COMMISSION
OF THE
EUROPEAN COMMUNITIES

Institution of a third programme of research "Health in mines"

LUXEMBOURG, DECEMBER 1970

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I – INTRODUCTION

1. Previous work

The funds made available for the second programme of research on dust control in mines, launched at the end of 1964, were fully utilised by 1970.

Bearing in mind the importance of the pneuconiosis problem, this second programme was designed to cover all aspects of dust control in coal and iron ore mines, and especially:

- Dust measurement and physical characteristics of dust;
- Dust control in coal or ore winning;
- Dust control outside coal or ore winning areas;
- The epidemiological relationships between the cause and development of pneumoconiosis and environmental factors.

Since this programme was launched undeniable progress has been made and the methods devised have paid off.

Thus in many workings, in which existing control methods were difficult to apply, suitable techniques have been discovered as a result of the research work. As examples in this connection we may mention the various seam infusion processes and techniques devised to control dust raised by winning and roadway heading machines or during the various stowing operations.

The faulty use of dust measurement equipment has overcome its scope determined, it has been made simpler and handier to use, and the interpretation of results has been made more straightforward and readily comparable. At the same time research into the physical characteristics of dust have shed light on many aspects hitherto little known and relatively unexplored.

As a result of the epidemiological research the most important harmful effects to be considered in the efficient organisation of personnel protection have been defined in the countries concerned. Although there is still a large area of uncertainty in this field, it should be noted that the international contacts created be the research programme have done a great deal to bring ideas on these problems into line.

2. Drafting a new programme

In the light of progress made so far, the drafting of a new programme presupposes the definition of new objectives which would take this work a stage further.

Of course this research programme must correspond with the realities of operating techniques and be capable of adjustment to foreseeable new developments. It is indeed important that control methods should be developed along with production methods, as otherwise the efficiency of the control methods will be diminished and the results suffer.

A new mine hygiene programme must therefore be intimately linked with the programme concerned with production targets.

The present trends in mining show certain outstanding features: mechanisation increasing in intensity, increasingly concentrated production and optimally productive employment of faces.

An analysis of these trends in coal and iron ore mines, applicable to the approximate term of the second programme, is given further on in this study. It shows clearly the way in which research must develop for approximately the next five years. In this field the recent past is a good index of future developments.

A new programme must also develop what was only briefly touched upon in the previous one.

Thus attention must be given, especially in the iron ore mines but also to a certain extent in the coal mines, to the control of emissions of nitrous gases from Diesel engines or blasting operations.

Moreover, the increasing depth of the faces and the more powerful machinery to be used will give rise to climate problems, especially as a large number of dust control techniques have hitherto been applied using wet methods.

3. Trends in the coal mines

a) *Concentration of production*

The mine of the 70's will be characterised by a small number of working faces, coupled with a high output per day.

For example in 1964 in the West-German coal industry, some 1 200 faces produced a daily average of 450 tons net. From 1964 to 1969 the number of faces dropped to 588 while average production rose to 780 tons net per day. The target for 1980 is an average production of 3 000 tons net per day. Some faces already produce more than this average.

A similar trend is to be noted in all the mining areas of the ECSC countries.

In Belgium (Campine area) in 1964, the number of working faces in operation was 90; in 1969 there were 54. At the same time average net output per day and per face increased from 415 to 600 tons. At the beginning of 1970, 25% of the faces were already producing on average more than 975 tons.

In France, the number of faces fell from 541 to 250 during the same period. Average production per face rose from 246 to 426 tons (mechanised workings: from 318 to 520 tons; non-mechanised from 187 to 251 tons).

At the present moment some faces reach or exceed a daily average of 2 000 tons; one produces well over 3 000 tons.

b) *Daily face advance*

Owing to the geological and technological conditions which limit the length of faces, the sought-after increase in daily face output can only be obtained by increasing their speed of advance.

