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European standards for emission of pollutants into the atmosphere and the selective exploitation of power coal beds

Key words

Mining industry, selective exploitation, management of production, quality parameters of coal

Abstract

The paper presents a review of the problems concerning the management of the exploitation process in black coal mines in the aspect of guaranteeing the supply of coal of proper quality, especially of low sulphur content for professional power plants that do not intend to build expensive desulphurizing installations, being simultaneously obliged to satisfy the European Union standards concerning the emission of pollutants into the atmosphere.

Introduction

The instruction 2001/80/EC of the European Parliament and the European Council of October 23, 2001 (Dyrektywa... 2001) that will be implemented from January 1, 2008 onwards concerns the limitation of emission of some pollutants into the air by big power plants of the combustion of fuels — Large Combustion Plants (LCP). The aim of the implementation is the reduction of emission of sulphur oxides, nitrogen oxides and dust. The instruction will be obligatory for plants of power combustion of fuels in which the amount of the thermal power introduced in the fuel per unit of time, at the nominal load of the plant (thermal power) is equal or greater then 50 MW, independently of the type of the applied fuel.

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The instruction refers to power plants of the combustion of fuels designed for power production excluding plants in which the combustion products are used directly in the production processes. According to the instruction, the so-called “value of allowable emission” is determined as an allowable quantity of a substance present in waste gases from a power plant of the combustion of fuels that can be introduced into the air in a determined period of time. It ought to be calculated as the mass of the emitted substances in a unit of volume of the waste gases and expressed in mg/Nm^3 , with the assumption that the volumetric content of oxygen in the waste gas is 3% at the combustion of liquid and gas fuels, 6% at the combustion of solid fuels and 15% in the case of gas turbines.

1. Standards of emission of the combustion gases and possibilities to satisfy them by professional power industrial plants

The instruction allows for two variances of the limitation of emission from the so-called existing sources, i.e. the sources that obtained the permission for their construction before July 1, 1987:

- 1) through the readjustment of all sources to the new strict standards of emission by January 1, 2008,
- 2) through the introduction of the Home Plan of Emission Reduction (Krajowy Plan... 2004).

In the Polish professional power industry the sources belonging to the existing categories are dominating. They need considerable investment outlays to meet the requirements of the instructions concerning the emissions of pollutants into the atmosphere. As it was estimated, the outlays ought to those investment undertakings that are necessary to reduce the emission of SO_2 from the year 2008 onwards and nitrogen oxides from the year 2016 (Uzasadnienie... 2004). Considering the fact that the year 2008 is the nearest of the two, the problem of the readjustment to the requirements of the instruction limiting the emission of SO_2 is particularly urgent.

Following the instruction, the standards of SO_2 emission are differentially depending on the power of the source, and divided according to the sources as subjects to the instruction into three groups (Fig. 1):

- 1) sources of the power $M \geq 500 \text{ MW}$ — allowable emission unit $400 \text{ mg SO}_2/\text{Nm}^3$,
- 2) sources of the power $100 \leq M < 500$ — allowable emission unit decreasing linearly from $2000 \text{ SO}_2/\text{Nm}^3$ for $M = 100 \text{ MW}$ to $400 \text{ SO}_2/\text{Nm}^3$ for $M = 500 \text{ MW}$,
- 3) sources of the power $50 \leq M < 100 \text{ MW}$ — allowable emission unit $2000 \text{ SO}_2/\text{Nm}^3$.

As it follows from the above restrictions the limitation of SO_2 emission into the installations of the power of 500 MW and higher is the most important. In the case of sources of the power $M < 100 \text{ MW}$ and some sources of the power $100 \leq M < 500 \text{ MW}$ the emission can be limited to the level of the standards allowable by the instruction through combustion of coal with reduced sulphur content.

