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SUBSTANTIATION OF THE IMPACT OF GRANITE QUARRIES DUMPS ON pH OF SURROUNDING AREAS SOIL

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Purpose. The influence of dumps granite quarries on parameters such as seasonality and distance to dump quarry on the pH of the soil surrounding areas. **Methodology.** An experiment in which soil samples were selected on the surface areas that are at a distance of 100 m, 500 m and 1000 m from the dump Penizevytchy granite deposits in Zhitomir region west relatively dump, as a predominant trend in frequency of winds of the area. **Results.** Determined that the pH of the reaction corresponds to slightly alkaline soil. Established using two-factor analysis of the impact away from the heap of granite quarry, season and their interaction on the pH of soil adjacent to the dump area. **Originality.** Setting the pH dependence of soil surrounding areas on the season and the distance to dump granite quarry allows to assess the state of soil adjacent to the dump sites by limiting factor is pH. **Practical value.** The practical significance of the results is to construct interpolation pH dependency on seasonality and distance to dump a career that can be used for prediction and monitoring of soil surrounding piles of granite quarrying areas. Also, if necessary, it is possible to choose methods to reduce soil pH to the optimum value. *References 10, tables 2, figures 1.*

Key words: pH, dump, granite, soil, two-factor analysis, experiment, quarry, surrounding area.

ОБГРУНТУВАННЯ ВПЛИВУ ВІДВАЛІВ ГРАНІТНИХ КАР'ЄРІВ НА ВЕЛИЧИНУ pH ҐРУНТІВ ПРИЛЕГЛИХ ТЕРИТОРІЙ

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Досліджено вплив відвалів гранітних кар'єрів за такими параметрами як сезонність та відстань до відвалу кар'єра на величину pH ґрунту прилеглих територій. Проведено експеримент, в результаті якого виявлено, що рівень pH відповідає слаболужній реакції ґрунту на відстанях 100 м, 500 м та 1000 м від відвалу. Встановлено, за допомогою двофакторного аналізу, що відстань від відвалу гранітного кар'єра, пора року та їх взаємодія здійснюють суттєвий вплив на величину pH.

Ключові слова: pH, відвал, граніт, грунт, двофакторний аналіз, експеримент, кар'єр, прилегла територія.

PROBLEM STATEMENT. As a result of mining and technological activities in the world raised at least 15-20 million hectares of land, of which 59% of the area used for

various mining, 38% - under piles of empty rock or tailings, 3% - the place subsidence, collapses and other irregularities surface associated with underground mining. Space rock dumps and industrial waste from the joint activities of mining companies in the world, is more than 2,000 km^3 [1]. Waste dump has impact on the environment, scattering rock piles with negative impact on the land resources of the surrounding area.

Rate all the properties of the soil is problematic. For the rapid diagnosis of soil using a limited number of indicators that are key indicators of its environmental hazard [2]. One of the main features is the pH.

Biochemical activity of soil, which is measured at pH is characteristic of many genetic and production characteristics of the soil. From pH dependent enzyme activity that is the basis of biochemical of activity is microbes. The pH affects microbiological processes, development of plants, soil formation processes direction and soil fertility. At pH less than 7 the soil negatively affects the assimilation by plants of phosphorus, nitrogen, magnesium, calcium and promotes the flow of the ground aluminum and manganese. In plants that grow in acidic soils, delayed conversion of sugars into disaccharides and other complex compounds also disrupt the formation of proteins and metabolism. Increased alkalinity in the soil not only harmful effect on plant growth, but also increases the peptization of colloids, resulting in sharply deteriorating physical properties of the soil water regime, etc. [3]. Therefore, the determination of the pH of the soil surrounding areas is essential for monitoring soil. Deviations from the optimal pH adversely affects the economic activities of nearby residents, as well as on human health.

Various aspects of the impact of limiting factors on soil piles of mining companies was engaged many scientists, including: Gorbunov M. I., Krasavin A. P., Zubova L. G., Motorina L. V., Butyuhin O. V., Kostenkov M. M., Vorobyov S. G. and other. The bulk of the research is necessary to study soil pH heaps of coal mines. Well-researched topic of choice plants for fixing the mine dumps rock. So in Baschutskoyi U. B. taking into account the pH value recommended the formation of new artificial plant communities in the dumps for neutralization of harmful geophysical flows and recovery in the region as a whole [4].

Investigation of the pH value on dumps of granite quarries and the surrounding areas is not fully carried out. Maznytskoyu O. V., Pedko N. A. and Eagle V. I. [5] the problem of acidity of the soil piles of granite rocks Poltava region and is recommended for remediation of such plants: myshiy (Setaria spp.), pyriy povzuchyy (Agropiron repens), proso volosovydne (Panicum capillare L.), tonkonih odnorichnyy (Poa annua L.), vostrets psevdopyriynyy (Aneurolepidium pseudoagropyrum), viynyk nazemnyy (Calamagrostis epigeios (L.) Roth).

