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Occupational Hygiene and Health Care in Polish Coal Mines

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Polish underground mining has a long history. The first written records on mining operations carried out in the area of the Silesian-Cracow basin come from 1136. Excavated at that time were silver and lead ores and later also iron ores.

The first act of law related to underground mining was passed in 1515.

Coal mining in Poland dates back to the 16th century. The first underground coal mines were established in 1760 in Silesia. The coal mining industry soon began to develop gradually as coal had become an indispensable resource material for the ferrous metallurgy as well as for the industries based on other metals.

In 1818 there were already 54 mines employing 2500 miners who excavated ca. 350,000 tons of coal in the same year. The deepest coal mine was then 84 m (250 ft). The present-day mines are built at depths exceeding 1000 m (3000 ft) while coal excavating sites are located as far as 3-5 km (2-3 miles) from the shaft.
The coal mining industry began to flourish in Poland after the end of the WWII. Not only was coal utilized by the economy, but it also constituted a main export commodity ensuring a steady flow of hard currency into the country.

At the end of the 80s of the 20th century, ca. 80 mines produced annually almost 200 million tons of hard coal and about 40 million tons of brown coal. The next decade, however, saw a considerable decline in the coal industry and current production does not significantly exceed 100 million tons per year.

**Development of coal extraction since 1930**

The steady development of the coal industry was followed by a continuous increase in the workforce from 83,000 up to 460,000 in 1990.
The system transformations in Poland in 1989 resulted in significant changes in the economy that was no longer managed centrally. In the conditions of market economy it became only too clear that coal production in Poland significantly exceeded the needs for this resource in the country while the export demand slowed down and rendered coal excavation unprofitable. This was soon followed by re-organization of the coal industry, lower production and significant reduction of employment.

Hard coal, however, continues to play an essential role in Poland. It satisfies ca. 70% of the total national power demand and in comparison with imported commodities such as oil and gas, it constitutes an inexpensive and easily available resource material.

Energy supply to all consumers in Poland in the year 2002

- Coal = 2500 PJ - 70%
- Oil = 700 PJ - 20%
- Gas = 325 PJ - 10%

(PJ = 10^{15} J)
The occupation of a hard coal miner belongs among the most dangerous jobs as regards life and health hazards, incomparable with any other profession. Only a coal miner has to perform his duties against the forces of nature. Not only do miners have to ride down a shaft to a depth that nowadays exceeds 1000 m, but they also have to work as far as several miles from the shaft bottom, the embodiment of contact with the natural environment and promise of a safe return to the surface. Only miners are exposed at any time to unpredicted rock mass movements, roof collapses, fires, massive breakouts of water, dust or gases as well as other factors causing accidents and disasters with direct health and life hazards. Facing practically unpredictable forces of nature on daily basis, a requirement never demanded of any other profession, miners are time and again left helpless and incapable of overcoming grave perils lurking underground.

The miner's occupational environment is characteristic of numerous, specific factors not encountered in other industries - often causing calamities with great loss of life or many serious occupational accidents.

All of these factors result in significant psychological burden and excessive stress that causes various acute functional and organic disturbances. Among secondary effects of excessive stress are significant general morbidity, sickness absenteeism, the so-called escape into sickness, subjective, unpleasant feelings of being burned-out, lack of enthusiasm or life force as well as readiness for being involved in accidents. Further consequences often manifest themselves in substantial deterioration of the general health status or depletion of the so-called biological potential of the organism.

Occupational underground workplaces are characteristic of the occurrence of hazardous chemical, biological and physical factors, also found in other industries. The most common, causing numerous cases of occupational diseases among miners include:

- dust with silica impurity, causing pulmonary silicosis;

**Specific events most directly responsible for fatal injuries of miners:**

- falls and sudden movements of rock or other material
- explosions of methane and / or coal-dust
- pressure bumps and bursts
- self ignition and uncontrolled burning of coal
- sudden emission / burst of dust, water, mine gases
- fire initiated by explosion of gas or dust
- excessive noise, leading to occupational hearing damage;
- mechanical vibration, resulting in the vibration disease;
- nitric oxides and other toxic chemical compounds in gases and explosive charge fumes, contributing to chronic bronchitis;
- microflora, responsible for occupational skin diseases.

