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CREATION OF THE ENVIRONMENT OF WETLANDS WITH THE USE OF DRAINAGE***

1. INTRODUCTION

Dehydration of agricultural lands is one of many methods of natural environment creation. Many ways of doing it, which may be distinguished, depend on a number of physico-chemical characteristics of soil, climate conditions on particular area and effect that is desirable to achieve, which in turn depends directly on agricultural operations and, in particular, on the type of cultivated plants.

Despite from what has been written, the aim of designing a proper drainage system is by all means an improvement of the agricultural ground quality through enhancing ground aeration. It results from the structure of the soil environment that is always built with tree essential phases – constant, liquid (soil water) and vapour (soil air), which should occur in a strict portions, so that the proper functionality of the ground could be enabled. The constant phase is mainly built from bedrock and spin-off minerals, as well as organic compounds of diverse volume. They percentage in the ground allows to determine its granulometric composition, which has a crucial influence on soil characteristics by determining its aeration and hydration. To the grounds of both best aeration and least hydration are rated light formations which contain a significant amount of the sand fraction. In a contrary, heavy soils containing big amounts of ash and clay fractions belong to best hydrated, however, less hydrated formations. As a result, the best features are shown by soils of the intermediate composition, so called medium soils, such as a light loam [3].

Using a drainage system or other methods leads to remediation of the disproportion between particular soil phases, through decreasing aeration of heavy grounds, which contain a great portion of water. The result will be to achieve the correct, aggregate structure of the ground and maintain the proper level of ground water, and eventually to improve both the quality and the productivity of the ground.

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2. CHARACTERISTICS OF THE EXAMINED AREA

The area being under the design work is located in a village named Rzozów in Skawina municipality, district of Krakow, Lesser Poland province, around 16 km to the south-west from the city centre of Krakow (Fig. 1).

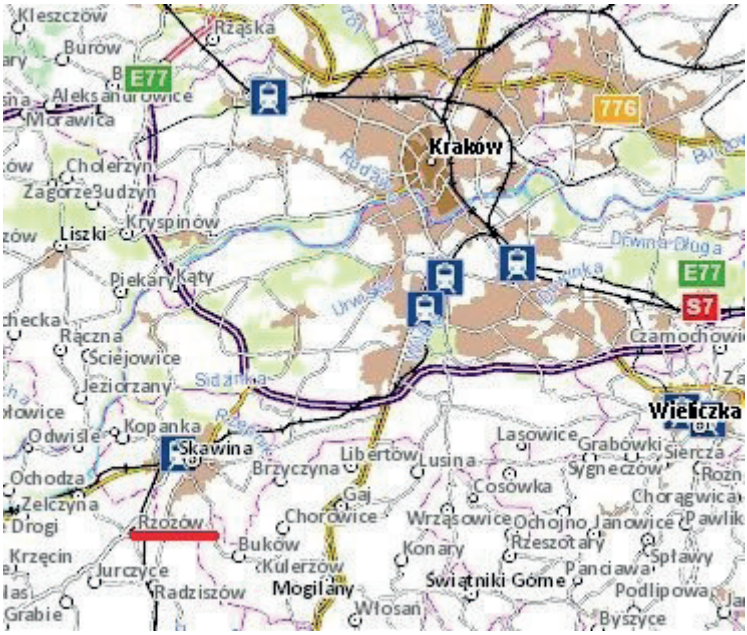

Fig. 1. The extract from a topographic map showing location of Rzozów village in regard to Krakow location [2]

Rzozów is located in the central part of Skawina municipality in the area of Pogórze Wielickie at an average elevation of (350–400) meters above sea level. Relief of the terrain is defined as slightly hilly. There is a possibility to observe low and oblate humps, disarticulated by plenty of valleys with paths that are minor in relation to the Skawinka river, which bed is located to the east from the investigated terrain. Table-like tops and valleys' bottoms are connected by convex and convexo-concave slopes, which gives the relief s smooth character [1].

Rzozów is situated in the boarders of the Carpatian climate region. Minimal average temperatures occur in January (−3.5°C), while the warmest days happen in July (18.5°C). The annual precipitation in that area waves from 675 to 775 mm. The climate is calm and high air humidity is mostly caused by the evaporation of water from the rivers flowing through the region – Wisła and its main right supply Skawinka, as well as from the minor paths, backwaters and standing water [1].

Soils that are taken under investigation belong to leached brown soils which, moreover, are a part of the 6th rye weak complex of agricultural usage, also known as rye-potato weak complex. It allows us to deduce that the soil has rather negative characteristics in terms of agriculture and enables mainly rye and potatoes cultivation. Type of soil on the examined

river basin is a light loam created on partly permeable background, which is beneficial for the creation of excessive humidity of the grounds [1, 6].

