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Selected physical and water properties of soils located in the vicinity of proposed opencast lignite mine "Drzewce" (middle Poland)

Abstract: The paper presents physical and water properties of six soils located in the areas directly adjacent to "Drzewce" lignite open cast mine (KWB Konin). The conducted works included preparation of pits of various soil types in points characteristic to large and representative soil allotments. The selected soil types represented mineral and organic soils. Samples of disturbed and undisturbed structure were taken from various genetic horizons for laboratory analysis. Such properties as content of total carbon, texture, specific density, bulk density, total and drainage porosity, moisture, saturated hydraulic conductivity, the potential of water bonding, total and readily available water, and total retention were determined in the samples from the horizons of 0–100 cm. The investigated soils showed mostly sandy texture with few local loam insertions. Texture and the content of organic matter were the most important parameters which influenced all analyzed properties. Morphology and the properties of the examined soils as well as deep level of soil – ground water were decisive factors when categorizing them as a precipitation-water type. Such soils will not undergo degradation caused by the dehydrating depression cone of open cast mine.

Key words: soil degradation, dehydratation, texture, density, retention

INTRODUCTION

Dynamically developing lignite mining leads to numerous significant changes in the hydrography of the terrain. This is true for both the terrain where mining ground works are conducted as well as for the neighbouring areas. Such changes are the result of the draining influence of the so-called dehydration barrier which is set up in order to drain deep tertiary deposits among which a lignite is settled (Mocek et al. 2000a, 2000b). Dehydrating degradation of soil productivity caused by the opencast mining proceeds mainly in hydrogenic soils, where a shallow mirror of soil-ground water was the crucial soil forming factor (Rząsa et al. 1999). Such process happens to occur, however, also in mineral soils located in the vicinity of the opencast mine. The basis of dehydrating processes is the presence of so called free water which leaches out and is not constantly bound with soil solid phase. The leaching of these waters, which are usually not productive ones and very often cause a seasonally harmful excess of moisturization in the arable grounds, may also be a positive phenomenon which ameliorates the excessively moisturized farmlands (Rząsa et al. 1999). When conducting the assessment of the influence of a dehydration barrier of deep mining excavations and any other excavations, it is especially important to recognize the primary physical properties of the soils (before the start of opencast mine activity – the 1st stage of the research) and the assessment of changes which proceed in them, both during the operation and when the opencast works are done (monitoring) (the 2nd stage of the research) (Kaczmarek et al. 2000, Mocek et al. 2000a). The knowledge about basic physical and water properties of soil allows for the assessment of its original productive properties. Among all, on such a basis it is possible to forecast the vulnerability of each soil (allotment) to dehydration. The paper presents the results of the research which were a representative element of the 1st stage of the research conducted in the vicinity of the proposed "Drzewce" opencast lignite mine.

MATERIALS AND METHODOLOGY

The object of the research was located in the eastern part of Wielkopolskie voivoidship (middle Poland) and included the territory of four villages: Konstantynów, Budzisław, Budki Stare and Witowo (province of Kramsk) of total area of 1200 ha (Kondracki 2009). These grounds were located in the direct neighbourhood of the proposed excavation of

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the "Drzewce" opencast within a bottom-moraine plain of the last glacial period. They were most often covered with mucky soils, organic mucky soils, black earths, arenosols, and rusty soils (PSC 2011), which can be classified as Umbric Gleysol, Sapric Histosol, Gleyic Phaeozem, Haplic Arenosol, Brunic Arenosol according to WRB (IUSS Working Group WRB, 2015). Parent rocks were mainly: moraine loams (sandy loams in near-surface horizons), and fluvioglacial sands. The investigated soils remained arable lands and represented wide scopes of land classification (from III to VI) and complexes of arable soils (from 2z to 7). Six excavations were completed in the representative points of large allotments. Their morphology and systematics were described according to PSC (2011), and their classes and complexes of arable soils were marked (Mocek and Drzymała 2010). The soils studied represented mucky soils – Umbric Gleysol (profile 1 and 2), arenosol – Haplic Arenosol (profile 3), organic mucky soil – Sapric Histosol (profile 4), typical black earth – Gleyic Phaeozem (profile 5), and typical rusty soil – Brunic Arenosol (profile 6).

