

THE USE OF MICROORGANISMS IN BIOREMEDIATION

Microorganisms need to take in nutrients from their environment to grow and divide. The microbes metabolize these nutrients, which means that the substances the microbe takes in are broken up and the microbe excretes different substances. In bioremediation, the substances they excrete are less harmful than the original pollutant. Basically, the microbes eat the pollution and clean up the area.

Microorganisms perform bioremediation in one of three ways. Sometimes the microbes in a polluted area adapt to the pollution naturally and break it down as part of their food source or adapt to the toxins enough to survive and convert the pollution into substances that are harmless to the microbes and to other forms of life. This natural system is called natural attenuation. If the microbes will not break down the pollutant naturally, addition of nutrients may stimulate bioremediation. This process is bio-stimulation. Lastly, humans can artificially add a new microbial population to an area to deal with the pollutant. This is known as bio-augmentation. Some microbes can break down petroleum products and the by-products of petroleum that are carcinogenic. This can work for groundwater contamination or marine oil spills. Bacteria can also remove heavy metals from the environment such as mercury. Other bacteria can break down solvents and chlorinated substances. Certain pesticides are also edible to bioremediation microbes. Although some species of microbes naturally have the capability to break down pollutants, some other microbes for bioremediation use are genetically modified to artificially give the microbe those abilities.

Microorganisms are relatively cheap to produce and use compared with other pollution control measures. Landfill is reduced as the contaminated soil does not need to be removed and no materials are used to soak or collect the pollutant. The microbes self-replicate, and their use tends to be more environmentally-friendly with fewer side effects than other control methods. Microorganisms in bioremediation may take several years to completely clean the polluted area. Even after the clean-up is complete, the microorganisms themselves may need to be harvested to remove pollutants such as stored uranium. Climate can also play a role in the efficiency of the process, as the applied microbes may be washed away or killed through drought.

1

Number these topics in the order they are dealt with in The use of microorganisms in bioremediation.

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|--|--|
| <input type="checkbox"/> Advantages of bioremediation | <input type="checkbox"/> Types of bioremediation |
| <input type="checkbox"/> Artificial design of microorganisms | <input type="checkbox"/> Types of pollution |
| <input type="checkbox"/> Disadvantages of bioremediation | |

2

Decide which of these verbs – taken from The use of microorganisms in bioremediation – are synonyms of the following phrasal verbs: absorb, purify, remove by water, separate, treat. Tip: copy the pairs in your indexed book.

- a. take in:
- b. break up/down:
- c. clean up:
- d. deal with:
- e. wash away:

3

Decide which of these adjectives – taken from The use of microorganisms in bioremediation – are antonyms of the following ones: expensive, few, friendly, more, partial, poisonous, same. Tip: copy the pairs in your indexed book.

- a. different:
- b. harmless:
- c. natural:
- d. edible:
- e. cheap:
- f. fewer:
- g. several:
- h. complete:

4

Which of the words underlined in The use of microorganisms in bioremediation match the definitions below? Tip: copy the definitions in your indexed book.

- a. accidental releases of petroleum into a water body:
- b. addition of nutrients to stimulate bioremediation:
- c. all the surroundings of a living organism:
- d. damaging moisture shortage:
- e. disposal of waste buried under the ground:
- f. food substances providing energy and building material:
- g. harmless for the environment:
- h. having an altered genetic make-up:
- i. microbial population added artificially to an area to deal with pollutants:
- j. poisonous metals with a high specific gravity:
- k. poisonous substances produced by the metabolic activity of living organisms:
- l. secondary or incidental product:
- m. secondary usually undesirable outcomes:
- n. substances that can be dissolved in or dissolve other substances:
- o. substances used to kill pests:
- p. the contamination of the environment by harmful substances:
- q. very tiny one-celled organisms:
- r. water beneath the earth's surface: