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**Highlights**

1. High Fe and  $\text{SO}_4^{2-}$  treatment is most favorable for As sequestration in soils in the presence of wetland plants.
2. As retention in soil and accumulation in plants was mainly controlled by  $\text{SO}_4^{2-}$  rather than Fe levels.
3. High  $\text{SO}_4^{2-}$  can stimulate the growth of As dissimilatory reduction bacteria, leading to more As(V) reduction to As(III).

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