Samples of disturbed and undisturbed structure (V=100 cm^3) were collected from each genetic horizon and submitted to laboratory research. In the samples the following properties were studied: texture – with the aerometric-sieve method (PKN 1998), particle density – with the pictonometric method (Soil Conservation Service 1992), whereas in mineral-organic and organic horizons – with Okruszko's pattern (Okruszko 1971), soils bulk density – with Nitzsh's vessels of 100 cm^3 capacity, total porosity – calculated on the basis of density, moisture – with the dryer-gravimetric method, maximal hygroscopic capacity – in a vacuum chamber at the vacuum of 0,8 atm and with K_2SO_4 saturated solution (Mocek and Drzymała 2010), the content of organic matter – on the basis of calcination loss, saturated hydraulic conductivity – with the method of constant pressure drop (Klute and Dirksen 1986), water bonding potential – with Richard's method of pressure chambers (Klute 1986), total (TAW) and readily (RAV) available water – calculated on the basis of pF markings, effective (drainage) porosity (the sum of soil macro- and mesopores, called drainage porosity throughout the text) was defined as a difference between total porosity and moisture corresponding with field water capacity (marked at the potential –10 kPa, which corresponds with the value at pF=2.0) and partial capacity of pores of >30 μm diameter. The correlation coefficient was calculated in Microsoft Excel. All the published results are average values from five replications.

RESULTS AND DISCUSSION

Texture of the investigated soils was sandy. Within A horizons, the coarsest texture was found in soil 2 (the content of sandy fraction was almost 94%), and the heaviest – soil 4 (with the content of sandy fraction of 78%).Textures from sand (S) through loamy sand (LS) to loam (L) were found (FAO 2006) (Table 1). Texture of epipedones was determined by the origin of parent rocks. Texture was not determined in mineral-organic and organic horizons.

Apart from texture, a very important feature which determinates physical and water properties, is the amount and quality of organic matter. In epipedones it oscillates between 0.95 and 41.12%. It was also very high – of 79.25% – in the peat horizon, in profile 4 (Table 2).

Particle density oscillated between 2.63 and 2.65 Mg·m^{-3} in mineral horizons. Much lower values of this property were observed in horizons built of mineral-organic and organic deposits; muck (profile 4) at the depth of 0–12 cm – 2.10 Mg·m^{-3}; peat (profile 4), at the depth of 12–55 cm – 1.68 Mg·m^{-3} (Table 2). The lowest values of dry soil density were found in profile 4. In the mucky horizon, at the depth of 0–12 cm, it was 0.49 Mg·m^{-3} (at total porosity of 76.67%); in peat (depth of 12–55 cm) – 0.28 Mg·m^{-3} at the highest total porosity of 83.33%. In case of other soils, low bulk density – 1.43 Mg·m^{-3} – was observed in profile 2; depth of 0–32 cm (at total porosity of 40.91%). The highest density – 1.72 Mg·m^{-3} – was observed in profile 5; depth of 100–150 cm (at the lowest total porosity of 35.09% (Table 2).

Natural moisture was highly differentiated in the examined samples and oscillated within the scope of 7.04 (profile 1; depth of 40–150 cm) and 36.97%v/v (profile 5; depth of 80–150 cm) (Table 3). The presented values of natural moisture cast light on the relation between the content of water in soil and its texture and humus. They cannot, however, be the subject of a detailed analysis as they characterize only the state of temporary (current) moisturization of each genetic horizon of the investigated soils and these parameter undergoes dynamic changes, mainly as a result of precipitation, tillage, vegetation etc. The only objective ones are – discusses below – the so called water-soil constants.