**Underground miners** are exposed to harmful environmental agents:

- coal and silica dust
- noise
- mechanical vibration and shocks
- nuclear radiation
- hot and wet microclimate
- toxic gases, vapors and fumes
- biological hazards

Among other factors are hot and humid microclimate, significantly hard work coupled with exceptional high energy expenditure, performance of work in the stooping position with the twisted spine and overload of the joins and muscular systems in the lumbar-sacral region.

**Additional hazards:**
- ergonomic stress
- heat stress
- high energy expenditure
- insufficient ventilation
- insufficient illumination of worksite

These occupational conditions are most characteristic for confined coal excavating sites located deep underground and at a considerable distance from the shaft.
The unfavorable occupational conditions are well demonstrated by recorded cases of occupational accidents as well as the occupational disease incidence among miners.

Occupational accidents occur twice as often among miners than among other workers, while fatal accidents occur three times as often. It is more probable to be killed working as a miner than participating in a traffic accident. An interesting comparison contains fatal accident rates among miners in the USA and Poland. This indicator expressed as a value per 100,000 employees is in the USA ca. twice as high as in Poland. However, converted to 1 million tons of excavated coal, the indicator is significantly unfavorable for Polish miners.

![Rate of fatal injuries, per 100 000 full-time workers: in all industry in Poland and in underground coal mining](chart)

**The rate of fatal injuries of miners is about 3 times higher**
The risk of developing an occupational disease is exceptionally high among miners. Hard coal industry occupies a leading position on the list of occupational disease incidence for all industries while the related morbidity rate is 6-7 times higher than in the whole economy.

The most common cases of occupational diseases among miners include:

- pulmonary silicosis, an incurable disease that intensifies even after the miner retires and results in death among painful symptoms of respiratory failure;
- occupational hearing damage, an irreversible injury, worsening with age and depriving the miners of the possibility to communicate with others, using speech.
This results in acute degradation in the family and the society, denying the affected miner one of the basic values in life;
vibration disease, an incurable, painful disorder of the blood vessels, nerves and joints of the upper limbs that deprives patients of sensation in the fingers whose precise movements are then impossible.

These incurable diseases are most common among hard coal miners. Other occupational diseases contained in the official record are mostly disorders that following appropriate treatment recede without leaving any permanent effects.

Among the most characteristic factors related to the occupation of a coal miners are:

enormous accident risk;
the highest risk of suffering permanent and significant health damage due to occupational diseases;
extraordinary physical load resulting in hyper-stress;
risk of suffering from the status of psycho-physical burn-out.

The specificity of exposures as well as health and life hazards constitutes an ever-present characteristic of an occupation of a hard coal-miner. Sadly, no marked improvement should be expected in the years to come since the work of miners is closely related to the occupational techniques and technologies used in the underground coal mining and these will not be replaced in the conceivable future by better products.

In view of the data presented above it is only too clear that the currently standing in Poland system for health and life protection among miners remains inadequate and inefficient.

Focused on three different subjects, such as occupational safety, occupational hygiene and health protection, the system in question has so far suffered especially from lack of coherence when dealing with these three aspects. They are addressed separately, without any attempt to treat them as a complex of problems and tasks related to an individual miner and undertaken for his sake.
As regards occupational hygiene and health protection, the miner himself has become the focus of all attention. The issues concerning occupational safety, however, are tackled mainly in technical and organizational terms or in relation to the almost unpredictable behavior of coal deposits. Strangely enough, this is so even despite the fact that most available records indicate the significant role miners play in the creation of accident scenarios in almost every accident or dangerous event at an underground workstation.

The current safety and health care system focuses mainly on safety aspects underestimating the issues relating to occupational hygiene and preventive health care. In the 50s of the 20th century there were departments of Work Safety and Occupational Hygiene set up at every hard coal mine. These departments employed on average 4-6 inspectors. Even though the number of such specialists was on the increase - the 70s already saw the employment of more than 360 inspectors at different mines across the country – they have never really been professionally trained to operate effectively in the fields of occupational hygiene. The Work Safety and Hygiene inspectors do go through additional and thorough training as part of their regular duties, but for decades they were not instructed on occupational hygiene issues, with all the emphasis laid on work safety. The official records or statistics from 1970 concerning all aspects of operation of the coal mining industry do not even mention the concept of occupational hygiene.

