

# Global Situation of Bioremediation of Leachate-Contaminated Soils by Treatment with Microorganisms: A Systematic Review

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**Table S1.** Studies selected for the systematic review

Number	Year	Title	Reference
1	2017	Bioremediation of heavy metals from contaminated sites using potential species: a review	[1]
2	2017	A preliminary report of indigenous fungal isolates from contaminated municipal solid waste site in India	[2]
3	2017	Microbial and plant-assisted bioremediation of heavy metal polluted environments: a review	[3]
4	2017	Potential of Cordyline sp plant for remediation of metal-leachate contaminated soil	[4]
5	2017	Optimal Removal of Heavy Metals From Leachate Contaminated Soil Using Bioaugmentation Process	[5]
6	2017	Effect of inoculation with white-rot fungi and fungal consortium on the composting efficiency of municipal solid waste	[6]
7	2017	An innovative multistage treatment system for sanitary landfill leachate depuration: Studies at pilot-scale	[7]
8	2017	Assessing the bioaugmentation potentials of individual isolates from landfill on metal-polluted soil	[8]
9	2017	Characterization of induced metal responses of bacteria isolates from active non-sanitary landfill in Malaysia	[9]
10	2017	Impact of methane concentration and temperature on the activity of a methanotrophic strain isolated from a municipal landfill	[10]
11	2017	Sustainable remediation of heavy metal polluted soil: A biotechnical interaction with selected bacteria species	[11]
12	2017	A comparison of technologies for remediation of heavy metal contaminated soils	[12]

13	2017	Enhanced dissipation of DEHP in soil and simultaneously reduced bioaccumulation of DEHP in vegetable using bioaugmentation with exogenous bacteria	[13]
14	2017	Advanced technologies for the remediation of pesticide-contaminated soils	[14]
15	2017	Assessing the efficacy over time of the addition of industrial by-products to remediate contaminated soils at a pilot-plant scale	[15]
16	2017	Optimal reduction of chemical oxygen demand and NH(3)-N from landfill leachate using a strongly resistant novel <i>Bacillus salmalaya</i> strain..	[16]
17	2018	Application of bioremediation in the decontamination of polluted soil with petroleum hydrocarbons	[17]
18	2018	Application of biochar to sewage sludge reduces toxicity and improve organisms growth in sewage sludge-amended soil in long term field experiment	[18]
19	2018	Phytoremediation of seleniferous soil leachate using the aquatic plants <i>Lemna minor</i> and <i>Egeria densa</i>	[19]
20	2018	Characterization of Leachate and Groundwater in and Around Saduperi Municipal Solid Waste Open Dump Site, Vellore District, Tamil Nadu, India	[20]
21	2018	Bioremediation of petroleum-contaminated soil using aged refuse from landfills	[21]
22	2018	The National Program for the Liquidation of Pesticide Waste Landfills, Successes and Unused Opportunities–Case Study from Poland	[22]
23	2018	BIOTRANSFORMATION AND REMOVAL OF HEAVY METALS: A REVIEW OF PHYTO AND MICROBIAL REMEDIATION ASSESSMENT ON CONTAMINATED SOIL	[23]
24	2018	Screening of Silver-Tolerant Bacteria from a Major Philippine Landfill as Potential Bioremediation Agents	[24]
25	2018	<i>Raoultella</i> and <i>Enterococcus</i> species identified as high chromium and arsenic tolerant bacteria	[25]
26	2018	Phycoremediation of landfill leachate with the chlorophyte <i>Chlamydomonas</i> sp. SW15aRL and evaluation of toxicity pre and post treatment	[26]
27	2018	Metagenomics profiling for assessing microbial diversity in both active and closed landfills	[27]
28	2018	Biodegradation of dissolved humic substances by fungi	[28]
29	2018	Microbial functional diversity plays an important role in the degradation of polyhydroxybutyrate (PHB) in soil.	[29]
30	2018	Effective use of iron-aluminum rich laterite based soil mixture for treatment of landfill leachate.	[30]
31	2018	Phytoremediation of sewage sludge contaminated by trace elements and organic compounds.	[31]

