Ročník 6. 2003 Mimoriadne číslo

Acta horticulturae et regiotecturae

◆ ENVIRO Nitra 2002

◆ Zborník vedeckých prác

7

Acta horticulturae et regiotecturae – Mimoriadne číslo
Nitra, Slovaca Universitas Agriculturae Nitriae, 2003, s. 158–160

ESTIMATION OF POSTMINING AREAS OF THE KAZIMIERZ PÓŁNOC STRIP MINE INTERIOR DUMPING GROUNDS

HODNOTENIE ZEMÍN VNÚTORNEJ HALDY POVRCHOVEJ BANE „KAZIMIERZ PÓŁNOC"

Piotr STACHOWSKI, Czesław SZAFRAŃSKI, Paweł KOZACZYK

Poznanská poľnohospodárska univerzita, Poznaň, Poľsko

The article presents the results of the research and field observations carried out on nine experimental plots situated on the area of the interior dumping grounds, situated on the area of the Kujawskie Lakeland (latitude 52° 20' N, longitude 180° 5' E). Trans section A-A, as the most representative for the analysed experimental plots, was subjected to a detailed analysis. The surface infiltration and deeper strata percolation measurements in four repetitions, applying the method of single infiltrometers of 11 cm diameter, were carried out in every representative profile. The dominant formations occurring in the surface layers of the postmining grounds are clays, originating from Central Polish glaciation. A layer of clayish having the thickness of 0.5–1.0 m, situated on sandy clay, was found only on two plots (4 and 5).

Key words: soil texture, dump soil, postmining areas, soil recultivation

Brown coal excavatory exploitation brings about geomechanical and hydrological transformations in the surrounding natural landscapes (Stankowski, 1991). A particular influence is imposed on soil (Boroń and Klatka, 1997). The position of soils, most frequently of low land - capability taxation classes, was replaced by exterior and interior dumping grounds and final excavations. The arising dumping areas change the landscape architecture and create new ecological relations which demand a long period of time to reproduce proper structures (Lyle, 1986).

As a result of various recultivation procedures and long time utilization, they are introduced into the field of either agricultural or forest production. The aim of the research was both to evaluate the state of the postmining areas cover and their infiltration capabilities, the interior dumping areas of the Kazimierz Północny strip mine where technical recultivation had been carried out and agricultural recultivation had been begun.

Material and methods

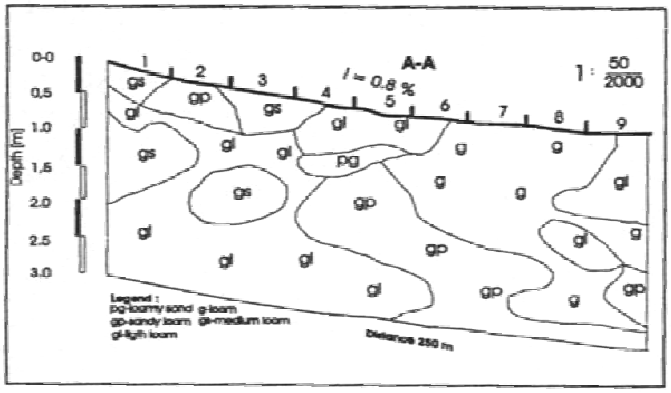
The work was based on the results of the research and field observations carried out on nine experimental plots situated on the area of the interior dumping grounds, situated on the area of the Kujawskie Lakeland (latitude 52° 20' N, longitude 180° 5' E). The dumping area where the investigation was conducted is levelled out with the data of the surrounding area and belongs to the type of dumping site with the top cover adjusted to the neighbouring land level. After the technical recultivation had been completed in 1998, the agricultural recultivation procedures started. Detailed field investigations comprised drillings and soil excavations in three trans sections crossing the selected plots from East to West. On the basis of 27 drillings performed in every trans section (altogether 80 drillings) down to the depth of 3 m, the reach of grounds of the same soil texture was denoted for every plot. They were selected according to the site selection (Zając, 1994) and are in 70–80% representative for the analysed experimental surfaces. Samples with undisturbed texture were taken in the profiles for laboratory analyses. The granulometric composition of the investigated profiles was denoted applying Casagrande's aerometric method after Prószyński's modification. Trans section A-A, as the most representative for the analysed experimental plots, was subjected to a detailed analysis. The surface infiltration and deeper strata percolation measurements in four repetitions, applying the method of single infiltrometers of 11 cm diameter, were carried out in every representative profile.

