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Study of the Ecotoxicity of Oil-Containing Wastewater Treated in the Helio Installation by Biotesting Method

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ABSTRACT

The article discusses the ecotoxicological properties of wastewater from a bitumen plant, as well as water treated in a solar installation. It also examines the toxicity of its constituent components. To assess the quality of purified water and its effect on plant vital activity, crops of oats, cucumbers and beets were grown as a test sample. The results of this research showed that water obtained through distillation of wastewater and decomposition of light petroleum fractions using ozone oxidation in a helium-containing setup is suitable for the cultivation of garden crops.

Keywords: wastewater treatment, bitumen plant, ecotoxicity, biotesting, desalination.

INTRODUCTION

Oil-containing waste water is considered to be the main source of industrial pollution of soil and water environments. Wastewater from the petroleum industry is characterized by a stable emulsion and suspension content with high pH >7, high pH >30 mg/l, high pH >125 mg/l and high >30 mg/l [Kowalik et al., 2015; Ospanov et al., 2022]. Analysis of the biological quality of domestic wastewater, including the physical and chemical characteristics of domestic wastewater and the total number of coliform bacteria, is conducted to determine the environmental impact of treated wastewater released from industrial treatment facilities. At the same time, the high density of biomass in it indicates that wastewater is subject to bioremediation [Kaszycki et al., 2014].

Due to the stable nature of organic compounds present in wastewater, they are resistant to disposal using conventional methods. Studies have shown that solar energy and oxidizing agents can be used to increase the effectiveness of disposal [Trus et al., 2019; Sowik et al., 2024; Rusdianto et al., 2023].

In our early studies, the wastewater, which was contaminated with oil from bitumen extraction, was heliotechnically purified [Patent, 2023]. Based on the results obtained as part of this work, it has reduced the impact on the environment caused by oil extraction and processing plants. Wastewater treatment is carried out using a green energy-based approach. An environmentally effective method of water purification using solar energy that does not require reagents has been developed [Serikbayeva et al., 2023].

To justify the use of purified water only for the irrigation of green areas based on its chemical composition or for reuse as technical water is not sufficient, as a recommendation should also consider the amount of its constituent elements in relation to the requirements of state standards. The fact is that some compounds that require a small amount of oxygen in treated water are hydrocarbons that can form complex compounds with complex compositions and are prone to bioaccumulate, or they can be stable complex compounds containing toxic heavy metals such as lead (Pb), zinc (Zn), and cadmium (Cd) in the soil. Therefore, as a novelty of these studies, the ecotoxicological properties of the source wastewater and purified water were determined as a result of the toxicity indicators of their constituent components. Biotesting of plants was carried out in order to assess the environmental toxicity of the water treated by us and to study its effect on the vital activity of plants.

MATERIAL AND METHODS

Bitumen plant wastewater has not previously been classified in terms of its toxicity, and experimental data have not been obtained. Therefore, the criteria specified in Table 1 and the principle of interpolation [Filenko, 2007] were used to classify the ecological toxicity of the water by individually considering the properties of the elements contained in the water under study. Table 1 presents the hazard class criteria.

The additive formulas 1 and 2 were used to determine the hazard class for acute environmental toxicity caused by bitumen plant wastewater and purified and cubic wastewater.

$$\frac{\sum C_i}{L(E)C_{50m}} = \frac{\sum_n^i C_i}{L(E)C_{50i}} \quad (1)$$

$$L(E)C_{50m} = \frac{\sum C_i}{\sum_n \frac{C_i}{L(E)C_{50i}}} \quad (2)$$

where: C_i – the mass fraction of component i in the percentage indicator; $L(E)C_{50m} = CL_{50}$ or EC_{50} – experimental data obtained from the mixture or its components; $L(E)C_{50i} = CL_{50}$ or EC_{50} – details of component *i*, mg/l, *i* – from 1 to *n*, *n* – number of components.

In computational work, additivity of the solution and the relationship between quantities and their sum were used. That is, the value of a quantity corresponding to the entire solution is equal to the sum of quantities corresponding to its components [GOST 32419-2013].

In the process of classifying wastewater, the standards for classifying industrial waste were not followed, as wastewater is sent to evaporate in open ponds. Therefore, the classification of the waste is based on their environmental impact, using indicators related to chemical products. Moreover, the mineralization of the wastewater in general does not exceed 25%.