32	2018	Next-generation sequencing showing potential leachate influence on bacterial communities around a landfill in China.	[32]
33	2018	Biocompatible metal decontamination from soil using <i>Ageratum conyzoides</i> .	[33]
34	2018	Role of Microbes in Bioremediation of Pollutants (Hydrocarbon) in Contaminated Soil	[34]
35	2018	Biominalisation performance of bacteria isolated from a landfill in China	[35]
36	2019	Emerging sustainable technologies for remediation of soils and groundwater in a municipal solid waste landfill site – A review	[36]
37	2019	Design and start-up of a constructed wetland as tertiary treatment for landfill leachates.	[37]
38	2019	Enhanced degradation of 1-naphthol in landfill leachate using <i>Arthrobacter</i> sp.	[38]
39	2019	Effect of biochar on the nutrient contents and metal recovery efficiency in sorghum planted on landfill soils	[39]
40	2019	Effect of soil types and ammonia concentrations on the contribution of ammonia-oxidizing bacteria to CH <sub>4</sub> oxidation	[40]
41	2019	Leachates and natural organic matter. A review of their biotreatment using fungi	[41]
42	2019	Can biochar and designer biochar be used to remediate per- and polyfluorinated alkyl substances (PFAS) and lead and antimony contaminated soils?	[42]
43	2019	Optimizing bioremediation of hydrocarbon polluted soil by life cycle assessment (LCA) approach.	[43]
44	2019	Effect of biostimulation on the distribution and composition of the microbial community of a polycyclic aromatic hydrocarbon-contaminated landfill soil during bioremediation	[44]
45	2019	Selective bacterial colonization processes on polyethylene waste samples in an abandoned landfill site	[45]
46	2019	Bioaccumulation and biosorption of zinc by a novel <i>Streptomyces</i> K11 strain isolated from highly alkaline aluminium brown mud disposal site.	[46]
47	2019	Isolation of arsenic accumulating bacteria from garbage leachates for possible application in bioremediation	[47]
48	2019	Succession and diversity of microbial communities in landfills with depths and ages and its association with dissolved organic matter and heavy metals.	[48]
49	2019	Phytoremediatory efficiency of <i>Chrysopogon zizanioides</i> in the treatment of landfill leachate: a case study.	[49]
50	2019	Biodegradation of polyacrylic and polyester polyurethane coatings by enriched microbial communities.	[50]

51	2019	Phytoremediation of Heavy Metal-Contaminated Soil by Switchgrass: A Comparative Study Utilizing Different Composts and Coir Fiber on Pollution Remediation, Plant Productivity, and Nutrient Leaching.	[51]
52	2019	Metabolism of diethyl phthalate (DEP) and identification of degradation intermediates by <i>Pseudomonas</i> sp. DNE-S1.	[52]
53	2019	Isolation of a polyethylene degrading <i>Paenibacillus</i> sp. from a landfill in Brazil	[53]
54	2019	A PAH-degrading bacterial community enriched with contaminated agricultural soil and its utility for microbial bioremediation	[54]
55	2019	Phytoremediation: Climate change resilience and sustainability assessment at a coastal brownfield redevelopment.	[55]
56	2019	Enhanced Bioremediation of Heavy Metal Contaminated Landfill Soil Using Filamentous Fungi Consortia: a Demonstration of Bioaugmentation Potential	[56]
57	2019	In Situ Bioremediation of Textile Dye Effluent-Contaminated Soils Using Mixed Microbial Culture	[57]
58	2019	Zooremediation of leachates from municipal waste using <i>Eisenia fetida</i> (SAV.).	[58]
59	2019	Transport, retention, and release of <i>Escherichia coli</i> and <i>Rhodococcus erythropolis</i> through dry natural soils as affected by water repellency.	[59]
60	2019	Biodegradation of pyrene by <i>Pseudomonas</i> sp. ISTPY2 isolated from landfill soil: Process optimisation using Box-Behnken design model	[60]
61	2020	Enhanced Immobilization and Phytoremediation of Heavy Metals in Landfill Contaminated Soils	[61]
62	2020	Antagonistic and plant growth-promoting effects of bacteria isolated from mine tailings at El Fraile, Mexico	[62]
63	2020	A Review of Landfill Microbiology and Ecology: A Call for Modernization With 'Next Generation' Technology	[63]
64	2020	Microbial Degradation and Valorization of Plastic Wastes	[64]
65	2020	In-situ biodegradation of volatile organic compounds in landfill by sewage sludge modified waste-char	[65]
66	2020	Optimized bioleaching of copper by indigenous cyanogenic bacteria isolated from the landfill of e-waste	[66]
67	2020	Biotransformation of chromium (VI) by <i>Bacillus</i> sp. isolated from chromate contaminated landfill site	[67]
68	2020	The effect of different levels of leachate on phytoremediation of pyrene-contaminated soil and simultaneous extraction of lead and cadmium	[68]
69	2020	Improvement of soil properties and plant responses by compost generated from biomass of phytoremediation plant	[69]

