SECTION 3

PROBLEMS OF MODERN ENVIRONMENTAL SAFETY (BIOMONITORING, BIOINDICATION, BIOREMEDIATION, RADIOECOLOGY AND RADIATION SAFETY, ENVIRONMENTAL MONITORING, MANAGEMENT AND AUDIT. INFORMATION SYSTEMS AND TECHNOLOGIES IN ECOLOGY)

PATTERNS OF CADMIUM AND LITHIUM IONS EFFECT ON YEAST CELLS

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The widespread use of cadmium and lithium, as well as their environmental pollution, make the study of the effects of these metals extremely important. In this study it was shown that cadmium has the acute toxic effect on Saccharomyces cerevisiae cells. The medium toxic time was 7,3 minutes for 1 MAC. The effect of lithium on yeast cells was less toxic than cadmium. The medium toxic time of lithium ions was 39,7 minutes for 1 MAC.

Keywords: saccharomyces cerevisiae, yeast cells, lithium, cadmium, medium toxic time.

Batteries are becoming very popular in the modern world. They are used in personal devices, in medicine, agriculture, and transport.

There are various types of rechargeable batteries, but some of the most widely used are lithium-ion (Li-ion), lithium-polymeric (Li-pol) and nickel-cadmium (NiCd). Their electrodes contain cadmium and lithium. In most cases, rechargeable batteries which have spent their resources are utilized as household garbage and are buried in the ground with tons of other garbage. Heavy metals exist in the soil in the form of organic-mineral complexes. They can change its physical, chemical and biological properties and have toxic effect on soil biota. As a result they slow down the processes happening in the soil (an ammonification, a nitrification etc). In this regard it is interesting to study the influence of these metals on microorganisms.

Research object in this work are yeast cells of Saccharomyces cerevisiae the wild diploidic strain of XS800. Sabouraud agar was used for cultivation. Cadmium was taken in concentration of 1.5 mg/kg based on hygienic standards of maximum allowable concentration (MAC) of cadmium in the soil [2]. Due to the lack of information for MAC of lithium in the soil, it was decided to use lithium MAC for water objects. Based on hygienic standards of MAC the lithium was taken for 0.03 mg/l [1].

Cell survival after cadmium impact within 30 minutes decreases to 5,11 % compared to control, and after cadmium impact within 60 and 90 minutes – to 2,96 % and 1,08 % respectively. The medium toxic time of cadmium impact was 7,3 minutes. The obtained data are similar with those presented by other authors on cadmium toxicity [3; 4]. The impact of lithium is less fatal in comparison with cadmium: at thirty-minute impact the survival is 52,96 %. Further impact within 60 and 90 minutes reduces this rate to 43,55 % and 26,34 % respectively. The medium toxic time for lithium was 39,7 minutes.

BIBLIOGRAPHY

1. ГН 2.1.5.1315-03. Предельно допустимые концентрации (ПДК) химических веществ в воде водных объектов хозяйственно-питьевого и культурно-бытового водопользования. – Взамен ГН 2.1.5.689-98; введ. 27.04.2003. – Москва: Минздрав России, 2003. – С. 59.

2. ГН 2.1.7. 2511-09. Ориентировочно допустимые концентрации (ОДК) химических веществ в почве. Взамен ГН 2.1.7.2042-06; введ. 01.07.2009. – Москва: Федеральный центр Роспотребнадзора, 2009. – С. 6

3. *Богачева, А. С.* Чувствительность цианобактерий Synechocystis sp. к токсическому действию солей тяжелых металлов / А. С. Богачева, В. В. Шилов, Е. В. Полозова // Актуальные проблемы токсикологии и радиобиологии: Тезисы докладов Российской научной конференции с международным участием. – Санкт-Петербург, 2011. – С.26.

4. *Маячкина, Н. В.* Изменение токсичности почв, загрязненных кадмием в полевом модельном опыте / Н. В. Маячкина, И. В. Дроздова, Л. Г. Бакина, Ю. М. Поляк // Материалы I Всероссийской междисциплинарной научно-практической конференции. Симферополь, 2017. – С.161–166.

INFLUENCE OF MACHINE-BUILDING ENTERPRISES ON SOIL CONTAMI-NATION

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The paper presents the data on the estimation of the content of total and mobile forms of heavy metals in soil samples taken in uncoated areas within the industrial site and sanitary protection zone of OJSC “Minsk Motor Plant”.

Keywords: heavy metal (HM), soil.

The main natural resource and the basis for economic activities of the Republic of Belarus is land. In 2018, the share of industrial, transport, communications and energetics lands accounted for about 3.0 % [1]. However, the growth of cities and the development of their industrial potential lead to a change in natural landscapes and the pollution of all environmental components, including soils.

In the soils of machine-building enterprises, heavy metals are the dominant pollutants. In 2017, the following excessive values were recorded: in lead – up to 5 MPC, cadmium – up to 8 APC, nickel – up to 5 MPC, zinc – up to 10 APC and in copper – up to 86 APC [1]. Biological, chemical, and physical properties of contaminated soils noticeably change [2]. One of the ways to prevent soil pollution by heavy metals is the organization of monitoring, as well as the identification and elimination of trace element sources of soil contamination.

When conducting field research and soil sampling in the influence area of the OJSC “Minsk Motor Plant” in-dustrial site, we are guided by STB ISO 10381-4-2006, GOST 17.4.3.01-83, GOST 17.4.4.02-84, GOST 5681-84, GOST 17.4.3.04 -85, GOST 17.4.2.03-86.

The samples are taken from 0-5 and 5-20 cm soil horizons using a soil auger with a strictly fixed sampling depth. In some cases (if it is not possible to take samples at a depth of 20 cm), samples are taken at a depth of 5-15 cm. The averaged data on the content of total HM and mobile forms of heavy metals in the soils of uncoated terri-tories within the boundaries of the OJSC “Minsk Motor Plant” industrial site are presented in Table 1.

Table 1

The contents of gross and mobile forms of heavy metals in the soils of uncoated territories in the bound-aries of the industrial site of OJSC Minsk Motor Plant

Index	Cd	Zn	Pb	Cu	Ni	Cr
0–5 cm horizon						
The average for the sample (mobile), mg/kg	0.3	101.1	3.9	30.9	1.6	0.6
The average for the sample (total), mg/kg	0.5	414.2	34.2	192.0	48.7	388.4
5–20 cm horizon						
The average for the sample (mobile), mg/kg	0.3	75.6	3.4	25.1	1.1	0.4
The average for the sample (total), mg/kg	0.5	311.1	26.8	152.8	31.9	245.7

As a result of the soil-ecological survey of the soils of the OJSC “Minsk Motor Plant” site, it is found that almost all soils undergo chemical pollution. The average concentrations of all the heavy metals studied exceed the local geochemical background with an anomaly coefficient: cadmium – 1.3 times; zinc – 14.1-18.8; lead – 2.7–3.4; copper – 30.6–38.4; nickel – 6.4–9.7; chromium – 3.6–5.7; arsenic – 3.1 times. The highest occurrence of samples with values exceeding MPC in soil horizons of 0–5 cm and 5–20 cm is recorded for zinc (77,8–100 %).

In the sanitary protection zone, the content of mobile forms of heavy metals does not exceed sanitary and hygienic standards. However, total zinc slightly (1,5 times) exceeds the maximum permissible concentration, both in the upper and in the deeper horizons.