The highest values of the maximal hygroscopic capacity (MH) were observed in muck and peat horizons (profile 4) and were, respectively, 15.2412 and 10.8263%v/v, whereas its lowest value was observed in profile 2 (depth of 32–60 cm) and was 0.3352%v/v (Table 3). Among mineral horizons, the highest MH was observed in endopedon of the heaviest texture

TABLE 1. Texture of the investigated soils

Profile No.	Genetic horizon	Depth (cm)	Percentage content of fraction in diameter (mm)									Texture acc. FAO
			2.0 –1.0	1.0 –0.50	0.50 –0.25	0.25 –0.10	0.10 –0.05	0.05 –0.02	0.02– 0.005	0.005 –0.002	<0.002	
1	Au	0–25	0.18	7.06	49.23	8.53	13	9	11	1	1	LS
	Cg	25–40	0.98	6.42	36.77	16.83	11	8	13	4	3	LS
	2Cg	40–150	0.43	3.31	75.33	17.93	1	1	1	0	0	S
2	Au	0–32	9.86	32.98	31.36	15.80	4	2	4	0	0	S
	C1	32–60	6.15	38.75	33.30	18.80	1	1	0	1	0	S
	2Cg	60–70	0.09	1.76	6.08	9.07	28	16	9	22	8	L
	3Cg	70–150	4.22	36.78	34.85	16.15	3	2	1	2	0	S
3	Ap	0–23	2.83	5.73	15.95	41.49	19	8	6	0	1	S
	C1	23–33	0.48	1.48	6.89	74.15	13	2	1	1	0	S
	C2	33–150	0.69	2.14	7.33	67.84	15	3	1	2	1	S
4	M	0–12	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	muck
	Oa	12–55	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	peat
	C1	55–80	1.55	12.47	39.75	62.98	11	6	3	2	1	S
	Cg2	80–150	0.45	9.77	18.99	23.79	31	8	3	4	1	LS
5	Ap	0–32	0.75	2.75	18.15	43.35	17	9	5	3	1	LS
	AC	32–45	2.20	3.76	21.88	38.16	14	8	1	2	2	S
	C1	45–60	0.76	4.32	35.85	48.07	5	2	1	2	1	S
	Cg2	60–100	0.78	4.45	29.97	55.80	4	3	0	1	1	S
	G	100–150	1.54	5.79	38.24	44.43	3	4	1	1	1	S
6	Ap	0–22	3.17	7.46	33.31	36.06	6	6	6	2	0	LS
	Bv	22–55	0.95	5.50	28.15	50.40	8	3	3	0	1	S
	C1	55–110	0.65	3.78	33.01	54.56	3	3	1	0	1	S
	C2	110–150	1.10	6.33	39.14	43.43	5	3	0	1	1	S

n.a. – not analyzed, LS – Loamy sand, S – Sand, L – Loam.

(profile 2; horizon 2Cg). The same rule – the relation between the size of MH and the content of colloids (both mineral and organic), caused the differentiation of hygroscopic moisturization which values oscillated between 0.1676% v/v in humus-free loose sand (profile 2; horizon C1) and 5.3835% v/v (profile 4; horizon M).

Values of the saturated hydraulic conductivity in epipedones from the investigated soils were high and very differentiated. In mineral top horizons they oscillated between 16.03 (profile 5; depth of 0–32 cm) and 39.63 µm·s^{-1} (profile 3; depth of 0–23 cm). Much higher values were observed in the epipedones of two soils: 85.03 µm·s^{-1} (profile 4; depth of 0–12 cm) and 121.17 µm·s^{-1} (profile 2; depth of 0–32 cm). The lowest speed of filtration was found in endopedones with the composition of a loamy sand – 1.43 (profile 1; depth of 25–40 cm) and loam – 0.87 (profile 2; depth of 60–70 cm). A visible influence of texture on the speed of filtration was also noticeable – along with the decreasing content of colloid clay, the speed of filtration grew. In accordance with this rule, maternity and underlying rocks with the composition of a loamy sand carried water with high speed when fully saturated; the speed usually exceeded 100 µm·s^{-1} (Table 4). It provides conditions for fast and effective natural drainage of precipitation water in these soils.