In order to achieve this end it is necessary to use more efficient and more powerful machines, to increase their utilisation rate and to go over to multi-shift winning.

In order to speed up winning, great use will be made in the future of road headers, shortwall and stablehole machines.

In Western Germany the average daily speed of advance went up from 140 cm in 1964 to 191 in 1969.

In Belgium (Campine) the corresponding figures are: 147 cm and 174 cm.

In France the increase was from 130 cm to 184 cm.

There has also been a remarkable increase in the number of plough faces where winning is carried out during more than two shifts per day.

In Germany there were 29.4% of these faces in 1966 and in 1969 there were 50.2%.

In Belgium (Campine) the percentage of faces with two-shift winning went up from 72.8% in 1964 to 81.6% in 1969.

From 1964-1969 most ploughed workings in France have been working with at least two shifts, and since 1966 the percentage of 3-shift workings is on the increase.

c) *Installed motor capacity – Ventilation*

The increase in production and the ever-increasing capacity of electrical motors require that larger volumes of air be introduced into the workings in order to check the methane emissions and control the climatic conditions.

In Germany, for plough winning, the installed capacities advanced from 207 kW in 1964 to 289 kW in 1969. For shearers the corresponding figures are 268 kW and 374 kW.

In Belgium these figures are 199 kW und 232 kW respectively.

In France, installed capacity for plough winning increased from 225 kW to 268 kW, whilst for shearers the increase was from 258 kW to 335 kW.

With regard to ventilation, the average airflow introduced into the workings in Germany was 490 m^3/minute in 1960 and 720 m^3/minute in 1966.

In Belgium, in 1964: 460 m^3/minute; in 1969 597 m^3/minute.

In France 450 m^3/minute in 1964, and around 800 m^3/minute in 1969.

4. Development in the iron ore mines

The following analytical data has been supplied by the Lorraine iron ore mines. However they are quite representative of all the mines in the European Community.

a) *Development of production and outputs*

	years						forecasts
	1964	1965	1966	1967	1968	1969	1970-1975
Production (millions of tons)	57.4	56.1	51.7	46	52	53	52 – 55
Output – OMS in tons:							
Face	50	53.5	59	66.4	75.6	82.6	100 – 120 *)
Underground	21	22.6	24.4	27.3	32.2	35.8	45 – 52 *)
Underground + surface	16.3	17.5	18.8	21.2	25.2	28	35 – 40 *)

*) The outputs indicated are those forecast for 1975.

Outputs have constantly increased between 1963 and 1970, it seems reasonable to assume that the peak outputs achieved in various pits in 1970 will be the average coalfield figures in 1975.

b) *Technical development*

The improvements in output between 1963 and 1970 were made possible by technical development in all sectors, even though the winning methods did not change.

The jumbo drilling rigs have been considerably improved thus enabling on the one hand drilling and drilling operations to be speeded up and on the other hand the shotfiring rounds to be extended.

For shotfiring, catridged explosives are being progressively replaced by bulk charges ("nitrate-oils"), liquid oxygen has more or less maintained its position.

In loading, one of the factors has been the introduction of loader-transporters and of diesel-driven shovels. The new shuttle-cars are equipped with more powerful diesel engines – they travel faster and further.

Permanent equipment for transporting ore has been installed to totally or partially replaced tracked equipment. This equipment calls for preliminary crushers in the workings.

The creation of networks of concrete or tarmac tracks has made it possible to introduce many diesel transport vehicles.

The mechanisation of handling and shotfiring preparation operations in the district have also been carried out with diesel-powered equipment. Consequently it can be envisaged that between 1970 and 1975 development will proceed along the following broad lines:

- Extended shotfiring rounds,
- Faster drilling and, perhaps, an increase in the diameter of explosive charges,
- Utilisation of a larger quantity of explosives per round,
- "Dieselisation" of a large number of engines and increase in the unit-rating of each engine,
- Utilisation in the district of crushers,
- Automation and remote control trials for district equipments.

