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TECHNOLOGY FOR PURIFICATION OF WASTEWATER CONTAMINATED WITH ORGANIC COMPOUNDS USING AN AZOLE PLANT

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ABSTRACT: Environmental pollution is one of the most pressing problems today. In particular, the development of methods for the purification and reuse of contaminated wastewater is one of the mysteries of our time. In this regard, biological treatment, including the use of higher aquatic plants, is recognized as a promising method that does not harm the environment. This is due to the fact that wastewater is mainly polluted with chemical pollutants - chemical compounds, oil residues and other wastes, and various microorganisms in nature are their natural destroyers. Decomposition of organic compounds by high aquatic vegetation (azolla) does not significantly affect the biocenosis. On the contrary, in the presence of this plant, the decomposition of organic matter in wastewater can be purified by stimulating microbes.

KEYWORDS: biological, household, azole, symbiotic, pharmaceutical antibiotics, organic, petroleum.

INTRODUCTION: Water is the most useful and important natural resource on Earth. Although most of the planet is inundated, the problem of treated water still exists. In less than 20 years, two-thirds of the world's population will experience a lack of fresh water. In the future, these problems can be solved through the treatment and reuse of wastewater from human and agricultural activities, as well as from industry.

THE MAIN RESULTS AND FINDINGS: Domestic waste water consists mainly of 99.9% water and 0.1% soluble and dissolved organic and inorganic solids, including macronutrients and basic trace elements (Tan, B.S., P. Payaval) [1]. Solids include wastewater detergents, food residues, oils, heavy metals, various biomolecules and their degradation products, sand and crumbs, feces, paper products and various impurities. This section describes the most common biological wastewater treatment systems that are also used to extract valuable resources. According to the method of growth or the composition of microbes, biological processes are divided into two groups: filtration and reactor. In resurrected purification systems, microbial cells grow as plankton in a low-liquid environment without any changes in the lower layer. Despite the different characteristics of the wastewater, the treatment system achieved optimum efficiency in removing harmful additives over a 5-day period of hydraulic storage. Currently, in some countries of the world, azole, based on living and dead biomass, is used to remove heavy metals from industrial effluents and wastewater. The bioaccumulation potential of various types of azole for various heavy metals is shown in Table 1.

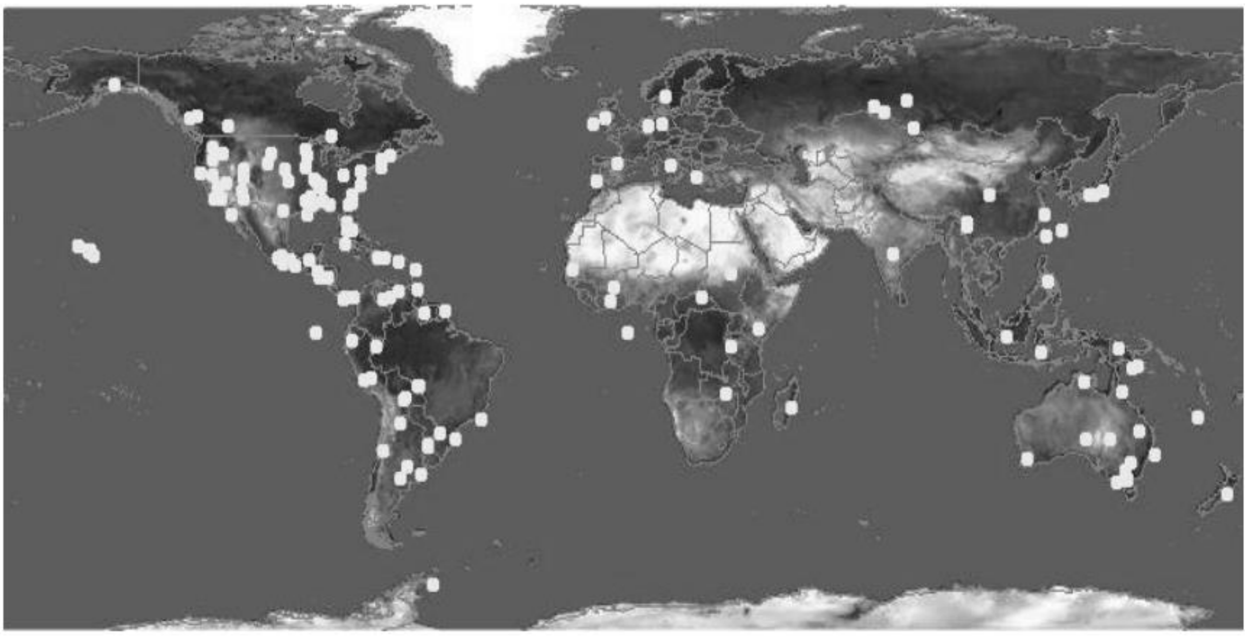
Table 1.
Bioaccumulation of heavy metals of azole nature