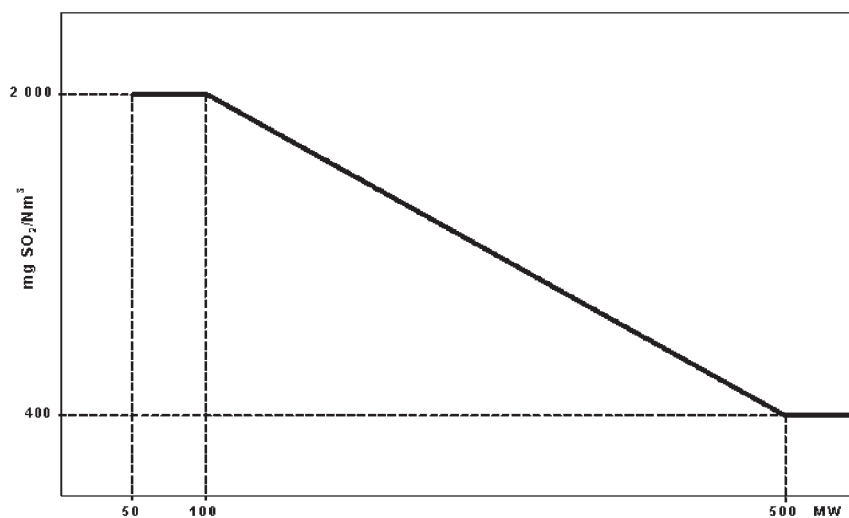


Fig. 1. Standards of SO₂ emission depending on the power of the source

Rys. 1. Wartość dopuszczalna emisji SO₂ w zależności od mocy cieplnej źródeł produkcji energii

The performed analyses have shown that the installation of desulphurizing system is the only solution for plants of the power greater than 350 MW. For all the other installations there are two solutions possible:

- 1) construction of desulphurizing systems of the combustion gases,
- 2) combustion of coal of low sulphur content.

2. Possibilities of the supply of power coal of low sulphur content

Construction of the systems of desulphurizing the combustion gases is an expensive investment. It was estimated that at the level of prices for the year 2002 the unit investment outlays in relation to the power contained in the fuel come up to about 150 000 zł/MW (Magda i in. 2005). An alternative consisting in the combustion of coal of relatively low sulphur content may be a cheaper solution.

The country's supplies of coal of low sulphur content are considerable and this fact guarantees the supplies in the long run for the professional power plants that are not going to build the desulphurizing systems. A special attention ought to be given to the supplies of coal in the beds of the group 500 that are not only characterized by their low content of sulphur but also low content of ash and high calorific value.

The mines with such supplies of coal can make long-term contracts with the consignees of the professional sector of power. Thus we should estimate the reserves of power coal of the content of sulphur as not exceeding 0.6%. A preliminary analysis shows that transacting of such a contract would be profitable for both sides.

It was estimated that the combustion of power fine coals with content of sulphur not exceeding 0.6% may correspond to the standards of the SO₂ emission allowable by the instruction. The consignee of coal could avoid the capital — consuming investments connected with the construction of the desulphurizing installations of combustion gases. However, in order to satisfy the standards of emission they would have to buy coal of low content of sulphur. They could buy it even at an appropriately higher price.

However, the increase of this price must not exceed a certain level resulting from the potential possibilities of saving financial means when not investing in the installations of desulphurizing the combustion gases.

The advantage for the suppliers of coal of relatively high quality, resulting from long-term transactions with the consignees from the sector of professional power plants, is the guarantee of the sale of coal for a long period of time. In the case when the desulphurizing installations are built by the receivers, it might be difficult to sell this coal at a price adequate to its quality. The possibilities of exporting this coal at a higher price would be also limited.

Generally, the commercial power coal produced by mines comprises coarse, medium and fine classes (crushed, washed and raw classes included). The possibilities of production of coal of the qualitative parameters satisfying the requirements of the consignees of the professional power industry sector. The consignees who are interested in the supplies of fine coal that will not exceed the standards of emission of pollutants in the process of combustion ought to be defined.

In order to do that, we can define the percent participation of production of individual classes and their qualitative parameters, especially, in relation to the power fine coal. It can be done on the basis of the planned exploitation of coal beds with the sulphur content not higher than 0.6%.

Using the data about the particular coal beds and their parts designed for exploitation, about volumes of reserves deposited there and their qualitative parameters, in the particular years in a defined period of time, we can define the possibilities of production of power fine coal that could be the object of future supplies for professional power industry, i.e. power fine coal of appropriate calorific value and sulphur content not greater than 0.6%.