70	2020	Investigation of the influence of biofertilizer synthesized using microbial inoculums on the growth performance of two agricultural crops	[70]
71	2020	Assessment of biodegradation efficiency of polychlorinated biphenyls (PCBs) and petroleum hydrocarbons (TPH) in soil using three individual bacterial strains and their mixed culture	[71]
72	2020	Evaluation of a biosurfactant producing bacterial strain <i>Pseudomonas</i> sp. ISTPY2 for efficient pyrene degradation and landfill soil bioremediation through soil microcosm and proteomic studies	[72]
73	2020	Soil bioremediation: Overview of technologies and trends	[73]
74	2020	Bioremediation of landfill leachate by <i>Aspergillus flavus</i> in submerged culture: Evaluation of the process efficiency by physicochemical methods and 3D fluorescence spectroscopy	[74]
75	2020	Effective bioremediation of heavy metal-contaminated landfill soil through bioaugmentation using consortia of fungi	[75]
76	2020	Discovery of a novel native bacterium of <i>Providencia</i> sp. with high biosorption and oxidation ability of manganese for bioleaching of heavy metal contaminated soils.	[76]
77	2020	Bioprospecting potential of microbial communities in solid waste landfills for novel enzymes through metagenomic approach	[77]
78	2020	In-situ biodegradation of harmful pollutants in landfill by sludge modified biochar used as biocover.	[78]
79	2020	Exploration of strategies to increase the nitrogen and phosphate content of solid waste landfill soil	[79]
80	2020	Phytoremediation of waste dumping site soil and landfill leachate by using cattail ( <i>Typha latifolia</i> ).	[80]
81	2020	Degradation of di-(2-ethylhexyl) phthalate by <i>Bacillus aquimaris</i> isolated from Ajakanga municipal solid waste leachate	[81]
82	2020	Bioaugmentation assisted mycoremediation of heavy metal and/metalloid landfill contaminated soil using consortia of filamentous fungi	[82]
83	2020	Screening and selection of autochthonous fungi from leachate contaminated-soil for bioremediation of different types of leachate	[83]
84	2020	Biodegradation of the plastics PLA and PET in cultivated soil with the participation of microorganisms and plants	[84]
85	2020	Evolution properties and dechlorination capacities of particulate organic matter from a landfill.	[85]
86	2021	Bioremediation of organic contaminants based on biowaste composting practices	[86]
87	2021	Effect of biochar addition on the improvement of the quality parameters of compost used for land reclamation	[87]