Azolla spp	**Heavy metal**	**Pre-concentration of heavy metal**	**Experiment duration (days)**	**Accumulation of heavy metals (dry matter)**	**Quote**
A. pinnata	Mercury (Hg)	3.0 mg l^{-1}	13	667 μgHgg^{-1}	Rai (2008)
	Mercury (Hg)	10.0 μg l^{-1}	21	450 μgHgg^{-1}	Mishra et al. (2009)
	Mercury (Hg)	3.0 mg l^{-1}	6	940 μgHgg^{-1}	Rai and Tripathi (2009)
	Cadmium (Cd)	3.0 mg l^{-1}	13	740 μgCdg^{-1}	Rai (2008)
	Cadmium (Cd)	10.0 mg l^{-1}	7	2759 μgCdg^{-1}	Arora et al. (2004)
	Chrome (Cr(III))	3.0 mg l^{-1}	13	1095 μgCrg^{-1}	Rai (2010b)
	Chrome (Cr(VI))	20.0 μgl^{-1}	14	9125 μgCrg^{-1}	Arora et al. (2006)
	Nickel (Ni)	500 mg l^{-1}	7	16252 μgNig^{-1}	Arora et al. (2004)
A. caroliniana	Mishyak (As)	80.0 μgl^{-1}	7	>120 μgAsg^{-1}	Zhang et al. (2008)
	Lead (Pb)	1.0 mg l^{-1}	12	416 μgPbg^{-1}	Stepniewska et al. (2005)
	Cadmium (Cd)	1.0 mg l^{-1}	12	259 μgPbg^{-1}	Stepniewska et al. (2005)
	Chrome (Cr(VI))	1.0 mg l^{-1}	12	356 μgCrg^{-1}	Bennicelli et al. (2004)
	Chrome (Cr(III))	1.0 mg l^{-1}	12	964 μgCrg^{-1}	Bennicelli et al. (2004)
	Mercury (Hg)	1.0 mg l^{-1}	12	578 μgHgg^{-1}	Bennicelli et al. (2004)
A. filiculoide	Mishyak (As)	80.0 μgl^{-1}	7	>60 μgAsg^{-1}	Zhang et al. (2008)
	Chrome (Cr(VI))	20.0 μg l^{-1}	14	12383 μgCrg^{-1}	Arora et al. (2006)

	Chrome (Cr(III))	9.0 mg l^{-1} (mln^{-1})	4	1904 (mln^{-1})	Sela et al. (1989)
	Cadmium (Cd)	9.0 mg l^{-1} (mln^{-1})	4	10 441 (mln^{-1})	Sela et al. (1989)
	Cadmium (Cd)	10.0 mg l^{-1}	7	2608 $\mu gCdg^{-1}$	Arora et al. (2004)
	Nickel (Ni)	9.0 mg l^{-1}(mln^{-1})	4	8814 (mln^{-1})	Sela et al. (1989)
	Nickel (Ni)	500 mg l^{-1}	7	28443 µg Ni g^{-1}	Arora et al. (2004)
	Copper (Cu)	9.0 mg l^{-1}(mln^{-1})	4	9224 (mln^{-1})	Sela et al. (1989)
	Zinc (Zn)	9.0 mg l^{-1}(mln^{-1})	4	6408 (mln^{-1})	Sela et al. (1989)
A. microphylla	Chrome (Cr(VI))	20.0 $\mu r l^{-1}$	14	14931 $\mu gCrg^{-1}$	Arora et al. (2006)
	Nickel (Ni)	500 mg l^{-1}	7	21785 $\mu gNig^{-1}$	Arora et al. (2004)
	Cadmium (Cd)	10.0 mg l^{-1}	7	1805 µg Cd g^{-1}	Arora et al. (2004)