Technical development is indispensable to maintain the competitiveness of Lorraine iron-ore, but it has only been, and will only be, possible to continue this to the extent to which (as a parallel development) it has been, and will be, possible to successfully combat the environmental hazards which technical development entails.

This necessitates the application of known solutions, the continuance of current research and the launching of new research projects.

II – RESEARCH PROGRAMME

1. Technical prevention as such

The technical developments described in the previous chapter entail the following consequences so far as dust levels in mines are concerned.

A – CONSEQUENCES OF THE CONCENTRATION AND THE INCREASE IN THE SPEED OF FACE ADVANCE

a) On the one hand the amount of dust placed in suspension in volumes of airs of more or less the same order of magnitude as those encountered at the present time can only decrease – or even remain stable – if methods of prevention at the face make it possible *to reduce the specific dust level* per ton won or per square metre of caved surrounding rock.

It will, in fact, be impossible to increase the airflows in proportion to the tonnage if only because the lateral strike roads are getting longer and transport and support equipment is taking up more room.

b) On the other hand we have *less time* for anti-dust treatment of a given volume of coal.

Incidentally, there is the risk that the volume of water infused into the solid before winning may be insufficient. We shall, therefore, be obliged to carry out a supplementary wetting of the products won at the risk of causing a deterioration in the climate of the working, and this all the more so as the power of coalwinning and transport equipment increases.

Proposals:

It would therefore be advisable to include in the programme all research relating to *improving deep infusion, suppression of dust caused by caving* and to the dedusting of mechanical production equipment such as:

- Perfecting methods of water infusion in the solid independent of work carried out in the face;
- Use of additives to improve water penetration (wetting agents) or fixing dust during winning (coagulants and foams) and evaporation retarders to enhance the effect of the injection;
- Treatment of caving by means of spraying;
- Decreasing the amount of dust produced when the material is stowed pneumatically;
- Improving dedusting methods on winning machines and road headers;
- Choice of preventive methods which do not prejudice climate, and study of such methods.

B – CONSEQUENCES OF FLUCTUATIONS IN, AND METHODS OF, PRODUCTION

Fluctuations in production cause major peaks in dust level, the intensity of which is, incidentally, directly linked to the tonnage which has been won or caved. As these tonnages increase these dust level peaks rapidly become unbearable.

At the same time as researching into more effective methods of prevention, it is also necessary to lay down the parameters which will make it possible to forecast the method of action and probable effectiveness *before the panel to be treated is worked,* whereas at the moment the success or failure is merely confirmed during actual winning.

Proposals:

- Study of the distribution of water in the solid coal;
- Definition of wetting-rate predictors of a panel after infusion; study of the macro- and microstructure of the seam;
- Determining the dust level which must be expected during winning of a seam treated by a given infusion method taking into particular account the type of equipment used.

C – CONSEQUENCES OUTSIDE THE FACE OF THE INCREASE IN UNIT PRODUCTION

At transfer points, where all the coal won is once again set in motion, there is the risk that the dust level increases in line with tonnage. The methods of prevention used to date at transfer points are fairly hit-or-miss.

Proposals:

- Research on the development of aspiration and dedusting methods at transfert points;
- Dedusting in the roadway (e.g. by means of accelerated flocculation);

D – CONSEQUENCES OF INTENSIFIED PRODUCTION IN PARTICULAR FACES

Unforeseen new problems occur or can occur in special cases such as methods of working by the bunker method in thin seams or resulting from the mechanisation of steep seams.

In some coalfields, steep seams which contain reserves of coal which are often valuable still have a very low degree of mechanisation; it is planned to considerably increase this degree of mechanisation.

Proposals:

- To develop methods of dust suppression in faces worked by the bunker method;
- To find methods of suppression adapted to steep faces and to their type of mechanisation;
- Research into individual methods of protection.