88	2021	Treatment of landfill leachate with different techniques: an overview	[88]
89	2021	Microbial consortia for industrial waste bioremediation: an insight to related patents	[89]
90	2021	A survey of intact low-density polyethylene film biodegradation by terrestrial Actinobacterial species	[90]
91	2021	Screening of Fungal Microbiome to Identify Potential Polyethylene Degrading Fungi	[91]
92	2021	Bioremediation of petroleum contaminated soils-A review	[92]
93	2021	Biochar derived from pig manure with ability to reduce the availability of Pb in contaminated agricultural soils	[93]
94	2021	Phytoremediation of PAHs in Contaminated Soils: A Review	[94]
95	2021	Phytoremediation of soil treated with metalliferous leachate from an abandoned industrial site by <i>Alternanthera sessilis</i> and <i>Ipomoea aquatica</i> : Metal extraction and biochemical responses	[95]
96	2021	Environmental risk assessment in selected dumpsites in Abakaliki metropolis, Ebonyi state, southeastern Nigeria	[96]
97	2021	Effect of green waste and lime amendments on biostabilisation, physical-chemical and microbial properties of the composted fine fraction of residual municipal solid waste	[97]
98	2021	Bioremediation of heavy metals and other toxic substances by microorganisms	[98]
99	2021	Aerobic composting remediation of petroleum hydrocarbon-contaminated soil. Current and future perspectives	[99]
100	2021	Potential environmental and human health risks caused by antibiotic-resistant bacteria (ARB), antibiotic resistance genes (ARGs) and emerging contaminants (ECs) from municipal solid waste (MSW) landfill	[100]
101	2021	Low density polyethylene degradation by filamentous fungi	[101]
102	2021	Actinobacteria: An eco-friendly and promising technology for the bioaugmentation of contaminants	[102]
103	2021	Feasibility Study of the Soil Remediation Technologies in the Natural Environment	[103]
104	2021	Bioremediation of clay with high oil content and biological response after restoration	[104]
105	2021	Aerobic degradation of decabrominated diphenyl ether through a novel bacterium isolated from municipal waste dumping site: Identification, degradation and metabolic pathway	[105]
106	2021	Biodegradability of di-(2-ethylhexyl) phthalate by a newly isolated bacterium <i>Achromobacter</i> sp. RX	[106]

107	2021	Global soil pollution by toxic elements: Current status and future perspectives on the risk assessment and remediation strategies—A review	[107]
108	2021	Relationship between Leachate Pollution Index and growth response of two willow and poplar hybrids: Implications for phyto-treatment applications	[108]
109	2021	A combined approach to remediate cadmium contaminated sediment using the acidophilic sulfur-oxidizing bacterial SV5 and untreated coffee ground	[109]
110	2021	Resistance of bacteria isolated from leachate to heavy metals and the removal of Hg by <i>Pseudomonas aeruginosa</i> strain FZ-2 at different salinity levels in a batch biosorption system	[110]
111	2021	Application of in situ bioremediation strategies in soils amended with sewage sludges.	[111]
112	2021	Kinetics and Stoichiometry of an Efficient Methanotroph <i>Methylosarcina</i> sp. LC-4 Isolated from a Municipal Solid Waste Dumpsite	[112]
113	2021	Assessment of heavy metal bioremediation potential of bacterial isolates from landfill soils.	[113]
114	2021	Landfill microbiome harbour plastic degrading genes: A metagenomic study of solid waste dumping site of Gujarat, India.	[114]
115	2021	Biodiversity of Actinomycetes from Heavy Metal Contaminated Technosols	[115]
116	2021	Influences of geochemical factors and substrate availability on Gram-positive and Gram-negative bacterial distribution and bio-processes in ageing municipal landfills.	[116]
117	2021	The Impacts of Different Biological Treatments on the Transformation of Explosives Waste Contaminated Sludge	[117]
118	2021	Diesel degradation efficiency of <i>Enterobacter</i> sp., <i>Acinetobacter</i> sp., and <i>Cedecea</i> sp. isolated from petroleum waste dumping site: a bioremediation view point.	[118]
119	2021	A review on disposal and utilization of phytoremediation plants containing heavy metals.	[119]
120	2022	Biodegradation of low density polyethylene (LDPE) by mesophilic fungus ' <i>Penicillium citrinum</i> ' isolated from soils of plastic waste dump yard, Bhopal, India	[120]
121	2022	Ability of <i>Urtica dioica</i> L. to adsorb heavy metals (Pb, Cd, As, and Ni) from contaminated soils	[121]
122	2022	Insights into the effects of Fenton oxidation on PAH removal and indigenous bacteria in aged subsurface soil	[122]
123	2022	Diverse sustainable materials for the treatment of petroleum sludge and remediation of contaminated sites: a review	[123]
124	2022	Review on recent progress of bioremediation strategies in Landfill leachate - A green approach	[124]