In [6] investigated the pH of soil adjacent to the dump granite quarry area, proved that the percentage is over the average pH value (5.7) in the Malin area of almost 1.5 times.

From the above consideration, we can conclude that the dumps granite of quarries have an impact on the state of the soil surrounding areas, one of which is the change in the pH of the soil surrounding piles of granite quarrying areas. Work on the study conducted soil pH, about the impact of specific factors studied were not.

Despite the large amount of literature devoted to this issue, the study of influence of dumps granite quarries on the pH of soil surrounding areas was not carried out and therefore not justified factors of influence.

The aim of work is the influence of dumps granite quarries in pH change and adjacent areas of influence depending on the season and the distance from the dump.

MATERIAL AND RESULTS. To investigate the influence of factors such as seasonality and distance to dump on the pH of soil surrounding areas conducted an experiment with the determination of pH at distances of 100 m, 500 m and 1000 m in the west relatively dump Penizevytchy granite quarry since dominates in this direction wind rose in the Zhytomyr region [7]. The required number of parallel experiments determined at 95%-s probability. trust factor Z_α (1,38) and value limit of error in the assessment of investigational q_v parameter equal to unit [8]:

$$m = \frac{Z_\alpha^2}{q_v^2} = \frac{(1,38)^2}{(1)^2} \approx 2.$$

In table 1 shows the pH value as determined experimentally by using a portable pH meter Kellymeter PH-009 (I) adjacent to the dump Penizevytchy granite quarry area depending on seasonality and distance to the dump pit.

To process the results of the experiment used two-factor analysis, which determined the effect of such factors as the distance to the dump and seasonality on pH and their interaction.

Determined hypothesis for factor A (the distance from the dump), factor V (seasonal) and their interactions.

Table 1 – The pH of the soil, depending on seasonality and distance to dump granite quarry

Distance to dump	Season	
	Winter	Summer
100 m	8,1 8,2	8,0 8,3
500 m	7,5 7,2	7,8 7,7
1000 m	6,8 6,7	7,1 7,4

Hypotheses for interaction:

H_0: The distance from the dump and the season did not have the effect of interaction on the pH of soil surrounding areas.

H_1: Distance from the dump and the season have the effect of interaction on the pH of soil surrounding areas.

Hypotheses for factor A:

H_0: For different distances from the dump is no difference between the average pH.

H_1: For different distances from the dump there is a difference between the average pH.

Hypotheses for factor B:

H_0: For different seasonality is no difference between the average pH.

H_1: For different seasonality there is a difference between the average pH.

Each independent variable or factor has several levels (takes several values).

Factor A – distance from the dump: 100 m, 500 m, 1000 m; $a = 3$.

Factor B – season: winter, summer; $b = 2$.

a and b – factor is the number of values A and B respectively.

Degrees of freedom for each factor:

factor A: df.N = $a - 1 = 3 - 1 = 2$;

factor B: df.N = $b - 1 = 2 - 1 = 1$;

interaction, (A×B): df.N = $(a - 1)(b - 1) = (3 - 1)(2 - 1) = 2$;

the error within the group: df.D = $ab(n - 1) = 3 \cdot 2(2 - 1) = 6$,

where n – the number of objects in each group. In this case $n = 2$.

The critical value of Fisher F-distribution level of significance $\alpha = 0{,}05$ [9]:

factor A: $\alpha = 0{,}05$, df.N = 2, df.D = 6, $F_{ФA} = 5{,}14$;

factor B: $\alpha = 0{,}05$, df.N = 1, df.D = 6, $F_{ФB} = 5{,}99$;

interaction, (A×B): $\alpha = 0{,}05$, df.N = 2, df.D = 6, $F_{Ф(A\times B)} = 5{,}14$.

To calculate the values of F- criterion performed calculations for finding sum of squared deviations for factor A, factor B, their interaction and frequency error values k by formulas (1–4):

$$SS_A = k\sum(\overline{y_i} - \overline{y})^2, \quad (1)$$

$$SS_B = k\sum(\overline{y_j} - \overline{y})^2, \quad (2)$$

$$SS_{A\times B} = n\sum(\overline{y_{ij}} - \overline{y})^2, \quad (3)$$

$$SS_{error} = \sum\sum\sum(\mathrm{y}_{ij} - \overline{y_{ij}})^2. \quad (4)$$

Mean square deviation according to formulas (5–8):

$$MS_A = \frac{SS_A}{a-1}, \quad (5)$$

$$MS_B = \frac{SS_B}{b-1}, \quad (6)$$

$$MS_{A\times B} = \frac{SS_{A\times B}}{(a-1)(b-1)}, \quad (7)$$

$$MS_{error} = \frac{SS_{error}}{ab(n-1)}. \quad (8)$$

F-criterion value for each case calculated as (9–11):

$$F_A = \frac{MS_A}{MS_{error}}, \quad (9)$$

$$F_B = \frac{MS_B}{MS_{error}}, \quad (10)$$

$$F_{A\times B} = \frac{MS_{A\times B}}{MS_{error}}. \quad (11)$$

The results of calculations performed by formulas (1-11) are listed in table 2.