E – CONSEQUENCES OF THE DEVELOPMENT OF PRODUCTION IN IRON-ORE MINES

The increase in the number of shotfiring rounds and the intensified usage of diesel-driven equipment will result in a more pronounced increase in nitrous vapours than in the past, particularly in iron-ore mines.

Proposals:

- To study the development of clouds of shotfiring fumes which pass through the roadways in relation to the dimensions of the latter, their temperature and the velocity of the air current;
- Development of processes to reduce the quantity of harmful gases produced by Diesel engines;
- To deal with problems relating to the balance and the kinetics of the different nitrous oxides, to their respective toxicity and to the synergy of dust and gases;
- Development of apparatus for measuring harmful gases underground;
- Development of ventilation methods for room and pillar workings, for dead-ends and for faces being worked by slices;
- Development of ventilation barriers by means of air curtains;
- Development of apparatus for ventilation measurements for very low air current velocities;
- Development of apparatus for dry dedusting.

2. Monitoring of technical prevention

a) The dust level is monitored in a discontinuous manner by means of various apparatus placed in the workings in well-selected sites.

This method, which at the present time makes it possible to adequately judge the average dust level, could prove insufficient in the case of high-output faces where a measurement which is *instantaneous, continuous* throughout the shift, and *daily* with remote recording, is desired.

Proposals:

In order to set up a rational network of measurements or remote measurements two problems must be solved:

- To find an aspirator-analyser capable of giving instantaneously the level of dust in a pre-determined size range;
- To fix the sampling points, after the dynamics of the dust levels have been studied, which enable the probable level of pollution in all the other points of the working to be assessed.

b) From a supplementary point of view it will be useful to know the *individual dust levels* inhaled by certain categories of miners and, consequently, to develop a light and self-contained portable sampler or analyser which can be permanently left near the man's face.

c) In order to interpret the results obtained in the different countries in a uniform manner, this apparatus should from now on be compared with the other instruments adopted for routine measurements.

3. Environmental factors – epidemiology

a) The required object of technical prevention is to achieve a level of dust which does not imperil the miners' health or which does not aggravate the state of those who have already contracted the disease.

Proposal:

In order to define the objectives, it is therefore necessary to *lay down* firstly the *maximum permissible concentration* for the healthy subject and secondly the equivalent values capable of slowing down – if not avoiding as far as possible – the aggravation of those types of pneumoconiosis which are not readily apparent from X-rays.

Research into a maximum permissible concentration and the development of an adequate measuring process presuppose that the efficient parameters which take correct account of the harmfulness of dust levels be defined.

This difficult and vital problem has been tackled to a great extent during the second research programme; but even if some solutions are starting to emerge there are many points which still remain unclear.

The whole problem of maximum permissible concentrations in the cases of redeployed pneumoconiotic subjects has yet to be tackled.

b) After pneumoconiosis has become distinct from pure silicosis to the extent to which quartz (wich was the main toxic factor) disappeared from the dust in mines, it gives place to a general pollution without any particular predominating toxic factor.

Mixed-dust pneumoconiosis will probably continue to develop along with the drop in dust levels which has been noted for several years now in European coalfields.

It also seemed that the ecological and lithological conditions of each coalfield would alter the permissible concentration for all the subjects, at the same time as individual sensitivity would explain the particular development of the illness amongst some of them.

These conditions are closely connected with some co-factors which are often unknown and whose existence is suspected but not proved.

Proposal:

To study:

- The action of the specific mycobacteria sensitisers;
- The influence of the trace elements (Cu, Zn, etc.);
- The inhibitory power of some petrographic elements;
- The action of nitrous vapours, and to establish thresholds of toxicity applicable to them.

III – IMPLEMENTATION OF THE RESEARCH PROGRAMME

1. Duration of the programme

Taking into account the development of research which, usually, requires a minimum of two years of actual work and often involves extensions connected with the process of the research itself, it appears advisable to allocate a total duration of five years for the third programme of health in mines.

