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MINERALOGICAL INVESTIGATIONS PERTAINING TO WASTE MINERAL RAW MATERIALS

One of essential tasks faced by geology and mining in the management of mineral raw materials includes a full utilization of all industrial minerals and rocks present in a given deposit; this problem should be tackled during exploitation, beneficiation and processing. Each of these steps is associated with inherent generation of wastes dependent on the stage of operations, technology used and the nature of a raw material treated. Most of these wastes, however, can be further utilized and as such they are called waste mineral raw materials. Not all of them find an immediate use and, bearing this in mind, should be stored as the so-called anthropogenic deposits (M. Nieć 1999). This way of deposition gives a chance that in the future they can represent mineral raw materials looked for, providing development of new technologies, changes of economic trends, etc.

Storing of waste mineral raw materials generates some problems of its own, not known in the case of natural mineral deposits. Formation of waste depositories depends on:

- selective exploitation;
- the history of deposition and the time that elapsed from the start of storing.

Both these factors can lead to differentiation of the material stored, and in extreme cases may limit or eliminate perspective of its use. It happened in the past that because of the lack of selective exploitation, wastes of differing types, not always representing waste mineral raw materials, were directed onto the same stockpile. For this reason the stockpile was contaminated with the components that make its utilization difficult or even impossible.

The time of existence of the stockpile may affect intensity and direction of chemical and other mineral-forming processes taking place within it. They may lead to changes in the primary character of the wastes stored.

Waste mineral raw materials should meet the criteria of anthropogenic deposits as in such a case they can be treated as utilizable. These criteria were defined by A. Bolewski (1994) and M. Nieć (1999). A stockpile may be treated as an anthropogenic deposit on the basis of a geological report if it shows that the material stored has the features of a mineral raw material. To reveal them it is necessary to complete many investigations, including mineralogical ones.

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Anthropogenic deposits should show, first of all, their practical usability, resulting from the data gathered in a report. The lack of sufficient information makes impossible an assessment of an industrial potential of the deposit, technological processes applicable and, finally, marketing perspectives. Main conclusions can be drawn from mineralogical and chemical studies (A. Bolewski 1995, S. Kozłowski 1996). It must be remembered that some of the properties determined for a natural mineral raw material can change in the course of its transport and stockpiling due to atmospheric factors, interactions among constituents, etc. Important are transformations resulting from weathering (penetration of water and air) as they initiate oxidation and leaching, giving rise to advanced alterations, particularly if sulphide minerals are present in the material stored. Thus, the range of mineralogical and chemical investigations that should be carried out in the case of anthropogenic deposits usually differs from that typical of natural deposits.

Another problem dealt with in the case of anthropogenic deposits is their sampling as it determines the extent of investigations necessary to establish the quality of a mineral material and makes a basis to plan selective exploitation (J. Kuszneruk, W. Wiśniewski 1996). With regard to their technological utilizability, anthropogenic deposits are highly variable, and their sampling must be more precise. For instance, weathering-induced transformations strongly differentiate the grain size of the material deposited near the surface and inside a stockpile. This issue was dealt with, among others, by J. Greszta (1963), W. Wiśniewski (1996) and T. Ratajczak (1998). Sampling of the outer layers of a stockpile provides information only on the material deposited in the last stages of stockpiling and usually does not represent the material that was disposed of earlier. The changes in grain size distribution within an anthropogenic deposit are associated with gravitational segregation or disintegration of grains during weathering. Obviously, sampling of such heterogeneous material is difficult, its rules cannot be standardized and each case present a problem of its own.

According to K. Skarżyńska (1997), information on mineral and chemical composition of waste mineral raw materials is indispensable because of:

- cognitive reasons (considering, among others, identification of processes taking place within anthropogenic deposits that affect technological potential of the material stored), and
- practical reasons, as they determine in turn
 - a. technological properties,
 - b. impact on natural environment,
 - c. possible use in civil engineering,
 - d. degradation of soils and possibility of their recultivation.

The initial group of analysis, in addition to standard methods, should include the determinations of the following:

- grain size distribution and grain morphology,
- the content of deleterious components (heavy metals, toxic elements, also sulphates and chlorides), controlling the possibilities and sense of further utilization,
- the content of organic matter,
- the presence and concentration of radioactive elements,
- self-ignition properties.

The significance of mineralogical investigations and the need of their customizing in the case of clay raw materials from the lignite deposit in Bełchatów was noticed by P. Simiczyjew et al. (1966). In general, the problem of research methods in the case of all waste mineral raw materials generated during utilization of coal in power plants (e.g. fly ash) is very specific and was considered, among others, by T. Ratajczak (1999).

The amount of waste mineral raw materials stockpiled as anthropogenic deposits and, by the same, their role in the domestic balance of mineral raw materials will be increasing in the future. Important methodological issues, such as those discussed above, represent a new challenge for mineralogical investigations and extend considerably their range. Their results can bring important information pertaining to the problems of anthropogenic deposits.

Praca powstała w ramach działalności statutowej realizowanej w Zakładzie Mineralogii, Petrografii i Geochemii Wydziału Geologii, Geofizyki i Ochrony Środowiska AGH (temat: Aspekty geologiczne, mineralogiczne i geochemiczne jako kryteria kompleksowego i proekologicznego wykorzystania Krajowych surowców ceramicznych.)

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