughout a mine. Please comment, giving views on the situation?

R. CYBULSKA (Experimental Mine Barbara, Poland): So long as an explosion does not happen people don't believe that the coal dust is able to explode and it is as long as the history of the coal mining exists, but about the moisture even with brown coal which has 60% moisture it is also able to explode and the explosibility is the same only there is a difference in the limits of explosibility. The lower limit of explosibility is nearly the same but the upper limit of explosibility is much lower than of black coal dust.

D.ROWLANDS (University of Queensland): Please comment on the comparison of explosibility tests done in laboratories with the tests done in the galleries.

R. CYBULSKA: To answer this question today would remove the need to read the second paper tomorrow. For tomorrow there will be more questions because today it is just a history and just a description of the disasters.

J. ROSE (Ulan Coal Mines Ltd.): The amount of work done with stone dust and water barriers is terrific. In the recent findings of the Appin Inquiry one of the recommendations has been that all or any water or dust barriers erected should not be removed. This would mean that there would be a multitude instead of in certain zones only which we do at this point of time. What is the right thing to do from the experimentation with barriers, where should they be sited, and should they be moved with the face as the face moves forward?

R. CYBULSKA: To put up barriers without knowing the mechanism of operating the barriers without the mechanism of an explosion is meaningless because the barriers are effective when they have their special localisation and have their special configuration and have their special type. But about the siting, the barriers are effective a minimum of 60 m from the face, they have to be installed but from a practical point of view it is known that the face is moving and the optimum for the barrier is 100 m from the investigations. But the barrier cannot always be on this 100 m because the face is moving and so the regulations allow the distance of 200 m for the barrier, but not more. The barriers are also effective even if they are 400 m - from Polish investigations. But much more stone dust is necessary per 1 m cross section of the working of the headings.

W. ALLISON (Queensland Collieries Employees Union): What effect do overhead structures have either inbye or outbye of the water barriers. How do they affect the effectiveness of the barriers? How do overhead structures such as conveyor belts, or pipelines which are within the vicinity of a barrier either inbye or outbye affect the barrier:

R. CYBULSKA: There are many possibilities to construct the barriers but the most important thing is that the barriers must be able to be put in operation. It depends also on the explosion that occurred underground. When there is a very violent explosion the barriers can be installed in any way chosen but with a weak coal dust explosion there is a difference. So the next question is when is it a weak coal dust explosion and when is it a violent coal dust explosion? When the workings are very wet, in these workings only very violent coal dust explosions can occur. But when workings are dry there are different sorts of installation of the barriers, but anyway they cannot trip and also they cannot be very fast - they must be able to turn over. They must be installed on frames as for the stone dust barriers or they can hang on wires. Also there are many other means too numerous to describe. If there are pipes for instance, there may be no room for the barriers. The barrier has no need to take all the distance of the working. The classical barrier is 65 per cent but the barrier cannot have spaces more than 1.3 m, so the containers can be put in at appropriate distances. This is all the regulations say about it and everything is allowed so when the barrier is over a longer distance it is better because it is more effective. The barrier is in a longer distance. Localised.

R. PARKIN (Western Collieries, Western Australia): Regarding the choice of barriers, in Germany, and in many parts of Europe the water barrier is traditionally used, but in the United Kingdom the stone dust barrier is used. What are the differences and what are considered to be the most effective?

R. CYBULSKA: From Polish investigations it is considered that when the flame velocity of the coal dust explosion is between 100 and 700 metres per second the water barriers and the stone dust barriers have the same effectiveness. But when there is a weak coal dust explosion the water barriers are less effective and the stone dust barriers are more effective. It is these explosions which are between 100 and 700 metres per second flame speed which are the easiest to stop but the most difficult thing is to stop the very weak explosions. The weak explosion passes through the barrier and it cannot be put into operation, therefore it is easier to be done by the stone dust barriers. For instance in Poland there are more stone dust barriers because the miners are more accustomed to these barriers. Many times these barriers stopped a real coal dust explosion in the mine, not only in the Experimental Mine. So in very dangerous places there are mostly stone dust barriers but water barriers are used where better conditions are expected. The water barriers are easier to instal and maintain.

C. ELLIS (New South Wales Department of Mineral Resources): It was mentioned that in the Luisenthal explosion the stone dust barriers were later withdrawn from the mines and were replaced by water barriers. Were the stone dust barriers ineffective or did they work, and if so, why were they withdrawn?

R. CYBULSKA: It was a personal opinion of some people. Between researchers there are always some for these means and some for others. In the Luisenthal disaster there was very often a methane explosion and the barriers are not for methane explosions, the barriers can stop the coal dust explosions. Of course the barriers do something in the case of the methane explosion. Barriers can decrease the extent of the explosion. Water barriers especially are also very helpful as a methane explosion can not so easily initiate as a coal dust explosion. This is what the barriers can do. But in the Luisenthal disaster there were these barriers which didn't stop what is thought to be a methane explosion. The Germans had the Haupt barrier and the Neben barrier. On the Haupt barrier there was 400 kg/m^2 stone dust and in the Neben barrier there was only 100 kg/m^2. This is not enough and in these places where there was this Neben barrier, the barriers did not stop the explosion. There are also some places where the barrier was very far from the point of initiation. Those barriers also were not effective. The barriers are effective only to some distance from the possible point of initiation.