When making a general assessment of the relation between the qualitative parameters of individual classes and the qualitative parameters of coal in a bed it has been established that for the determination of these relations the following assumptions can be considered:

- the calorific value of coarse and medium coal, crushed and washed fine coal corresponds approximately to the calorific value of coal in a bed,
- the calorific value of raw fine coal is smaller in relation to the calorific value of coal in a bed by 4 or 5 classes (i.e. the calorific value of raw fine coal is by about 4—5 MJ/kg smaller than the calorific value measured in the bed),
- in the volume of production of fine coal to meet the needs of coal supply with reduced sulphur content there can be included the medium classes and crushed, washed and raw fine coal and their calorific value is the mean weighted value of the calorific value of the particular components.

A possible satisfaction of the conditions of long-term contracts for the supply of coal of low sulphur content for professional power plants requires particular skill in the management of selective exploitation of power coal in the mines. These requirements refer to, above all:

- detailed reconnaissance of the supply base of the exploited bed both in regard to quantity as well as in relation to the qualitative parameters of coal,
- preparing a proper plan of the development of exploitation in a set period of time, correlated with the period of the contract,
- selection of coal flows of defined qualitative parameters at the bottom of a mine, starting from the foreheads and finishing with the treatment plant,
- in case of increased requirements of consignees in relation to the calorific value, we ought to consider the possibility of producing coal mixture of average qualitative parameters corresponding to the conditions of the contract in the technological process,
- in case when there will be no possibility of preserving the qualitative parameters by fine classes we ought to consider the possibility of improving the average qualitative parameters of the contract coal through grinding and mixing of average classes, e.g. pea-size coal with fine coal.

3. Possibilities of power coal export

Export to foreign markets is another possible way of taking full advantage of the power coal (fine coal of low sulphur content). The effectiveness of such a solution depends, to a considerable degree, on the fluctuation of the prices of coal on the world's markets. An example of the fluctuation of the price of power coal on the ARA market is shown in Fig. 2.

From the above diagram it follows that the observed tendency of a considerable increase of price in 2004 has been stopped lately. In the case of the Polish export of coal we ought to subtract the cost of transport from this price to obtain the price in the loco mine.

The cost of rail transport in 2005 is illustrated in Fig. 3. It is given according to the tariff of the Polish State Railways PKP concerning the consignment of coal of the mass 25 Mg in the biaxial rail car used in the home and international transport.

The figure illustrates the dependence of the unit cost of the rail transport expressed in dollars per tonne according to the exchange rate 3.24 zł/USD along the distance of transport. In the figure the basic rate and the decreased rates dependent on the minimum volume of a consignment have been given respectively:

- for consignments not less than 800 Mg — 5% reduction,
- for consignments not less than 1400 Mg — 8% reduction,
- for consignments not less than 2300 Mg — 9% reduction.

From the above data it follows that the cost of transport of coal is very high and, in the case of transport of coal from the Silesian mines to the home ports it oscillates at the level of over 25 USD/Mg.