The species A. pinnata of the aquatic macrophytes of utiazole is 1 to 2 cm long, and the species A. Nilotica is 15 cm or more. Azole consists of a main stem that branches out into a secondary stem, and the stems are composed of leaves arranged in small order. The solid, flying roots of the azalea are submerged in water from root to root. Azalea roots get their nutrients directly from the water. It has also been found that root nutrients can be extracted from the soil when the water layer is thin. Each flap consists of two parts: an upper and a lower part of the pipe, which is partially submerged in a colorless bowl-shaped part and provides buoyancy of water. Each top leaf has a depth that includes the symbiotic Anabaena azollae (Saunders, R. M. K. and K. Fowler. 1992). [2] The inner surface of each azole is formed and qualitatively flattened, covered with a layer of silt of unknown composition (Peters, 1976), while A. azollae is composed of multicellular fibers (Shi & Hall, 1988).It is known that the layer of plant mucus is produced by the symbiont (Shi, DJ, and DO Hall 1988) [3].

Figure 2. Map of distribution of Azole around the world



Oil spills on land and in many reservoirs are often difficult to clean up. In open systems, the biological distribution of hydrocarbon contaminants is limited by the availability of a recycled nitrogen source. Azolla can purify reservoirs contaminated with oil products, stimulating microbes that break down oil products (Rakhimova ST, Safarov KS) [4]. In the studies, A. Pinnata, as well as P. stratiotes and Salvinia molsta were applied to the soil filled with water contaminated with diesel fuel (2.4 l / m2). Soon all the plants sprouted.

However, microbial sprouts formed around the dead leaves of A. pinnata. After 16 weeks, the concentration of diesel fuel at the production site was less than half the concentration of the controlled area, and the concentration of xylene and ethylbenzene was 50-100 times lower. Bioaccumulation in many aquatic plants is carried out by metal chelators, which contain phytocellatins, metallothionins, organic acids and amino acids. Metal ions characterize A. filiculoides grown under the influence of heavy metals. These metallothionins have a low molecular weight (4-10 kDa) and are cystine-rich and metal-binding proteins that bind metals through the thiol groups of cysteine residues (Shoyakubov R.Sh.) [5]. The tested types of azoles that can be treated by bioremediation of wastewater are shown in Table 2.

Table 2. Azolla spp. bioremediation of environmental pollutants

Pests	Components	Azolla sp. tested for bioremediation	Quote
Heavy metals	Cu, Cd, Pb, Ni, Cr, Hg, As, Au, Zn	A.filiculoides, A.microphylla, A.pinnata, A.caroliniana	Jafari(2010); Kanoun-Boulé (2009); Mufarrege (2010)
Oil	Diesel hydrocarbons, BTEX, oil	A.pinnata,, A.africana	Cohen (2002); Edema (2010)
Antimicrobial drugs	Sulfadimethoxine	A.filiculoides	Forni (2006)
Paints	Red acid 88 (AP88)	A.microphylla	Padmesh (2005)

If there is a shortage of good quality water, consider poor quality water or even waste water for agricultural use. Agricultural wastewater use can play an important role in discharge planning in arid and semi-arid areas. In terms of irrigation, the use of substandard or waste water requires more sophisticated management methods and strict control procedures than the use of substandard water. Wastewater is characterized by a high concentration of pollutants such as heavy metals, organic solvents, oil, xenobiotics and other industrial waste.

Conclusion: Therefore, wastewater sources are typically wastewater, industrial wastewater, agricultural wastewater, and natural oil spills. Azolla can be used in agricultural wastewater treatment to reduce the concentration of wastewater for agricultural using. Studies of the growth of A. microphylla in domestic waters have shown that Azolla can act as a biofilter to remove pollutants. The resulting biomass can be used to fertilize rice fields or for other purposes, and the treated wastewater can be reused for irrigation. Azolla has an amazing ability to accumulate trace elements, petroleum compounds, pesticides, pharmaceutical antibiotics and dyes.

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