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Science for Environment Policy

Iron-coated brown seaweed used to remove arsenic from water

The removal of arsenic from water using a brown seaweed (*Sargassum muticum*), coated with iron hydroxide, has been tested in a recent study. Under optimal pH conditions, the method removed 100% of the arsenic, indicating the viability of this method for treating contaminated water.

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Source: Vieira, B.R.C., Pintor, A.M.A., Boaventura, R.A.R., Botelho, C.M.S. & Santos, S.C.R. (2017). Arsenic removal from water using iron-coated seaweeds. *Journal of Environmental Management*. 192:224–233. DOI:10.1016/j.jenvman.2017.01.054

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Arsenic is a toxic and carcinogenic semi-metal, which can enter waterways through natural deposits and human activity, including mining, agriculture and industrial activities. Arsenic has been linked to a number of cancers as well as other human health issues. Contamination of groundwater, which is used for drinking water, has been reported in many developing countries including Argentina, Bangladesh, Chile, China, India, Taiwan and Thailand. Waste water released from activities such as mining also requires efficient methods for removing arsenic. The two main forms of arsenic — arsenite and arsenate — are commonly found in water discharged from mines.

This study proposed a novel process of removing arsenite and arsenate forms of arsenic from water by adsorption on brown seaweed coated with iron-oxy (hydroxides). Adsorption refers to molecules adhering to the surface of a substance. The addition of iron oxy on seaweed creates specific adsorption sites for arsenic.

Brown seaweed was collected from beaches at Viana do Casetelo, Portugal, and coated with iron. The researchers tested a method of removing arsenite and arsenate from a contaminated groundwater sample by adsorption. The test results were used to model the adsorption of arsenic and to compare the new technique to other known methods of adsorption. Tests were also carried out at different pH values to see their impact on adsorption. The technique was compared with a conventional treatment of coagulation and flocculation, a process that encourages particles to form a mass in order to be filtered from water.

The modelling indicated a maximum adsorption at pH 7 and 20 °C of 4.2 milligrams per gram (mg/g) for arsenite and 7.3 mg/g for arsenate. The best pH conditions for adsorption of arsenic onto iron were between pH 4 and pH 7 — with 98% removal efficiency at pH4, and around 100% efficiency at pH 7. But in acidic conditions, iron was found to leach from the seaweed. For example, at pH 4 the iron concentration was 123 milligrams per litre (mg/L), whereas it was only 2mg/L at pH 7. Under optimal conditions, both the brown seaweed coated with iron-oxy and the conventional coagulation and flocculation treatment removed almost 100% of the arsenic from contaminated water.

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The researchers say this is probably the first test using iron treatment of seaweeds to remove arsenic. They say the main disadvantage of the new method was the leaching of iron from the seaweed into the water. However, this problem is mitigated by using a pH above 6, which also makes the treated water more suitable for uses such as irrigation.

Although quantity of arsenic removed was similar for the new and the conventional treatment methods, the researchers say the study does not allow a detailed comparison of the two methods as this would require the testing of different water samples. However, the new method does reduce the use of additional reactants (other substances used as part of the process) and sludge produced as a result of the process. Overall, the study indicates that using iron-coated seaweeds is a viable method of removing arsenic from water.

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