

Supporting Information

Mining wastewater treatment technologies and resource recovery techniques: A review

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Supplementary Table S1. Impacts of metals on aquatic animals, humans, and plants.

Constitutes	Aquatic animals	Humans	Plants	Reference
Hg	Reduce metabolism and liver function, damages gills and olfaction organs, and causes impaired reproduction, deformity, and mortality.	Damages the liver and kidneys, affects cell functions, visual impairment, and prolonged exposure results in permanent damage to the kidney, brain as well as developing foetus.	Reduce transpiration and photosynthesis, impairs several metabolic processes such as water status, nutrient uptake, etc., and affect physiology, morphology, and biochemistry.	[1–3]
As	Affects organs such as the liver, kidney, intestines, and gall bladder as well as muscles. Reduces reproductive output and growth.	Affects the lungs and skin, urinary bladder, and kidneys. Low exposure can cause weakness in feet and hands, diabetes, damage of blood vessels, and affects the nervous system. Acute toxicity affects the heart and brain.	React with enzymes concerned with the assimilation of nitrogen and reduces its efficiency like nitrate & nitrite reductase, and glutamine synthetase (GS). Increase the efficiency of aspartate aminotransferases and alanine. Inhibits the overall growth of the seedling.	[4–6]
Cu	Impact on intestines, kidney, liver, and gills, can result in vascular and	It causes Wilson disease, disturbs memory and learning, it is associated	It leads to the inhibition of seed germination, adverse effect on the length	[7–9]

skeletal system abnormalities, lowers reproductivity, prolongs parturition time, and highest mortality rate at 10 mg.L⁻¹. with hepatic disorders and neuro disorders. and number of roots produced, rolling of leaves, chlorosis, and growth retardation, and increases lipoxygenase activity, lipid peroxidation, H₂O₂, and the amount of proline.

Cd	Irregular oocytes, partly adhesion, empty follicle, and increase follicular atresia, cytoplasmic retraction, loose follicular lining, growth retardation, affect gills, kidney, liver, and intestines.	Causes liver disorder, nephrotoxicity, degenerative bone disease, and kidney dysfunction. It also causes iron deficiency and leads to cancer of the lungs, prostates, pancreas, and kidneys.	Impact on the systematic opening and closing of stomata disturbs the water balance as the toxicity damage the permeability of the cell membrane and damages the machinery of photosynthesis. Lowers Zn and Fe uptake which results in leaf chlorosis. [10–13]
Hg	Inhibits sperm motility, abnormal fin, flexure of the posterior tail region, causes cloudy swellings of the cells with large vacuoles, degeneration of	Causes pain in the abdomen, ulcer, diarrhea, inflammation, gastrointestinal, nephrotoxicity, neurological disorders, and Minamata disease.	Reduces the rate of photosynthesis by making interaction with metal ions in Photosystem(II) proteins. Disturbs the flow of water and function of stomata by [14–16]

nuclei, and vacuolation in the stroma, pycnotic nuclei.

attaching with the water channels present in the plasma membrane.

Cr Blood congestion, haemorrhage, Kidney dysfunction, DNA and excretory abnormalities in secondary gill lamellae, decrease growth performance, and after long-term exposure amount of spawning decreases. system damage, asthma, allergy, and cancer of respiratory organs. Genotoxicity, cytotoxicity, and dermal sensitivity. Reduces the growth of the primary root and the number of lateral roots, development of intense purple colour of leaves, necrosis, chlorosis, wilting, and finally death of the affected plant. [17–20]

Pb Irregular oocytes, partly empty follicle, increased atresia, and loose follicular lining. Affects ovarian irregular head, notochord defects, yolk-sac edema, and spinal curvatures. adhesion, Lung dysfunction, high risk of hypertension, gastrointestinal effect, and Alzheimer's disease. In men, it enhances the chance of infertility. If pregnant, the excess Pb present in the blood passes the placenta and causes severe abnormalities in the baby like neurological, low I.Q level, and encephalopathy. Affect the efficiency of ribulose biphosphate carboxylase which is responsible for carbon dioxide assimilation. Slows the growth of a plant and the germination seed and affects the length of the shoot, root, and biomass. [10,21–23]

Ni	Shrinkage of the central vein, Causes kidney, allergy, and accumulation of blood cells in the cardiovascular diseases. It also causes central vein, rupture of sinusoids, lung fibrosis, nasal, and lung cancer. degeneration, and necrosis in the hepatocytes and connective tissue.	Inhibits root growth, photosynthesis, and transportation. Results in ultrastructural modifications and affects the absorption of nutrients by roots.	[24–26]
Zn	Irregular oocytes, empty follicles, loose follicular lining, fibrosis, vomiting, and headaches. High levels are decreases sperm motility, low hatching rate, high mortality, hooked tail, spinal deformity, and visceral haemorrhage.	Prompts diarrhea, nausea, poor appetite, germination, inhibit plant growth, disrupt enzyme activities, degrade chlorophyll, oxidative stress, also cause iron deficiency and this is due to similar ionic radii.	[10,27–29]

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