Results and discussion

Typic Hapludalfs or Glossaquic Hapludalfs soils, frequently eroded, resulting from sands situated on a clay layer and boulder clays (Marciņek, 1992) were prevailing in the soil cover of the researched area before the excavatory exploitation started. Detailed geodesic measurements showed that at the stage of technical recultivation, the surface of the dumping area was properly formed. The maximum declivity on the length of a ten meter segment equalled 5 m and minimum one reached 0.75% of the 100 m long section in the analysed transection A-A. Mean declivity value for the whole investigated transection amounted to 0.8%. Relevant acclivity heights measured 0.5 m per 10 m segment. In agreement with The act concerning protection of agricultural and forest areas (1995), with the delevelling degree up to 0.7 m per 10 m segment, it is permissible to adapt such a postmining area for agricultural use. On the basis of the detailed pedological investigations, it can be stated that the surface layers (0–3.0 m) of the postmining areas show low diversification in the transection A–A (Fig. 1).

The dominant formations constituting the surface layers of the investigated experimental areas are selectively formed clays originating from the Central Polish glaciation. A layer of clayish sand with thickness from 0.5 to 1.0 m situated on sandy clay was

Figure 1 Pedogenetical section of investigated experimental areas A-A trans sections
Obrázok 1 Priečny pedologický rez experimentálneho povrchu transektu A–A

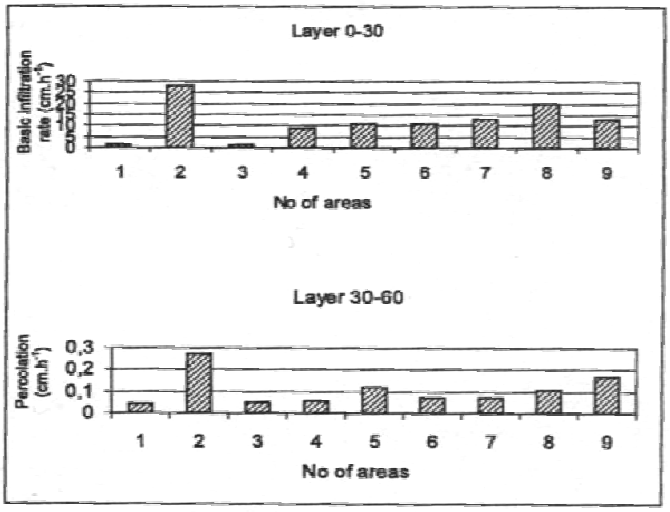


found in plots 4 and 5 only. Clays and light clays were prevailing in one – meter layer of the analysed surfaces. Surface layers (0–0.5 m) of plots 1 and 3 were formed from medium clays changing into light clay. However, the surface layer of grounds in plot 2 is formed from sandy clay, changing into light clay at medium depth. Grounds with graining of light clays with fillers of medium clays (areas from 1–3), as well as sandy clays and clays (plots 4–9) prevail in the formations situated below one - meter layer. The presented analysis proved that the formations with clay graining, potentially more productive and useful in agricultural recultivation, are dominant in the surface layer. The favourable state of the postmining areas cover was formed owing to the presently applied in the Polish mining method of selective dumping of the cap-rock material. In the system the covers of the dumping grounds are built to the height of the surrounding area (Gilewska, 1991). Whereas, the non selective dumping method applied formerly caused high diversification of granulometric composition and physical properties, as well as postmining water grounds. It also influenced the effectiveness of many – year agricultural recultivation practices lowering it (Szafrański and Stachowski, 1997).