Data on the acute and chronic environmental toxicity of components in bitumen plant wastewaters were obtained from the following sources: [ECOTOX; ECHA; GOST 57455-2017; Vorobyova et al., 2020; Order, 2015] (Table 2). The data required to determine the hazard class were used in the following literature [Alsharhan et al., 2020; Gamito et al., 1999; Ji et al., 2018].

Crops of oats (Allure variety), cucumbers (Phoenix variety) and beets (Bejo Boro F1variety) were selected as the test subjects to evaluate the quality of the purified water and its effect on plant vitality. For each test, 30 seeds of each crop were used. 4 control objects were also selected:

1) Drinking water (as control).
2) Bitumen plant wastewater.
3) Diluted wastewater, dilution number 5.7 (so that the concentration of wastewater is LC50 – 175 mg/l).
4) Purified water in the helio installation.

Parameters for assessing the degree of toxicity of control waters: germination energy (GE), laboratory seed germination (LG), morphometric parameters: shoot and root length, biomass accumulation of above-ground and below-ground parts. The germination and germination energy of the plant were simultaneously determined and expressed as a percentage [Evstifeeva et al., 2012; GOST 12038-1984; GOST 12039-1982].

In the first experiment, all parts of plants-roots, stems, leaves-were taken as samples. The plants were first dried to a stable mass in a 50–60 °C dryer cabinet. The muffle was then converted to ash by firing at 500–550 °C in the furnace. As a result, the ash content of cucumbers was 15%, oats 7.2%, and beets 3.5%. After the unburned residue was completely transferred to the solution in soda and alcohol solutions, the content of heavy nonferrous metals in the solution was determined.

Table 1. Hazard class of acute toxicity of toxic substances to aquatic environments [Filenko, 2007]

Hazard class	Criterion
1	$LC_{50}(EC_{50}) \leq 1$ mg/l (96 h for fish and\or 48 h for crustaceans) and\or $EC_{50} \leq 1$ mg/l (72 or 96 h for algae)
2	$1 < LC_{50}(EC_{50}) \leq 10$ mg/l (96 h for fish and\or 48 h for crustaceans) and\or $1 < EC_{50} \leq 10$ mg/l (72 or 96 h for algae)
3	$10 < LC_{50}(EC_{50}) \leq 100$ mg/l (96 h for fish and\or 48 h for crustaceans) and\or $10 < EC_{50} \leq 100$ mg/l (72 or 96 h for algae)

Table 2. Acute and chronic toxicity of bitumen plant wastewater components to the environment