Figure 2 presents size distribution curves of soil from the terrain of the drainage works. The soil contains 43% of sand fraction, 25% of ash fraction and 32% of clay fraction. The amount of mineral components, in the form of calcium carbonate $CaCO_3$, is 1.3% in the surface layer, while it is 2.6% and 3.1% in deeper ones. Iron oxide Fe_2O_3 occurs only in the surface layer of the soil, and it's content is 1.2% (tab. 1).

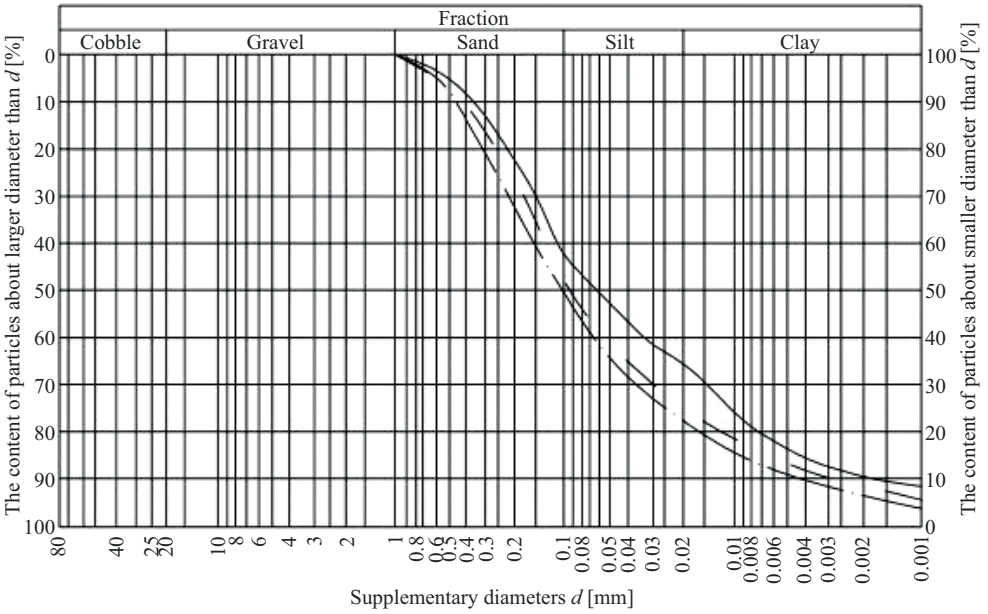

Fig. 2. Size distribution curves for the type of soil occurring in Rzozów village [1, 6]

Table 1

The content of particles from categories I and II and mineral components in particular soil layers [1, 6]

Depth [cm]	0–40	40–80	>80
Particles cat. I [%]	32	22	21
Particles cat. II [%]	16	12	15
Content of $CaCO_3$ [%]	1.3	2.6	3.1
Content of Fe_2O_3 [%]	–	–	1.2

3. DESCRIPTION OF DEHYDRATION PROJECT

The area of 0.42 square kilometers, which is the object of the dehydration project, is a hilly terrain, average down slope is 8.4‰, with local buildings located mainly along streets. There are significant number of agricultural grounds. Those not used for agriculture are covered by rather expanded plants such as straws and locally occurring individual trees.

The first stage of the project was to run a number of hydrological calculations that results enabled flow definitions: annual average, absolutely minimum, average low, normal, minimum of the great water and flows calculated according to Dębski and Loewe recommendations [4]. Thus was defined the definition of determinant flow which amount is 1.566 m^3/s.

In the following stage of the project, there were lead hydraulic calculations for each of the ditches, which aim was to determine its parameters. The next step was to design confirmations for dugouts and calculate the indicated level of the collectors' exit.

The finishing stage of calculations was to determine the distance between drain pipes, taking into consideration soil characteristics and the amount of annual precipitation on the examined terrain. There were also calculated the overall capacity of dugouts, that are the result of forming ditches. For the aim of dehydrating the examined area, there were designed 2 drainage ditches that are supposed to shed the excess of water from the ground to Skawinka river, which bed is located to the east from it. The ditches are to be placed in the north and south parts of the drainage area. The grounds are crossed in half with a street, what imposed designing culverts to preserve ditches' continuation. The calculated distance between drainage pipes was 19 m (Fig. 3) [4, 6].

