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LETTER TO THE EDITOR

THE UTILIZATION OF IRON FROM COAL

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Polish coals contain 4 to 10 per cent of iron, mainly as pyrite (FeS_2), but also as oxides dispersed in ash. In power stations the coal is mostly pulverized and burnt as small particles. On the way from the burners, temperature of these particles increases and the conditions needed for the reduction of iron oxides, namely high temperature and the presence of carbon, are maintained inside the particles. The iron oxides can thus be transformed into metallic iron (probably containing dissolved carbon).

Further on their way from the burner the heated coal particles begin to burn and the temperature inside the particles increases again. Since the melting temperature of carbon–saturated iron is low (below 1200° C), the dispersed iron can coagulate into small droplets and can be separated from the ash. After a coal particle is burned the metallic iron oxidizes, mostly into magnetite Fe_3O_4. Pyrite also oxidizes to $FeO \rightarrow Fe_3O_4$ under these conditions. Most of the droplets of Fe_3O_4 adhere to ash particles that remained from coal particles.

Magnetite has ferromagnetic properties and can be easily removed in a low–intensity magnetic field. In power stations equipped with dry electric precipitators, flat magnets (with rotating magnetic field) are installed above belt conveyors that transport fly ash from precipitators. In case wet precipitators are employed, wet drum magnetic separators are used.

The concentrate separated from the fly ash contains 50 to 62 per cent Fe while the efficiency of separation (recovery) is 20 to 30 per cent only. As a result of low cost of such a process, even the low recovery is viable.

It has been found that the second stage separation (cleaning) of the concentrate, after being mechanically treated, increases the iron content in the concentrate by about 3 to 5 per cent. Mechanical treatment (pressing between rolls) causes the detachment of magnetite droplets from ash. In a small–scale investigation a concentrate containing 60.4 per cent Fe has been obtained from coal containing 9 per cent Fe, with the recovery of 55 per cent.

There are several magnetic separation facilities in Polish power stations and in 1977 their production was approximately 12 000 tonnes of concentrate [1]. This concentrate was used in coal mines for dense liquid separation. The principal use of such a concentrate is in sintering with iron ores for blast furnaces. It was stated that the addition of up to 100 kg of concentrate per one tonne of sinter, instead of the concentrate from Krivoy Rog (Ukraine) caused only negligible difficulties (changes in coke breeze consumption and production intensity). The behaviour of such concentrates from fly ash is much better than the behaviour of cinder pyrites during sintering.

The concentration of iron in Polish coals is higher in coals containing high percentage of sulphur. With reference to environmental regulations the coal containing high concentration of sulphur must not be used in power stations. Coal mines are thus forced to remove sulphur (mainly as pyrite) which results in elimination of some iron from the coal.

In this new situation the viability of separation of magnetite from fly ash must be assessed for each coal separately. Desulphurization of coal creates additional complication, namely the utilization of the pyrite thus generated. Pyrite can be used for the production of sulphuric acid. The remaining cinder pyrite can be employed as an iron–bearing material for the production of sinter for blast furnaces. The applied technology must ensure low concentration of carbon in the pyrite and also only traces of sulphur in the cinder pyrite.

REFERENCE

[1] W. Sabela et al.: *Hutnik 60* (1988), 177 (in Polish)