However, the carried out field experiments showed meaningful differences in permeability of the surface layers of the investigated postmining areas profiles (Fig. 2). In the profiles typical for plots 1 and 3, where the surface layer (0–30 cm) is formed by medium clay, the coefficient of the defined infiltration oscillates from 1.05 (profile 3) to 1.6 cm.h^{-1} (profile 1), on the average 1.32 cm.h^{-1}. According to Ridder (1974) the grounds can be described as presenting very low or medium - low infiltration class (FAO, 1971). The remaining postmining grounds profiles perform higher infiltration capabilities. The areas formed of either sandy clays or light clays present stable infiltration coefficients reaching from 9.1 (profile 4) to 27.6 cm.h^{-1} (profile 2), on the average 15.0 cm.h^{-1}. The obtained values classify the areas as belonging to a very high infiltration class (Rider, 1974), or medium high class (FAO, 1971).

A few times lower values were observed in 30–60 cm layer of the grounds in interest. The pace of water percolation in this layer was the lowest also in the profiles built of medium clays. The measured percolation coefficients in the profiles reached the value from 0.045 cm.h^{-1} (profile 1) to 0.05 cm.h^{-1} (profile 3), on the average 0.045 cm.h^{-1}. Whereas in the remaining profiles formed from light clays and clays, the pace of water percolation in the layer was higher and reached 0.12 cm.h^{-1} on the average.

Figure 2 Value vertical percolation in layer 0–30 cm and vertical percolation in layer 30–60 cm of experimental plots
Obrázok 2 Hodnoty koeficientu infiltrácií ustaľovania vo vrstve 0–30 cm a perkolácií vo vrstve 30–60 cm na pokusných povrchoch



Conclusions

1. The method of a selective dumping of the cap-rock material applied nowadays has improved the process of technical recultivation. The research proved low changeability also in the spatial configuration, as well as in profile granulation and fundamental physical and chemical properties of the investigated interior dumping area.
2. The dominant formations occurring in the surface layers of the postmining grounds are clays, originating from Central Polish glaciation. A layer of clayish having the thickness of 0.5 m–1.0 m, situated on sandy clay, was found only on two plots (4 and 5).
3. The carried out field investigations proved the existence of vital differences in the permeability of the surface layers of the researched grounds. The lowest infiltration capabilities were observed on the surfaces formed from medium clays. The values of infiltration coefficients defined in the 0–30 cm stratum of the clays were on the average 1.32 cm.h^{-1} and over 10 times lower than in sandy clays and light clays.
4. Detailed geodesic measurements proved that also at the stage of technical recultivation, the area of the dumping ground was formed properly. The areas in focus can be agriculturally utilized.

Súhrn

V príspevku sú výsledky výskumu a terénnych pozorovaní, uskutočnených na 9 experimentálnych plochách, situovaných na vnútornej halde povrchovej bane „Kazimierz", ktorá sa nachádza na území Kujavských jazier (Pojezerzie Kujawskie, zem. šírka 52° 20' N, zem. dĺžka 18° 05' E). Výsledky podrobného terénneho výskumu a laboratórnych analýz ukázali, že metóda selektívneho zaobchádzania s krycou vrstvou spôsobila pomerne malú variabilitu zemín tak v priestorovom, ako aj v profilovom usporiadaní. Dominujúcou zeminou, ktorá tvorí po-

vrchovú vrstvu skúmaných experimentálnych plôch, je hlina. Tento výskum však ukázal, že sú rozdiely v priepustnosti analyzovaných zemín. Najmenšie infiltračné schopnosti sa zistili na experimentálnych plochách utvorených zo strednej hliny. Výskum potvrdil, že analyzované zeminy sú vhodné na poľnohospodársku rekultiváciu.

Kľúčové slová: granulometrické zloženie, rekultivovaný povrch, pôdna rekultivácia