Ditch *A* was located in the north. It's overall length is 716 m and it is lead through the bottom of the valley, from level 231 m above sea level to the east direction, taking a south-east direction after the culvert and then coming to the east again to the estuary. Considering the course changes, there were assumed 3 bows in the project: the first one – the length of 22.8 m and radius 58.8 m, the second one – the length of 99.8 m and radius 161.3 m and the third one – the length of 37 m and radius 21.6 m he alone lead to the south (Fig. 3) [4, 6].

Minimal ditch deep is 1.1 m. It locally increases to 1.36 m in the area of the culvert under the road, and then reappearing to the minimal deep. The ditch consists of 5 downslopes, out of which the minimum is 8.1‰, and the rest are 13.6‰, 18.1‰, 28.2‰ and 36.8‰. The maximum downslope is located at the beginning of the ditch, from the contour no. 231 to 230. Then, the terrain flattens to the east, what results in the decreasing of the ditch's downslopes, up to the minimum passing the culvert and following to the end of the dugout [4, 6].

The constant width of ditch bottom is 0.5 m and the downslope of ditch slopes is 1:1.5. The minimal drainage depth is dependent on the soil type, which is why it's value is the same for both ditches – 0.8 m. Designed height of filling with the water is 0.8 m, so the capacity of dugout is 1910.5 m^3 [4, 6].

On the ditch *A* there was designed a pavement consolidation to the height of 50 cm. Collectors exits are to be at the height of 21 cm above the bottom [4, 6].

The area from which water will be piped to the ditch *A* is divided into 4 draining sectors. To the ditch there are lead 9 collectors, directed to 4 exits. Those collectors with drain pipes, linked to them in the number of 88, gather water from the area of 0.25 km^2. On the region supported by the ditch *A* are also located 11 collecting drainage wells type S – 4 that link the collectors [4, 6].