TABLE 2. Basic physical properties

Profile No.	Genetic horizon	Depth (cm)	Organic mater (%)	Particle density (Mg·m^{-3})	Bulk density (Mg·m^{-3})	Porosity	
						total (%)	drainage (%)
1	Au	0–25	10.50	2.63	1.49	43.37	14.30
	Cg	25–40	n.a.	2.63	1.67	36.85	7.95
	2Cg	40–150	n.a.	2.65	1.62	38.87	30.04
2	Au	0–32	12.33	2.42	1.43	40.91	11.84
	C1	32–60	n.a.	2.65	1.68	36.75	29.46
	2Cg	60–70	n.a.	2.65	1.61	39.25	6.06
	3Cg	70–150	n.a.	2.65	1.66	37.36	22.61
3	Ap	0–23	0.95	2.64	1.54	41.67	24.92
	C1	23–33	n.a.	2.65	1.71	35.47	17.76
	C2	33–150	n.a.	2.65	1.58	40.37	34.37
4	M	0–12	41.12	2.10	0.49	76.67	12.66
	Oa	12–55	79.25	1.68	0.28	83.33	6.19
	C1	55–80	n.a.	2.65	1.69	36.23	21.60
	Cg2	80–150	n.a.	2.65	1.63	38.49	26.96
5	Ap	0–32	1.23	2.64	1.52	42.42	3.79
	AC	32–45	0.52	2.65	1.59	40.00	24.27
	C1	45–60	n.a.	2.65	1.68	36.60	29.29
	Cg2	60–100	n.a.	2.65	1.70	35.85	27.44
	G	100–150	n.a.	2.65	1.72	35.09	26.52
6	Ap	0–22	1.11	2.64	1.64	37.88	24.14
	Bv	22–55	n.a.	2.64	1.59	40.17	31.75
	C1	55–110	n.a	2.65	1.63	38.49	31.73
	C2	110–150	n.a.	2.65	1.67	36.98	28.45

n.a. – not analyzed.

TABLE 3. Basic water properties

Profile No.	Genetic horizon	Depth (cm)	Moisture (%v/v)	Higroscopic water		Maximum higroscopic capacity	
				(%m/m)	(%v/v)	(%m/m)	(%v/v)
1	Au	0–25	28.52	2.5347	3.7767	4.8780	7.2683
	Cg	25–40	24.45	2.4516	4.0942	6.7527	11.2770
	2Cg	40–150	7.04	0.2465	0.3994	0.5260	0.8521
2	Au	0–32	17.37	0.9588	1.3710	2.4289	3.4733
	C1	32–60	12.73	0.0998	0.1676	0.1995	0.3352
	2Cg	60–70	15.18	3.3367	5.3721	8.9624	14.4295
	3Cg	70–150	35.14	0.2854	0.4738	0.6452	1.0710
3	Ap	0–23	13.67	0.6601	1.0165	1.3978	2.1526
	C1	23–33	8.74	0.1981	0.3388	0.4673	0.7991
	C2	33–150	10.11	0.2091	0.3304	0.4183	0.6609
4	M	0–12	26.85	10.9867	5.3835	31.1046	15.2412
	Oa	12–55	18.10	13.9397	3.9031	38.6654	10.8263
	C1	55–80	28.75	0.4911	0.8299	1.2514	2.1148
	Cg2	80–150	36.97	0.9561	1.5585	0.7986	1.3017
5	Ap	0–32	27.31	0.8886	1.3507	2.7378	4.1615
	AC	32–45	14.17	0.4619	0.7344	0.8121	1.2912
	C1	45–60	15.41	0.3516	0.5907	0.8208	1.3789
	Cg2	60–100	27.26	0.2670	0.4538	0.4983	0.8471
	G	100–150	33.35	0.1896	0.3262	0.4709	0.8099
6	Ap	0–22	15.76	0.7287	1.1951	1.3765	2.2575
	Bv	22–55	11.37	0.1816	0.2887	0.6523	1.0372
	C1	55–110	10.53	0.2756	0.4492	0.6331	1.0320
	C2	110–150	8.77	0.2472	0.4128	0.5118	0.8547