This period encourages research into new objectives unconnected with the routine of normal work. However, it makes it possible to link up suitably with the fixed production targets without getting too much off the main track. Secondly it also corresponds with the duration of some national programmes.

The implementation of the programme, by presentation and examination in commissions of the projects laid down to be included in it, would therefore begin in 1972.

2. Financial aspects of the programme

The estimate of the credits to the granted for carrying out the research programme is based on the following considerations:

a) The implementation of previous programmes has shown over the years the research capacities of the different establishments and bodies which specialise in mining problems with whom the Commission of the European Communities establishes its research contracts. Their resources in terms of research workers and equipment are well known and constitute a precise basis for estimating the volume of work with which they can be entrusted. The majority of the establishments under consideration already possess sufficient basic equipment including measuring and analysing apparatus.

b) The third programme will differ from the previous one in so far as its activities will be concentrated on the most important points of technical prevention which have, moreover, been detailed above. We can act in this way thanks to the results produced in many other fields by the current programme.

The new research will mainly take place in the mines. Higher expenses than previously will result in order to have available the necessary testing personnel and equipment for carrying out research.

c) During the course of their work the research establishments and bodies have told the Commission of the European Communities of their projects and intentions with regard to the development of the activities which come within the framework of the new programme. These projects constitute one of the bases for assessing the financial resources to be placed at the disposal of research promotion.

d) The mining establisments are more disposed than in the past to entrust specialised parts of a research project to establishments which have the required equipment and specialists at their disposal.

Experience has shown that these commissioned research projects are expensive but have the advantage of preventing the dispersal of activities is one establishment and the acquisition of little-used equipment.

e) It is heardly necessary to say that the costs of equipment and staff have greatly increased during the past five years. Let us mention that in 1970 a comparative study pointed out that the total expenses necessary for a research project were 50% higher than in 1964.

It is essential to take account of this cost curve when allocating credits.

f) The credits to the allowed should make it possible to cover running costs throughout the duration of the programme.

Running costs comprise the holding of meetings of experts, publications, the circulating of results, travelling and subsistence allowances for experts and research workers, participation in specialised meetings, the organisation of study or information seminars, etc.

Taking these facts and the careful estimates made when this programme was prepared into account, it appears justified to ask for a credit of 4 500 000 units of account to be made available in order to bring the programme to a successful issue.

As in the past, it must be specified that the aid granted by the Commission of the European Communities may not under any circumstances exceed 75% of the total of the direct expenses resulting from the execution of each of the research projects.

3. Co-ordination of work — Circulation of results

As was the case for previous programmes, a renewed research commission will be charged with following the development of the research projects from the scientific and technical point of view and with ensuring the indispensible co-ordination of work in this field.

Groups of experts will be formed to study more particularly the development of specialised sectors, paying special attention to those regrouped under the three chapters of this programme.

These groups, which will be uniform in nature and small in number, will be required to examine, at the site where the research is being carried out, the relevant details and information to be deduced during the operations.

This will result in useful preliminary information, not only for the research workers but also for professional circles.

Furthermore, the Commission of the European Communities will make known, so far as it can, the knowledge acquired by research work, and will favourably receive all suggestions aiming at effectiveness in this field.

IV – CONCLUSIONS

The Commission of the European Communities,

Having regard to Article 55 of the ECSC Treaty has decided to allocate credits totalling 4 500 000 E.M.A. units of account over a term of five years for the execution of the research programme.

This decision is based on the following considerations:

- The pressing need, both from the social and industrial point of view, to continue the fight against mineworkers' pneumoconiosis by means of technical measures and to ensure better hygienic conditions in underground work
  - by technical dust control measures,
  - by preventive measures against air pollution caused by the vapours and gases emitted by mechanical equipment and shotfiring,
  - by improving the mine climate.
- the favourable and coinciding opinions received from consultative professional, governmental and scientific commissions for implementing a research programme entitled "Health in mines".

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P.O.B. 1003, Luxembourg 1

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