Bio-Buffers—Remediating Estuarine Water Pollution

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Estuarine ecosystems such as Washington's Puget Sound are especially vulnerable to the impacts of anthropogenic pollution. Increased concentrations of carbon dioxide and nitrate—termed acidification and eutrophication, respectively—threaten ecosystem stability by shifting the chemical equilibriums found in these aquatic systems. Excess dissolution of $CO_2(g)$ stresses the bicarbonate buffering system, harming marine calcifiers by increasing water acidity and decreasing the bioavailability of bicarbonate. Elevated nitrate levels precipitate the growth of harmful algal blooms (HABs), which restrict benthic plant growth and lead to hypoxia. However, algae have also been promising in the realm of aquatic phytoremediation due to their high productivity and sequestering ability. In this experiment, C. vulgaris was selected with the intent of decontaminating a series of simulated environments. Immobilized in the form of sodium alginate beads, the algae was introduced to samples contaminated with carbon dioxide, nitrate, or a combination of both pollutants. Each category consisted of three algae-containing experimental samples and one specialized control. A general control was also prepared as a standard of reference. In comparing each set of experimental samples to their respective controls, both CO_2 and nitrate levels decreased in the presence of algae, stabilizing within one week. Though nitrate removal was comparable between the samples containing exclusively nitrate and those containing both pollutants, CO_2 removal occurred to a greater extent in the samples containing CO_2 and nitrate. Algal beads remain a promising means of addressing estuarine water pollution, with additional potential to be recycled and utilized as an organic, nutrient-rich fertilizer post-remediation.