125	2022	Bacterial strains found in the soils of a municipal solid waste dumping site facilitated phosphate solubilization along with cadmium remediation	[125]
126	2022	Biotechnological potential of microorganisms from landfill leachate: isolation, antibiotic resistance and leachate discoloration	[126]
127	2022	Insights on the bioremediation technologies for pesticide-contaminated soils	[127]
128	2022	Advances and Applications of Bioremediation: Network of Omics, System Biology, Gene Editing and Nanotechnology	[128]
129	2022	An Overview of Antibiotic Resistance and Abiotic Stresses Affecting Antimicrobial Resistance in Agricultural Soils	[129]
130	2022	Biochar Produced from Organic Waste Digestate and Its Potential Utilization for Soil Remediation: An Overview	[130]
131	2022	Phytoremediation of leachate contaminated soil: a biotechnical option for the bioreduction of heavy metals induced pollution in tropical landfill	[131]
132	2022	Preliminary investigation of microorganisms potentially involved in microplastics degradation using an integrated metagenomic and biochemical approach	[132]
133	2022	A laboratory-scale phytocover system for municipal solid waste landfills	[133]
134	2022	Converting wastes to resource: Utilization of dewatered municipal sludge for calcium-based biochar adsorbent preparation and land application as a fertilizer	[134]
135	2022	Vermitechnology: An Eco-Friendly Approach for Organic Solid Waste Management and Soil Fertility Improvement—A Review	[135]
136	2022	Exploring the plastic degrading ability of microbial communities through metagenomic approach	[136]
137	2022	Review on bioremediation and phytoremediation techniques of heavy metals in contaminated soil from dump site	[137]
138	2022	A comprehensive review on recent advancements in biodegradation and sustainable management of biopolymers	[138]
139	2022	Heavy metals removal from dumpsite leachate by algae and cyanobacteria	[139]
140	2022	Nitrogen addition facilitates phytoremediation of PAH-Cd cocontaminated dumpsite soil by altering alfalfa growth and rhizosphere communities	[140]
141	2022	Degradation of dibutyl phthalate by <i>Paenarthrobacter</i> sp. Shss isolated from Saravan landfill, Hyrcanian Forests, Iran.	[141]
142	2022	Bioprocess potential of Eco-friendly fungal isolates converting organic waste to bioresource.	[142]
143	2022	Contrasted microbial community colonization of a bauxite residue deposit marked by a complex geochemical context.	[143]



144	2022	Pyrolytic Remediation and Ecotoxicity Assessment of Fuel-Oil-Contaminated Soil	[144]
145	2022	Bioleaching of As from mine tailings using an autochthonous <i>Bacillus cereus</i> strain	[145]
146	2022	Membrane composition and successful bioaugmentation. Studies of the interactions of model thylakoid and plasma cyanobacterial and bacterial membranes with fungal membrane-lytic enzyme Lecitase ultra.	[146]
147	2022	Bioaugmentation-assisted bioremediation and kinetics modelling of heavy metal-polluted landfill soil	[147]
148	2022	A review on settlement models of municipal solid waste landfills.	[148]
149	2022	Micro-algae assisted green bioremediation of water pollutants rich leachate and source products recovery.	[149]
150	2022	A critical review on microbes-based treatment strategies for mitigation of toxic pollutants	[150]
151	2022	Coupling phytoremediation of Pb-contaminated soil and biomass energy production: A comparative Life Cycle Assessment.	[151]
152	2023	Interaction among Heavy Metals in Landfill Leachate and Their Effect on the Phytoremediation Process of Indian Marigold	[152]

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