Element	Concentration, mg/l	Acute toxicity data L(E)C_{50} mg/l	M (multiplier), information on chronic toxicity in the detection of acute toxicity	M (multiplier), the hazard class of the component for acute toxicity in the detection of chronic toxicity	M (multiplier), when determining chronic toxicity	Hazard class by acute toxicity of the component
1	2	3	4	5	6	7
Lithium (on Li+)	7.98	For Fish, LC50 - 109 mg/l, EC50 - 29.4 mg/l for invertebrate amphibians, algae 550 - 153.4 mg/l	-	n-octanol / water (log KOW) = -0.77 (25 °C) EC50 - >1.7 mg/l for invertebrate amphibians	-	2
Aluminum (on nitrate)	396	For fish, LC50 – 0.07 mg/l, for Daphnia Daphnia magna Straus LD50 - 6.38 mg/l	-	not provided	-	1
By vanadium (V4O12)4 - and (V10O26)6- anion complexes)	0.806	For Fish LC50-Leuciscus idus 96 h - 0.693 mg/l; for daphnia and other invertebrate amphibians LC50 - Americamysis bahia (Mysid) - 13.3 mg/l - 48 h	1	EC50 is an active precipitate for bacteria - > 100 mg/l-3 hours	-	1
Chromium (by nitrate)	0.725	For fish, LC50 - Trout - 20.1 mg/l - 96 H. LC50 - Oncorhynchus mykiss - 24.1 mg/l - 96 h. EC50 - Daphnia magna (Daphnia) - 76.9 - 268.6 mg/l - 48 h	-	not provided	-	3
Manganese (by oxide)	72.0	For fish LC50 - Salmo trutta (kumja) - 12.4 mg/l - 96 h, EC50 - Daphnia magna (Daphnia) - > 100 mg/l -48 h	-	Desmodesmus subspicatus (жасыл балдырлар) - 1 mg/l - 72 h	-	3
Iron (by nitrate)	409	For Fish LC50 = 315 mg/l; Fundulus heteroclitus - 48 h. EC50 = 0.9 mg/l pH = 6.5-7.5. Daphnia magna: EC50 = 152 mg/l – 48 h EC50 >100 mg/l - 48 h for invertebrate amphibians	-	EC50 >10.000 mg/l Microorganisms – 3 h.	-	
Cobalt (by nitrate)	0.292	For fish, LC50-Pimephales promelas (Golian) - 1.866 mg/l - 96 h. LC50 for Daphnia - Ceriodaphnia dubia - 0.39 mg/l - 48 h	-	ErC50-green algae Pseudokirchneriella subcapitata - 0.095 mg/l - 72 h. EC50-active precipitate - 120 mg/l - 30 min	-	2
Nickel (by nitrate)	2.31	For Fish Lc50 Pimephales promelas (Minnow): 4.9 mg/l - 96 h LC50 Lepomis macrochirus - 5.3 mg/l - 96 h. EC50 - 0.51 mg/l - 48 h for daphnia and other invertebrate amphibians				2
Copper (by nitrate)	6.23	Lc50 - Pimephales promelas (Golian) for fish - 0.19 mg/l - 96 h				1
Zinc (by nitrate)	13.1	For Fish, LC50 - 112 mg/l - 96 hours, EC50 - 1.4 mg/l - 48 hours for invertebrate amphibians.		EC50 - 5.2 mg/l microorganisms, 3 h		3
Arsenic (by arsenic acid)	13.1	For fish, LC50 - 141 mg/l – 24 h. For algae EC50 - 159 mg/l vodorosli 96 h		EC50 - 0.256-mg/l algae for 14 days		3
Selenium (by elemental selenium)	0.422	No details		EC50 >3.200 mg/l microorganisms 3 h H-octanol / water (logKOW)-5		
Strontium (by carbonate)	61.2	For fish, LC50 >92.8 mg/l - 96 H; for algae, ErC50 > 43.3 mg/l - 72 h.		EC50 >100 mg/l microorganisms - 3 h		3
Barium (by nitrate)	15.9	For Fish LC50 >3.5 mg/l - 96 h. EC50 ≤18 mg/l - 48 h for invertebrate amphibians Baldyrlar 50 >1.15 mg/l for algae - 72 h	-	ErC50 >2.19 mg/l algae 72 d EC50 >1.000 mg/l microorganisms 3 h	-	2
Oil products	0.84	LC50 - 0.32 mg/l for hydrobionts	1	-	-	1
Nitrate ions	90,0	10 mg No. 3-N/l for hydrobionts	-	-	-	2

RESULTS AND DISCUSSION

The main methods of Ecotoxicology are bio-indication (assessment of Environmental Quality) and bio-testing (creation of experimental studies of toxic effects), as well as monitoring of human health. The most important methods of studying the mechanisms of toxic effects are the assessment of the ratio "dose–effect", the identification of toxicants in environmental objects, living organisms [Filenko, 2007]. The composition of the bitumen plant's wastewater includes trace elements essential for plants, such as copper, manganese, iron, and zinc. It also contains components that require purification, such as vanadium and arsenic, which have toxic properties and require a high chemical demand for oxygen (Table 3).