Table 2 – The value of settlements made by means of two-factor analysis

	SS	df	MS	F
Factor A	2,64	2	1,32	52,93
Factor B	0,27	1	0,27	10,8
Interaction, (A×B)	1,52	2	0,76	30,56
Error	0,15	6	0,025	
Total	4,58	11		

Since F_A = 52,93, F_B = 10,8 and $F_{A\times B}$ = 30,56 exceeds the critical level of $F_{ФA}$, $F_{ФB}$, $F_{Ф(A\times B)}$ respectively, the zero hypothesis is rejected. Therefore, since the null hypothesis is rejected, it can be concluded that the distance from the dump and the time of year a significant effect on the pH of soil surrounding areas.

By the method of least squares interpolation built depending on the pH value of seasonality and distance to dump career (Fig. 1).

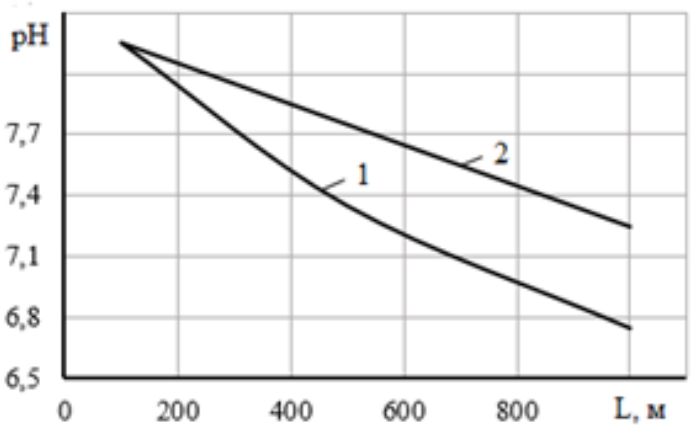

Figure 1 – Dependence varying the pH of the distance to the blade (L):
1, 2 - cold and hot seasons respectively

Dependencies 1 and 2 respectively approximated by the following formulas:

$$pH = -0,001L + 8,25, \quad (1)$$

$$pH = -0,0015L + 8,2385. \quad (2)$$

According to this study we can conclude that the distance to the dump granite quarry and seasonality affecting pH of soil surrounding areas. The average pH indicator for the cold season is 7,4, and for the warm – 7,7, characterized as slightly alkaline soil reaction.

This leads to increased soil pH, which negatively affects the soil and thus on the economic activity of the population.

CONCLUSIONS. The experiments determining the pH value of soil adjacent to the granite quarries dump areas. The results show that two-factor analysis that the distance to dump career and seasonality affecting the pH of soil surrounding areas. The dependences pH of seasonality and distance to the dump pit. Since the cold time of year the pH is 7,4, while warm – 7,7. Average pH value is 7,6 and corresponds to slightly alkaline soil reaction.

The results make it possible to assess the condition of the soil at limiting factor and, if necessary, choose methods to reduce soil pH to the optimum value.

The problem of weak soil alkalinity should be solved in two ways: firstly minimize concentration of dust with piles of granite quarry, the choice of dust control methods are analyzed in [10], and secondly, to normalize pH in soils surrounding areas by methods outlined in [6].

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ОБОСНОВАНИЕ ВЛИЯНИЯ ОТВАЛОВ ГРАНИТНЫХ КАРЬЕРОВ НА ВЕЛИЧИНУ pH ПОЧВЫ ПРИЛЕГАЮЩИХ ТЕРРИТОРИЙ

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Исследовано влияние отвалов гранитных карьеров по таким параметрам как сезонность и расстояние до отвала карьера на величину pH почвы прилегающих территорий. Проведен эксперимент, в результате которого выявлено, что уровень pH соответствует слабощелочной реакции почвы на расстояниях 100 м, 500 м и 1000 м от отвала. Установлено, с помощью двухфакторного анализа, что расстояние от отвала гранитного карьера, время года и их взаимодействие оказывают существенное влияние на величину pH.

Ключевые слова: pH, отвал, гранит, почва, двухфакторный анализ, эксперимент, карьер, прилегающая территория.

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