L. GRIFFITHS (Griffiths Consulting and Services Pty. Ltd.): Where there are barriers on conveyor roadways, is there a possibility of the dynamic pressure ahead of the flame front collapsing the stoppings and distributing the coal dust from the conveyor into other roadways and the explosion still carrying on in those other roadways?

R. CYBULSKA: When an explosion goes through the conveyor belt road?

L. GRIFFITHS: When an explosion destroys the stoppings between the conveyor belt road and other roadways.

R. CYBULSKA: The ventilation stoppings are nothing to resist an explosion. They are always destroyed.

N. BURTON (New South Wales Department of Mineral Resources): In New South Wales great efforts are made to suppress dust at the face by spraying water. Then the Regulations require the spreading of stone dust through the roadways to conform to certain regulations and then the normal underground coal mine in New South Wales uses water barriers along its conveyor belt roads. It has been stated that the water barrier is less effective than the stone dust barrier when in fact there is a moderate or a weak coal dust explosion. In the New South Wales situation where dust suppression is attempted and stone dust is spread in a general sense is it likely or possible to have a weak explosion. Are the present set up and the present arrangements of water barriers used here effective to combat any type of explosion likely to occur?

R. CYBULSKA: Weak coal dust explosions include the weakest explosions, with a flame speed about 30 m/sec. But these explosions occur very rarely. When the explosion develops with this flame speed it very soon dies out by itself. There have always been great difficulties in explosion investigations to make these very low coal dust explosions. With the installation of water barriers - specially installed - not fixed very strongly they can be used in all galleries. Polish regulations allow it. Polish practice will be presented and discussed with Paper 11 - the instances where the barriers are not being used and perhaps why in these places these barriers are not being used - from the theoretical point of view.

R. LAMA (Commonwealth Scientific Industrial Research Organisation): One of the problems of very weak explosions is that they are ineffective in tripping the barriers and putting them into operation. Is there any development going on in this area of research? Particularly with developments in electronics and microprocessors, are there sensors which can pick up the location as well as the speed of the flame, and could automatically tip the barrier at an appropriate time, so that it is most effective? If so, then could the problem of optimum distance and optimum size of barrier shelves be successfully solved?

R. CYBULSKA: The optimum distance should be at the point of the initiation because now the regulations allow the explosion to travel 60 m and on these 60 m many people can be there. Of course there is work being done to bring the means as close to the face as possible, and this is the sort of work which is being done in Poland with the triggered barriers. But with all this equipment there is always much trouble. The equipment is like the barrier which is very simple, it works very well in difficult mine conditions. So there is a lot of trouble because sometimes it works well, especially the triggered barriers which are being tried but this work is not finished. But there are many disadvantages of it and these can also happen when attempt is made to introduce them into the mines. There is no one in Poland who is so brave and would like to replace the barriers used there now by the barriers which are only now being tested in an experimental gallery. Because the barrier must stop the explosion. In Polish investigations it didn't stop once, even once, and so these sorts of means can't be introduced to the mines. Because it is sufficient for them to fail only once and the disaster happens.

M. CARR (New South Wales, Department of Mineral Resources): Please consider the practice of having a water barrier or a stone dust barrier located in only one roadway of a number. For instance in Australia or in New South Wales there may be a dozen roadways for a panel with one continuous miner or two continuous miners operating that panel, and where there are, for instance, two return airways, four return airways, plus a number of intake airways. Water barriers are placed in one of those roadways which happens to be the conveyor belt roadway. What is the effectiveness of this situation. Is it good practice or would it be better practice for instance to have them in more roadways than just the conveyor roadway?

R. CYBULSKA: A coal dust explosion can occur in every roadway, not only in the conveyor belt roadway, because in the mine there is dust enough to propagate the explosion. From the disaster at Courrieres it was seen that the explosion travelled 5 km in one direction and 1.5 km in the other direction. So these conditions can exist in every mine. Polish regulations say very exactly what is to be protected and how. All places where an initiation is possible are protected. That means all the faces, that means places where there are methane accumulations over 1%, it means where mine fire fears exist, it means inclined roadways over 10 degrees with electrical cables. From these places is the possible place of initiation and barriers have to be installed, that is the difference. Polish seams are divided into categories of gassy mines and non-gassy mines, there is one sort of protection in gassy mines, another in non-gassy mines and there are also dusty mines - two classes of dusty mines - and non-dusty mines.

So in every sort of these categories there are other ways of protection. Anyway every place where the initiation is possible must be protected by barriers. Sometimes only by one barrier, sometimes barriers every 200 m and when that is not enough the ventilation district is again protected by barriers. But this is not so easy to explain because it is always a big problem.