Elements that cause wastewater pollution are derived from oil products. Studies conducted by [Butarewicz et al., 2019] have assessed the ecotoxicity of wastewater from treatment plants and found a different range of susceptibilities of living organisms to different types of industrial waste. From an environmental point of view, oil trace elements are divided into two groups in terms of toxicity: non-toxic elements (Si, Fe, Al, Ca, Mg, P, etc.) and toxic elements (V, Ni, Co, Pb, Si, Ag, Hg, Mo, etc.). Vanadium and nickel are found in porphyry copper deposits and, as heavy metals, can have a toxic impact on living organisms. Taking into account the data obtained from literary references and studies, the toxicity of wastewater from the bitumen plant as a whole was calculated:

$$LC_{50} = 100/ \sum Ci/LC_{50i}\ 0.5714 = 175 \text{ mg/l} \quad (3)$$

According to the LC_{50} indicator, the waste water of the bitumen plant is not considered acute toxic. If we take into account that logKow ≥ 4 is a substance prone to bioavailability, and logKow < 4 is a substance not prone to bioavailability, and due to the fact that logKow = 5 in terms of selenium is considered chronically toxic for aquatic organisms. Cubic residual water toxicity indicator:

$$LC_{50} = 100/ \sum Ci/LC_{50i}\ 0.24151 = 414.052 \text{ mg/l} \quad (4)$$

As the principle of water purification is based on the distillation process, the concentration of toxins in wastewater should increase and its toxicity level should be higher than that of wastewater. As a result of the precipitation of iron arsenate and manganese arsenate in the cubic water, the coagulation of aluminium occurs, and they are separated out into a precipitate. As more toxic components form the precipitate, the content of these components in cubic waste decreases. This is because the LC_{50} indicator for cubic waste is lower than that for wastewater (Table 4). Interpolation calculations showed that wastewater cannot

Table 3. The composition of the studied wastewater and the hazard class of the elements contained in it

No.	Elements	Quantity mg/l	MPC in industrial wastewater, mg/l	Hazard class
1	Lithium	7.98	0.03	2
2	Aluminum	396	0.5	2
3	Vanadium	0.806	0.1	3
4	Chrome	0.725	0.5 Cr (III), 0.05Cr (VI)	3
5	Manganese	72.0	0.1	3
6	Iron	409	0.3	3
7	Cobalt	0.292	0.1	2
8	Nickel	2.31	0.1	3
9	Copper	6.23	1.0	3
10	Zinc	13.1	5.0	3
11	Arsenic	13.1	0.05	2
12	Selenium	0.422	0.01	2
13	Strontium	61.2	7.0	2
14	Barium	15.9	0.7	2
15	Oil products	0.84	0.1	-
16	Nitrate ions	90,0	45.0	3
17	COD	358.27	15.0	-

Table 4. Information necessary to determine hazard class

No.	Toxicants	LC_{50} for fish	Wastewater		Cubic residue	
			C_i mass fraction,%	C_i/ $L(E)C_{50i}$	C_i mass fraction,%	C_i/ $L(E)C_{50i}$
1	Lithium	109	0.000798	7.3211E-06	0.00319	2.92661E-05
2	Aluminum	0.07	0.0396	0.565714286	0.0154	0.22
3	Vanadium	0.806	0.0000806	0.0001	0.000322	0.000399504
4	Chrome	20.1	0.0000725	3.60697E-06	0.000299	1.48756E-05
5	Manganese	12.4	0.0072	0.000580645	0.0265	0.002137097
6	Iron	315	0.0409	0.000129841	0.0166	5.26984E-05
7	Cobalt	1.866	0.0000292	1.56484E-05	0.00012	6.43087E-05
8	Nickel	4.9	0.000231	4.71429E-05	0.00096	0.000195918
9	Copper	0.19	0.000623	0.003278947	0.00261	0.013736842
10	Zinc	112	0.00131	1.16964E-05	0.00527	4.70536E-05
11	Arsenic	141	0.00131	9.29078E-06	0.000114	8.08511E-07
12	Strontium	92.8	0.00612	6.59483E-05	0.000142	0.000250603
13	Barium	5.5	0.00159	0.000289091	0.023256	0.001098545
14	Oil products	0.32	0.000084	0.0002625	0.006042	0.0007875
15	Nitrate ion	10	0.009	0.0009	0.000252	0.0027

Note: *since there are no LC_{50} data on selenium, the wastewater hazard class was determined only on 15 components.

be disposed of in reservoirs by dilution and that it is not effective at LC_{50} = 175 mg/L.

Water of the following composition, mg/l, purified by distillation and ozonation in a helium installation: < 0.01Li, < 0.01Al, V, < 0.01Cr, < 0.01Mn, < 0.06 Fe, < 0.01Co, < 0.01Ni, < 0.01Cu, < 0.01Zn, <0.02As, 0.03Se, 48 COD.