Main determinants of insufficient hygienic surveillance over underground coal miners’ work sites:

- Limited knowledge of industrial hygiene among safety and hygienic inspectors
- Underestimation of hygienic requirements and standards related to organization and functioning of underground work sites
- Inconstant approach to occupational hygiene, occupational safety and health status of miners-treating the problems as separate issues and obligations

It was only within the period of the last 10 years that a new approach was adopted. Following the initiative launched by the Institute of Occupational Medicine and Environmental Health in Sosnowiec, a two-semester postgraduate training was organized at the Silesian Technical
University, Gliwice, for active inspectors and heads of the Work Safety and Hygiene departments in the field of occupational hygiene. In addition, a 5-year MA graduate course in occupational hygiene and safety is also offered at the same university. At the half of the 35 hard coal mines operating in Poland at present there is at least one Work Safety and Hygiene inspector with a technical university degree who successfully completed the two-semester postgraduate study. The postgraduate study and the 5-year MA graduate study are also officially recognized by the AIHA and ACGIH, whose representatives were consulted about the various aspects relating to the program of the training. Moreover, the Institute in Sosnowiec has for 6 years now directly monitored the operation of Work Safety and Hygiene departments at nearly one third of all active mines in the country. Training is offered in the field of occupational hygiene to the inspectors as well as mine-managers and supervisors.

It is worth mentioning that the participants themselves quickly notice the burning need to considerably broaden their knowledge and are highly motivated for acquiring further qualifications.

As regards miners’ health protection, the hard coal industry boasted its ‘Miners’ Fellowship’ organization set up as early as the 19th century, to address social issues as well as, to some extent, provide health care to miners. It operated a number of hospitals where treatment was offered first of all to coal mine workers. Immediately after the end of Second World War coal-mines offered employment to about 40 physicians whose main duty was that of certification of occupational disability cases. This was followed in the 50s by the establishment of the industrial health care system, from which the first units of the Mining Health Care Service were set up. Ten years later there were already more than 150 Departments of Treatment and Prevention, several mining hospitals, sanatoriums, and other units, operating in all branches of the mining industry. The Mining Health Care Service dealt with all health problems among active or retired miners as well as their families. One of the main tasks approached was prevention of occupational health damage in the true sense of the word. However, this almost exclusively consisted in carrying out preventive examinations both prior and during employment as well as in determining whether candidates were able to work in the coal mining industry. Among the advantages of the mining health service was the fact that its treatment and preventive facilities were located in the area of every mining settlement. This, however, was only appreciated when the service was suspended in 1998. Its tasks are now performed by units of Occupational Medicine, formally established in 1997.
Their structures include regional centers of Occupational Medicine as well as public and nonpublic field units and private medical offices.

These outpatient departments operate separately from industrial plants and they offer mainly services to the general population. Their activity in the field of Occupational Medicine is limited to preventive medical examinations carried out on the basis of agreements with individual employers. Only some 37% of physicians currently employed at Occupational Medicine outpatient clinics are specialists in Occupational Medicine.

On the strength of the act of law on Occupational Medicine passed in 1997, managers of industrial plants are no longer under obligation to run the plant’s own outpatient clinic. As a result, the health care system provided to the miners in Poland is not properly adapted to the specificity of the work of miners and is insufficient for the needs of this group of workers. Not only is this due to inadequate qualifications of Occupational Medicine physicians, but it is also caused by the still underestimated significance of prevention of accidents and health damage.

**Determinants of inefficiency of occupational health service related to underground coal miners:**

- Occupational health service – separated from coal mines them selves
- Limitation of occupational health service only to preventive medical examinations of miners instead of comprehensive approach to improve overall working conditions
- Insufficient professional knowledge and experience of occupational health service personnel (including occupational physicians).
It is a disturbing fact that the issues relating to health and life protection against unfavorable effects of accidents or exposures connected with underground work receive far less attention from coal mine managers than economic aspects. The miner’s health and life are still sacrificed for the sake of the primacy of production.

Enormous effort is yet to be made in order to markedly improve this situation. Work Safety and Hygiene inspectors as well as Occupational Medicine employees should obtain appropriate qualifications, however, it seems equally important that the awareness about health and safety issues should be raised among miners as well as all individuals responsible for proper operation of this branch of industry in Poland.