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## 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.

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## CHEMICAL MIXING SYSTEM

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The modern era of microelectronics allows creating not only flexible but also less resource-intensive control systems, in comparison to existing similar ones. Options of component set for task solving appearing, the possibility of creating a chemical mixing control system has become available. The rapidly changing economic situation has led to a rethink of the resource saving importance. This factor has increased the demand for automated resource control and management systems.

*Keywords:* Raspberry Pi, Arduino, chemical mixing, fertilizer, automation system.

An automated system allows you to optimize resource consumption, ensure data reliability, increase comfort by informing and automatic resources managing. Thus, it is possible not only to see the current consumption of resources, but also in case of abnormal consumption, to automatically cut it of.

The object of the study is to consider the possibility of creating a chemical mixing system as a separate module of a plant growing system.

The subject of the study is the use of a modern Arduino Uno R3 Microcontroller board in the system of control and management of chemical mixing.

Mineral fertilizers can be simple and complex. Each simple fertilizer contains one element (e.g. nitrogen or phosphorus), while complex fertilizers consist of two or more components [1].

A chemical mixing system (hereinafter ChMS) is an integrated chemical dosing control system in a closed water circuit which is implemented with automatic operation system, and with a possibility of manual control as well.

The purpose of ChMS is to develop a chemical mixing control and automation system.

The ChMS tasks are:

– to facilitate chemical dosing control;
– resource saving;
– to create an information base on chemical mixing systems.

The composition of the chemical mixing system includes:

– the centralized management of all peristaltic pumps;
– pH and EC measurement;
– a set of dosing sketches depending on the crop grown.

The management of dosing is centralized according to pre-configured sketches.

Sketches are defined programs with manual or automatic activation. By controlling the sketches, each pump can be activated, and the appropriate dosage and response time for each individual pump can be set.

ChMS technical resources:

– a Raspberry Pi Microcomputer;
– a set of peristaltic pumps;
– a set of sensors;
– Arduino Uno R3.

ChMS information resources:

– Raspbian operating system;
– a web resource (information management site);
– a monitoring system;
– a set of managing sketches.