Biotesting of purified water in plant indicators. Biotesting is a process for determining the toxicity of a medium through the use of various test objects. This indicates that the test objects cause changes in the vital functions of biological indicators, regardless of the substances and combinations used. The main advantages of biotesting are the simplicity, immediacy and accessibility of the experiment [Evstifeeva et al., 2012]. Plants and animals are involved here as test objects for assessing the quality of atmospheric air, underground, surface water, soil layer.

The results of laboratory experiments on the control of the growth of biological test objects are shown in Tables 26–29. According to the control of the 3rd day, the germination energy for seeds watered with drinking water is 96.6%, cucumbers – 100%, oats – 90 %; beets – 6.6%, cucumbers – 33.3%, oats –13.3%; beets – 60%, cucumbers – 40%, oats – 13.3% in diluted wastewater; beets – 100%, cucumbers – 100%, oats – 63.3% (Table 4). The germination energy of beets and cucumbers is 100 %, the germination energy of oats is lower than the control rate.

The germination rate of beet seeds is higher when they are irrigated with distilled water than in experiments using drinking water. In these experiments, almost all the seeds germinated. Only 6.6% of the seeds watered with the wastewater germinate, but by the 10th day, there is no root growth. By the 7–8th day, root rot has started, and germination is also uniform in the diluted wastewater. However, by the 10th day, rot has occurred on some of the seeds (Table 6).

The germination energy of cucumber seeds when irrigated with distilled water is close to experiments with drinking water, the majority of seeds are germinated. Only 33% of the seeds watered with the wastewater germinated. However, by the 10th day, root growth was inhibited. By the 7–8th day, root rot had begun. Germination, even in diluted wastewater, was uniform. However, by the 10th day, there was rot of some of the seeds (Table 7).

The oat crop showed a yield of 93.3% in the 8th day, although only 53% showed germination energy in the first days when watered with distilled water. Although the initial values are inhibited, the germination energy increases in the last days. In comparison with beet and cucumber crops, oat seeds showed a yield in diluted wastewater, in 10 days 60% of the seeds taken in the study showed a yield (Table 8).

Among the crops grown as a result of irrigation with water obtained through wastewater treatment

Table 5. Germination of the studied bio-objects watered with water

Sample number	The number of germinated seeds in the studied objects on the 3rd day of the experiment, pcs.		
	Beetroot	Cucumber	Oats
1	29	30	27
2	2	10	4
3	18	12	4
4	30	30	19

Table 6. The results of germination of beetroot seeds

No.	Date, day															
	3rd		4th		5th		6th		7th		8th		9th		10th	
	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm
1	29	0.7	28	1.5	28	3.0	28	4.4	28	6.2	28	7.5	28	7.5	28	7.5
2	2.0	0.5	2.0	0.6	2.0	0.6	2.0	0.6	2.0	0.6	2.0	0.6	2.0	0.6	2.0	0.6
3	18	0.4	18	1.4	17	3.0	17	4.4	17	6.0	15	6.1	15	6.1	15	6.1
4	30	0.6	29	1.8	29	3.2	29	4.2	29	6.1	29	7.0	29	8.8	29	9.0

Table 7. The results of germination of cucumber seeds

No.	Date, day															
	3rd		4th		5th		6th		7th		8th		9th		10th	
	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm
1	30	3.2	30	4.5	30	6.5	30	8.0	30	10.1	30	12.0	30	12.0	30	1 2.4
2	10	0.3	10	0.6	9	0.8	8	0.8	8	0.8	7	0.8	7	0.8	7	0.8
3	12	2.2	12	2.6	11	2.7	11	2.7	11	2.7	11	2.7	11	2.8	10	2.8
4	30	2.2	28	3.9	28	6.5	28	8.4	28	9.8	28	11.0	28	12.0	28	12

Table 8. The results of germination of oat seeds

No	Date, day															
	3rd		4th		5th		6th		7th		8th		9th		10th	
	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm	N, piece	L_{avg}, cm
1	27	0.7	27	2.5	27	3.8	25	6.5	25	10.4	25	14.2	25	18.0	25	18.5
2	4	0.5	4	1.9	4	1.9	4	1.9	4	1.9	4	1.9	4	1.9	4	1.9
3	4	0.5	4	1.8	4	2.1	4	4.6	4	6.9	4	10.0	4	14.1	4	14.6
4	19	2.2	18	3.4	18	6.1	18	10.1	18	14.0	18	18.5	18	20.0	18	20.5

at a bitumen plant, there was inhibition in oats. The inhibition is equal to 3.2%, which is less than the maximum permissible phytotoxic index. This figure is also less than 20% below the maximum permissible index. Therefore, the phytotoxicity of the water that has been desalinated using a solar installation and then treated with ozone derived from oil waste has been reduced (Table 9).