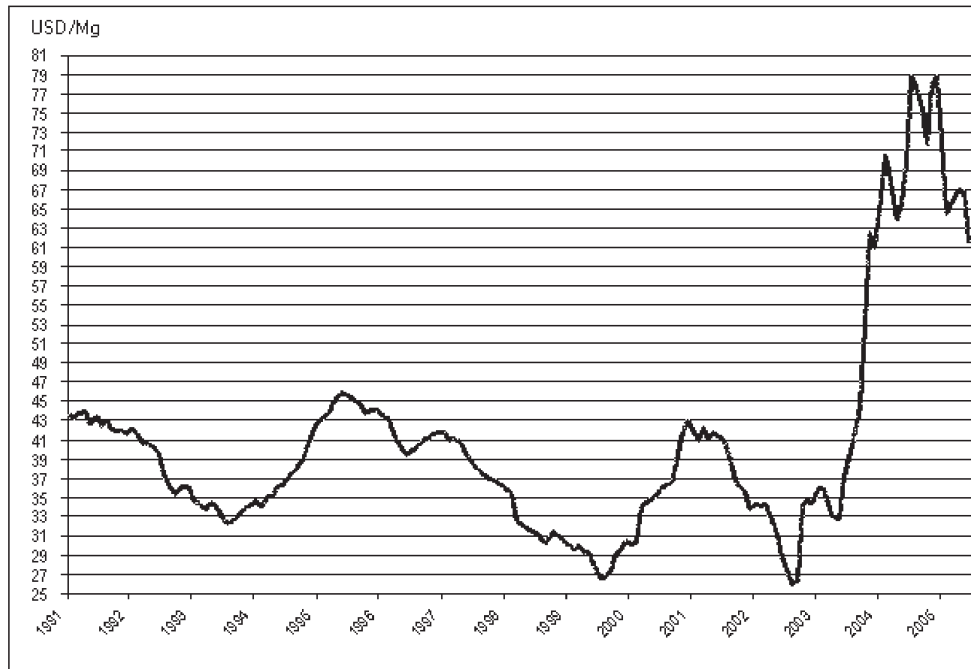


Fig. 2. MCIS steam coal marker price

Rys. 2. Cena węgla energetycznego na rynku światowym

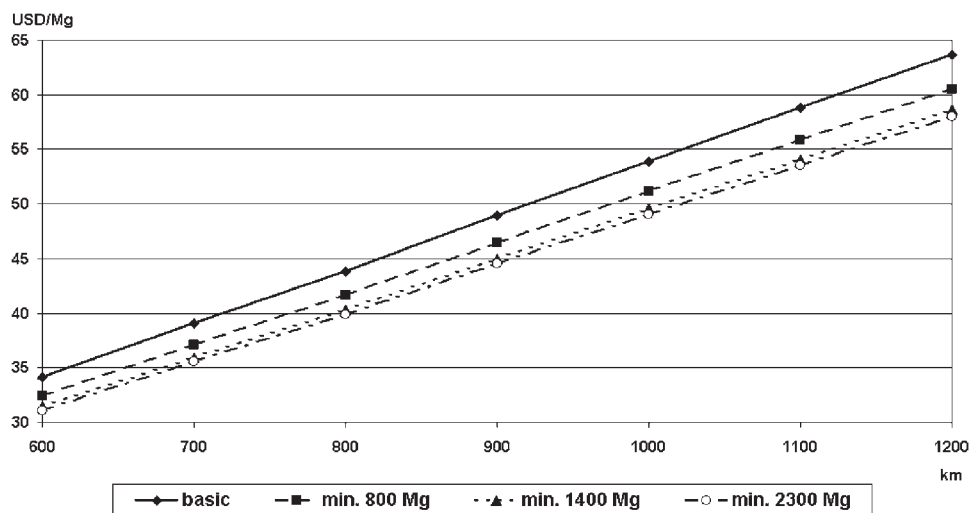


Fig. 3. Dependence of the unit cost of the rail transport in the year 2005 according to the PKP table of fares

Rys. 3. Kształtowanie się kosztu transportu kolejowego w 2005 roku według taryf PKP

Summary

Making possible the contracts for the supplies of power coal of low sulphur content to professional power plants requires greater efforts of the management staff of a mining plant and greater financial outlays.

However, as it follows from the conducted analyses, such solutions are profitable for the suppliers due to the possibility of achieving considerably high prices guaranteed in the contracts for the supplied coal of low content of sulphur in a long period of time.

At present, the mining plants interested in such contracts have sufficient time reserve to introduce in practice the appropriate solutions connected with selective exploitation, considering that the standards included in the instruction will become obligatory in their full range from the year 2008 onwards.

The paper is supported by MNiI — contracts no: 11.11.100.856, 11.11.100.949.

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EUROPEJSKIE NORMY EMISJI ZANIECZYSZCZEŃ DO ATMOSFERY A SELEKTYWNA EKSPLOATACJA POKŁADÓW WĘGLA ENERGETYCZNEGO

Słowa kluczowe

Górnictwo, eksploatacja selektywna, zarządzanie produkcją, parametry jakościowe węgla

Streszczenie

W artykule przedstawiono ogólny zarys problematyki związanej z zarządzaniem procesem wydobywczym w kopalniach węgla kamiennego w aspekcie zapewnienia sprzedaży węgla o odpowiednich parametrach jakościowych, szczególnie o niskiej zawartości siarki, do zakładów energetyki zawodowej, które nie zamierzają budować kosztownych instalacji odsiarczania, a jednocześnie są obligowane do spełnienia od 2008 r. norm Unii Europejskiej dotyczących emisji zanieczyszczeń do atmosfery.