TABLE 4. Saturated hydraulic conductivity

Profile No.	Genetic horizon	Depth (cm)	Drainage porosity (%)	Saturated hydraulic conductivity ($\mu m \cdot s^{-1}$)
1	Au	0–25	14.30	35.71
	Cg	25–40	7.95	1.43
	2Cg	40–150	30.04	399.66
2	Au	0–32	12.14	121.17
	C1	32–60	29.46	361.39
	2Cg	60–70	6.06	0.87
	3Cg	70–150	22.61	225.74
3	Ap	0–23	24.93	39.63
	C1	23–33	17.76	163.99
	C2	33–150	34.33	104.17
4	M	0–12	13.74	85.03
	Oa	12–55	6.45	102.04
	C1	55–80	21.44	120.57
	Cg2	80–150	26.96	86.59
5	Ap	0–32	3.70	16.03
	AC	32–45	24.27	112.64
	C1	45–60	29.29	130.53
	Cg2	60–100	27.59	91.84
	G	100–150	26.52	176.15
6	Ap	0-22	24.13	34.69
	Bv	22–55	31.75	129.68
	C1	55–110	31.73	186.78
	C2	110–150	28.45	93.28

Correlation coefficients between total and drainage porosity and the coefficient of filtration were surprisingly low – Pc/Ks – R^2 = -0.14645 and Pd/Ks – R^2 = 0.512977, respectively.

The obtained values of maximal water capacity (pF = 0) were a bit (of 2–3%v/v) lower than total porosity. It resulted from methodological limitations which impeded – or even precluded – complete dehydration of a soil sample. The highest values of this capacity were observed in soils of the lowest bulk density. Apart from profiles 6 (of a homogenous sandy composition) and 4 (muck underlain by peat), the highest maximal water capacity was observed in epipedones. At field water capacity (pF=2.0) which indicated the upper water availability limit for plants, moisture values oscillated between 13.74 (profile 6) and 64.01%v/v (profile 4). This trait was clearly influenced by texture and the content of organic matter (the highest field capacity in peat and mucky deposits). In lower horizons the size of field capacity depended basically only on texture. The highest field capacity was observed in profile 4, in muck – 64.01% and peat – 77.14%, and the lowest in two loamy horizons: 28.90 (profile 1; depth of 25–40 cm) and 33.19% v/v (profile 2; depth of 60–70 cm). Field capacity in other endopedones was much lower: from 6.76 – (profile 6; depth of 55–110 cm) to 17.71%v/v (profile 3; depth of 23–33 cm). At pF = 2.2 and 2.5 moisture was decreasing systematically by a few (2–4) or by over a dozen (around 10–12) percent. The highest moisture at pF 3.7 and 4.2 were observed in profile 4, in peat: 46.19 and 30.12% and muck 37.95and 24.33, respectively (Table 5).

The highest values of TAW and RAW were visible in horizons formed from organic deposits: Oa – TAW = 47.02%; RAW = 30.95% and M – TAW = 39.68%; RAW = 26.06% (profile 4). In epipedones of a sandy texture the values of retention were low, e.g.: TAW = 9.42%, RAW = 7.02% (profile 6; depth of 0–22 cm) or TAW = 12.80%, RAW = 9.92% (profile 3; depth of 0–23 cm). In profile 2, at the similar texture, higher values of TAW and RAW (20.07 and 15.35%) were determined by strongly mineralized muck. In sandy endopedones, corresponding values of both coefficients were much lower – from TAW = 5.05%; RAW = 3.53% (profile 3; depth of 33–150 cm) to TAW = 12.64%; RAW = 9.24% (profile 3; depth of 23–33 cm).