References

BOROŃ, K. – KLATKA, S. 1997. Use of the soil productivity index for evaluation of farmland influenced by coal mining. International. Symp. Green 2. Contaminated and derelict land. AR Kraków, 1997, p.157–160.
FAO 1971. Land and Water Development Division. Rome, Bull., 1971.
GILEWSKA, M. 1991. Rekultywacja biologiczna gruntów pogórniczych na przykładzie KWB „Konin" In: Rocz. AR Pozn. Rozpr. Nauk., 1991, no. 211. p. 60.
LYLE, E. S. 1986. Surface mine reclamation manual. Elsevier Science Publishing Co. N. Y., USA, 1986.
MARCINEK, J. 1992. Parametryzacja środowiska glebowego w aspekcie gospodarki wodnej gleb. In: Probl. Agrofiz., 40, Wrocław, 1992. Wyd. PAN, Ossolineum.
RIDDER, N. 1974. Drainage principles and applications. Wageningen, 1974.
STANKOWSKI, W. 1991. Przemiany środowiska geograficznego obszaru Konin-Turek. Praca zbiorowa. Inst. Badań Czwartorzędu UAM Poznań, 1991, no. 255.
SZAFRAŃSKI, CZ. - STACHOWSKI, P. 1997. Skład granulometryczny i właściwości fizyko-wodne rekultywowanych gruntów pogórniczych. In: Rocz. AR Pozn., 292. ser. Melior. Inż. Środ. 1997, no.18, p. 91–101.
USTAWA z dn. 3 lutego 1995 r. o ochronie gruntów rolnych i leśnych (1995). Dz. U. Nr 16, poz.78 z późniejszymi zmianami.
ZAJĄC, K. 1994. Zarys metod statystycznych. Warszawa : Państ. Wyd. Ekon., 1994, p. 57–60.

Contact address:
Dr. inż. Piotr Stachowski, prof. Dr. hab. inż. Czesław Szafrański, Dr. inż. Paweł Kozaczyk, Katedra Melioracji i Kształtowania Środowiska, Akademia Rolnicza im. A. Cieszkowskiego, 61-691 Poznań tel.: 061/846 64 26, 061/846 64 25, 061/846 64 17, e-mail: pstachowski@poczta.onet.pl

Acta horticulturae et regiotecturae – Mimoriadne číslo
Nitra, Slovaca Universitas Agriculturae Nitriae, 2003, s. 160–167

A STATISTICAL MODEL OF A RIVERBED SCOURING BELOW RAPIDS OF INCREASED ROUGHNESS

ŠTATISTICKÝ MODEL VÝMOLU POD ZDRSNENÝM SKLZOM

Ryszard ŠLIZOWSKI

Agricultural University Cracow, Poland

In the paper, investigations on rapids of increased roughness are presented. On the base of results obtained from hydraulic model investigations covering six engineering structures of rapids, parameters of functions were determined to describe the riverbed deformation phenomenon below those rapids. A multiple regression was used to describe the model, and this regression function was analysed with regard to the four-coefficient and seven-coefficient model. The main aim of using those two types of functions was to verify whether or not the function form essentially impacts the coefficient value of model consistency with the values as stated for the hydraulic model.

Key words: rapids, model, scouring, rapid parameter

Attempts were made to find adequate design solutions to mountainous stream engineering structures that would meet both technological and natural requirements. As a result there of, rapids, constructed of natural stones, were designed. Those rapids appear really successful in replacing traditional concrete drops. They are cheaper than the latter, and involve no engineering problems whilst being constructed, adequately harmonise with the surrounding natural environment, effectively aerate stream water, and enable the unimpeded passage of fish (Zastera, 1984).

The riverbed deformation phenomenon below rapids is an effect of water and rock-debris movements; this particular hydraulic phenomenon has been least investigated of all the hydraulic issues studied. So far, there is no satisfactorily accurate mathematical description of any local deformation ensuing below a river engineering structure. This is why numerous studies on this topic have been conducted (Błażejewski, 1989). These are mainly laboratory investigations, rarely, analytical studies, and field research are conducted only occasionally. On the basis of calculated parameters of a local deformation below the engineering structure, it is possible to discover something and to get an idea about the expected erosion and its scale below such a structure. Empirical formulas, allowing for the determination of an erosion magnitude below the structure, are applied, but only to a limited extent. Theoretical rates and numbers obtained are larger than those stated under natural conditions (Nowak, 1997). They are usually used in comparative analyses, or for the purpose of correlating the scour depth, the elementary decrease in the water discharge (flow rate), the depth of lower water. The rapids appear also useful when deciding on what preventive means should be taken to protect the lower site. The