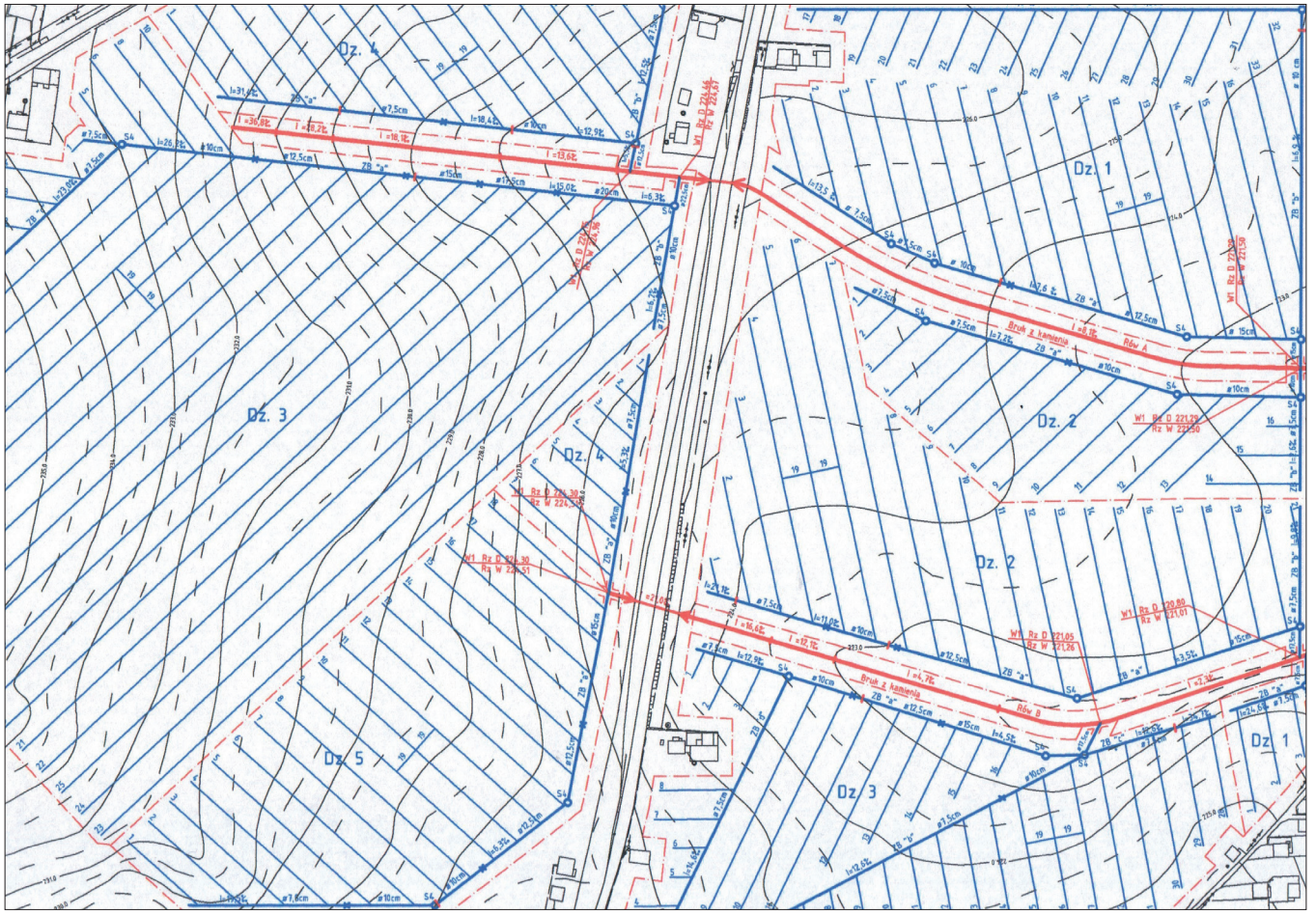

Fig. 3. Altitude situation plan of drainage on the examined area in Rzozów village

Ditch *B* is shorter than ditch *A* and located to the south from it. Its's total length is 471 m. The ditch has got it's beginning at the level of 225.6 meters above sea level, 17.6 m before crossing the road and is directed to the east, through the bottom of the local depression, to Skawinka river. Firstly, it's was it to the south – east, but then, thanks to the bow of the length of 43 m and the radius of 46,9 m, it takes a course to the north – east. Designed ditch has 5 downslopes: 21.0‰, 16.6‰, 12.1‰, 4.7‰ and 2.3‰, what is generated by the land configuration (Fig. 3) [4, 6].

Ditch *B* is designed to the depth of 1.2 m, which is equal at his whole length. The bottom width is also constant and at the level of 0.5 m. Unchangeable is also the downslope of the ditch slopes – 1: 1.5. According to the project, the height of filling with the water is 0.9 m. The capacity of this dugout is 1303.0 m^3 [4, 6].

The pavement consolidation of the ditch is up to the height of 50 cm. The collectors' exits are 21 cm over the bottom of the ditch [4, 6].

The area reached by ditch *B* is smaller than the area dedicated to ditch *A* and it stands for 0.17 km^2. It is divided into 5 draining sectors, which means that there are 5 exits leading to the ditch. The total number of collectors in all the sectors is 8, however, the most of them – 4 are located in the sector 3, which is the result of the diversity of land configuration on the area. To the collectors water is lead by 81 drainage pipes. In the area there are 8 collecting drainage wells type S – 4 (Fig. 3) [4, 6].

4. THE MANAGEMENT OF THE DUGOUT GROUNDS

The total capacity of the dugouts for both ditches is 3,214 m^3. The ground from dugout is rich in nutrients coat of soil, called humous. The ground reached this way is to be kept properly to enable it's usage during the creation the plot coat around the buildings. The excess ground could be sold [4, 6].

5. DRAINAGE SYSTEM CONSERVATION

The proper conservation of a finished drainage system it necessary for providing its proper working and prolong pipes' proficiency [6].

The necessary treatments in ditches conservation are mowing its' slopes and removing aquatic plants. Those are needed to be implement not less than twice a year during early spring and late autumn. To confirm the proper working of the drainage system, it is necessary to remove all the mechanical damages formed on the ditches. Bigger damages are suggested to be removed by building the pavement consolidation [6].

It is important to pay attention especially to plants which have roots that are likely to overgrow through the pipes. Plants like this are suggested to remove completely using mechanical methods or with the use of chemical substances. It is necessary to remove all trees growing in the distance of less than 20 meters from the collectors [6].

During the drainage system conservation a special care should be put on removing silt from the ditch's bottom as well as from the collector exits once a year. Moreover, in the time of early spring, it is necessary to examine the level of wells. During the process of removing the silt, it is important to focus on the culverts under the roads [6].

The project maintains the 4th (IV) stage of the silting possibility in the examined region, which means that the most likely time in which the silt may occur in the drainage system is the first year after dehydration of a less intensity than water's ability to wash the silt [7]. The owner of the field on which the drainage system occurs is a responsible for its maintenance [5].

6. CONCLUSIONS

1. The soil environment of the terrain taken under consideration consists of over hydrated light loam on a partly permeable background.
2. The examined are is characterised by disadvantageous air-ground conditions, which has a crucial effect on soil quality and planting.
3. The aim of the drainage is to improve soil structure and aeration, that leads to acquiring crop increase.
4. Assuring long-term efficiency and reliability of the drainage system demands it's proper control and conservation.

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