TABLE 5. Soil water potentials and the total and readily available water

Profile No.	Horizon	Depth (cm)	Water capacity at pF (%v/v)							Total available water (%v/v)	Readily available water (%v/v)
			0.0	2.0	2.2	2.5	3.7	4.2	4.5	2.0–4.2	2.0–3.7
1	Au	0–25	41.22	29.07	22.14	19.09	10.54	8.28	5.77	20.79	18.53
	Cg	25–40	33.35	28.90	26.49	20.01	13.40	8.26	6.64	20.64	15.50
	2Cg	40–150	35.78	8.83	7.53	4.66	2.31	1.02	0.66	7.81	6.52
2	Au	0–32	38.96	29.07	24.75	20.71	13.72	9.00	6.07	20.07	15.35
	C1	32–60	34.33	7.29	6.82	4.87	2.51	1.34	0.67	5.95	4.78
	2Cg	60–70	36.94	33.19	32.85	27.71	23.48	10.56	4.86	22.63	9.71
	3Cg	70–150	35.12	14.75	10.22	9.74	6.39	2.92	1.36	11.83	8.36
3	Ap	0–23	37.80	16.75	13.64	9.99	6.83	3.95	1.38	12.80	9.92
	C1	23–33	32.29	17.71	16.26	13.54	8.47	5.07	1.75	12.64	9.24
	C2	33–150	37.44	6.00	5.92	4.76	2.47	0.95	0.79	5.05	3.53
4	M	0–12	75.54	64.01	52.38	45.68	37.95	24.33	14.74	39.68	26.06
	Oa	12–55	80.46	77.14	65.79	56.87	46.19	30.12	11.64	47.02	30.95
	C1	55–80	34.11	14.63	10.25	7.77	5.46	3.51	1.43	11.12	9.17
	Cg2	80–150	35.74	11.53	7.49	8.26	4.64	3.01	1.23	8.52	6.89
5	Ap	0–32	40.28	38.63	31.01	27.25	17.73	8.00	6.96	30.63	20.90
	AC	32–45	38.94	15.73	14.00	9.86	6.55	3.78	0.36	11.95	9.18
	C1	45–60	33.70	7.31	6.88	5.29	1.96	1.42	0.54	5.89	5.35
	Cg2	60–100	34.05	8.41	7.15	5.36	2.81	1.32	0.76	7.09	5.60
	G	100–150	33.01	8.57	6.39	5.69	4.86	1.91	1.26	6.66	3.71
6	Ap	0–22	35.32	13.74	10.41	8.22	6.72	4.32	1.53	9.42	7.02
	Bv	22–55	38.57	8.72	8.42	5.83	2.19	1.43	0.51	6.99	6.23
	C1	55–110	35.50	6.76	5.39	3.19	1.98	0.97	0.36	5.79	4.78
	C2	110–150	33.74	8.53	7.04	5.17	2.09	1.46	0.58	7.07	6.44

Among mineral horizons, only those of loamy texture (profile 1; horizon Cg and profile 2; horizon 2Cg) had high retention coefficients (Table 5). The defined values of potential and effective useful retention were close to or only slightly different than the values of these parameters given by Ślusarczyk (1979) and Kaczmarek (2001a, 2001b) for soils and grounds of different texture.

Water retention abilities by soils were presented as the value of total retention in the horizons of 0–50 and 0–100 cm. In both scopes, the highest retention was observed in a peat-mucky soil (profile 4). In this soil, RAW and TAW in the horizon of 0–100 cm reached the values of 201.06 and 294.64 mm, respectively. It proves its ability to retain water after heavy precipitation at the level which exceeds a half of annual precipitation in the region. Much lower values of retention were found in the other analysed soils. Due to sandy texture of their endopedones, the corresponding values of retention were much – even 4 times – lower. In the soils of sandy texture, retention was very low in case of all the analysed variant. Its values (on the example of Brunic Arenosol – profile 6) were: for TAW: 0–50 cm – 40.29 mm; 0–100 cm – 69.85 mm; and for RAW: 0–50 cm – 32,89 mm 0–100 cm – 57.51mm, (Table 6).