The following studies were conducted by planting seeds in soil and watering them. In order to control the quality of water that will be used in laboratory conditions, the irrigation of garden crops with treated water has been tested. The results of the preliminary experiment are presented in Table 10. During the experiment, each crop was sown with 30 pieces and watered with appropriate water for 10 weeks. 1 Sprout was examined every week. The plants were watered with 50 ml of water with a frequency of 3 days. Seeds planted in soil gave good growth

Table 9. The effect of purified water on the vital activity of garden crops

Type of irrigated water	Garden crops	Medium length of garden roots, mm (*Lort.*), mm	Test reaction	Deceleration coefficient E_D, %
Drinking water	Beetroot	7.5	Normal	-
	Cucumber	12.4	Normal	-
	Oats	18.5	Normal	-
Bitumen plant distilled water	Beetroot	9.0	Normal	-
	Cucumber	12	Inhibited	3.2
	Oats	20.5	Normal	-
Bitumen plant wastewater	Beetroot	0.6	Inhibited	92.0
	Cucumber	0.8	Inhibited	95.16
	Oats	1.9	Inhibited	89.73

Table 10. Indicator of crop biotesting

Day	Drinking (pipe) water		Purified water		Wastewater	
	Bud, sm	Root, cm	Bud, sm	Root, cm	Bud, sm	Root, cm
Oat crop						
7 days	6.5	6.5	8.0	7.5	7.0	10
14 days	21.5	10	25	7.0	25	5
21 days	24.2	14	27	14	25	4.8
Cucumber crop						
7 days	7.0	4.5	8.5	2.8	7.2	9.6
14 days	17.0	10	14	4.6	19.0	12
21 days	18.0	11	17	4.9	19.0	7.5
Beetroot crop						
7 days	7.0	3.5	6.2	4.3	9	1.0
14 days	9.0	4.0	9.0	4.4	10.0	2.0
21 days	12.4	6	9.0	5.0	11.0	2.4

for up to 21 days. In plants watered with sewage, shoots showed good growth up to 14 days, but from 15 days, they began to wilt. Therefore, soil has the ability to absorb pollutants from sewage, and plant cells filter out as much water as possible.

After three weeks, examinations were carried out to determine the ability of plants grown in the soil, watered with distilled water, to accumulate (accumulate) chemical elements.

The content of heavy and non-ferrous metal ions in the unburnt residue of all crops was below 0.01. The results of the study showed that the water obtained as a result of purification of wastewater from the bitumen plant by distillation in a helium installation and decomposition of light fractions of petroleum products by ozone oxidation is suitable for growing melons.

CONCLUSIONS

A calculation method was used to determine the hazard class of wastewater from a bitumen plant. As a result of the research, it was found that the LC50 index is 175 mg/l and is not considered acute toxic, but according to the selenium content logKow = 5, that is, the water in the evaporation pond is considered chronically toxic to the organisms living in it.

To assess the quality of purified water and study its effect on plant life, plant biotesting was carried out. As a test form, crops of oats (llure variety), cucumbers (Phoenix variety), beets (Boro F1 "Bejo" variety) were obtained. The germination rate of beet and cucumber seeds when watered with distilled water showed the same results as when watered with drinking water. While oats showed only 53% germination in the first days when watered with distilled water, it showed 93.3% germination on the 8th day. Thus, as a result of irrigation with water obtained by purification of oily wastewater from a bitumen plant in a solar installation, an inhibition of 3.2% was observed in oats among crops cultivated in the soil, but this indicator is 20% lower than the maximum permissible phytotoxicity index. These results prove a decrease in the phytotoxicity of the water we purified.

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