TABLE 6. Water retention of investigated soils

Profile No.	Genetic horizon	Depth (cm)	RAV at pF = 2.0–3.7 (mm)	Retention at RAV in layers: 0–50 and 0–100 cm (mm)	TAW at pF = 2.0–4.2 (mm)	Retention at TAW in layers: 0–50 and 0–100 cm (mm)
1	Au	0–25	46.33		51.98	
	Cg	25–40	23.25		30.96	
	2Cg	40–50	6.52	76.09	7.81	90.57
	2Cg	50–100	32.60	108.69	39.05	129.80
2	Au	0–32	49.12		64.22	
	C1	32–50	8.60	57.72	10.71	26.02
	C1	50–60	4.78		5.95	
	2Cg	60–70	9.71		22.63	
	3Cg	70–100	25.08	97.294	35.49	139.00
3	Ap	0–23	22.82		29.44	
	C1	23–33	9.24		12.64	
	C2	33–50	6.00	38.05	8.59	30.49
	C2	50–100	17.65	55.71	25.25	75.92
4	M	0–12	31.27		47.62	
	Oa	12–50	117.61	148.88	178.68	226.29
	Oa	50–55	15.48		23.51	
	C1	55–80	22.93		27.80	
	Cg2	80–100	13.78	201.06	17.04	294.64
5	Ap	0–32	66.88		98.02	
	AC	32–45	11.02		14.34	
	C1	45–50	2.68	80.57	2.95	115.30
	C1	50–60	5.35		5.89	
	Cg2	60–100	22.40	108.32	28.36	149.55
6	Ap	0–22	15.44		20.72	
	Bv	22–50	17.44	32.89	19.57	40.29
	Bv	50–55	3.12		3.50	
	C1	55–100	21.51	57.51	26.06	69.85

The analysed soils showed highly differentiated retention abilities depending on their origin, the content of organic matter and texture of various horizons. Hydrogenic soil (profile 4) had high retention, whereas mineral soils of low humus content and sandy texture – very low. What is the most important from an agrotechnical point of view – moisture (RAW), the hydrogenic soil (profile 4) was able to retain even one third of annual precipitation at once, whereas mineral soils – much less (even around 5%). The depth of levelled soil-ground water mirror exceeded 100 cm in all the profiles, which classifies water management in all the analysed soils as a precipitation-water type. Therefore, yielding on them depends strictly on the sum of annual precipitation and its distribution in the vegetation season. The possibility of providing arable plants with water will be clearly connected with the values of retention.

CONCLUSIONS

1. In the investigated soils, basic physical and water properties depended mainly on texture and the content of organic matter.
2. Low retention and high speed of filtration cause total dependence of some soils on precipitation as a source of soil water.
3. In the future these soils will not undergo mining dehydrating degradation, and their system of physical and water properties will depend on tillage and climate factors.

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Wybrane właściwości fizyczne i wodne gleb przyległych do planowanej odkrywki węgla brunatnego „Drzewce” (środkowa Polska)

Streszczenie: W pracy przedstawiono właściwości fizyczne i wodne sześciu gleb, znajdujących się na terenach bezpośrednio sąsiadujących z odkrywką węgla brunatnego „Drzewce” (KWB Konin). W ramach przeprowadzonych prac, w punktach charakterystycznych dla dużych, reprezentatywnych wydzieleń glebowych wykonano odkrywki różnych typów gleb. Wybrane typy glebowe reprezentowały zarówno gleby mineralne, jak również organiczne. Z poszczególnych poziomów genetycznych pobrano próbki o strukturze naruszonej i nienaruszonej, przeznaczone do analiz laboratoryjnych. W próbkach oznaczono takie właściwości, jak: zawartość węgla ogólnego, skład granulometryczny, gęstość fazy stałej, gęstość gleby suchej, porowatość całkowitą i drenażową, wilgotność, współczynnik filtracji, potencjał wiązania wody przez glebę, potencjalną i efektywną retencję użyteczną oraz retencję całkowitą w warstwach 0–50 i 0–100 cm. Badane gleby wykazywały uziarnienie w większości piaszczyste, z lokalnymi, nielicznymi wstawkami glin, a w przypadku gleb hydrogenicznych, poziomy powierzchniowe zbudowane były z murszu o różnym stopniu przeobrażenia. Uziarnienie oraz zawartość materii organicznej były parametrami najsilniej kształtującymi analizowane właściwości. Morfologia i właściwości badanych gleb oraz głębokie zaleganie zwierciadła wody gruntowej zdecydowało o ich przynależności do typu gospodarki opadowo-wodnej. Gleby takie nie będą ulegać degradacji wywołanej przez odwodnieniowy lej depresji odkrywki kopalnianej.

Słowa kluczowe: degradacja gleb, odwodnienie, uziarnienie, gęstość, retencja