Complete degradation of perchlorate in wastewater by continuous adsorption/catalytic decomposition system

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Recently, perchlorate (ClO_4^-) has become one of major inorganic contaminant in drinking water because it is difficult to remove it from polluted water by using conventional treatment system due to high water solubility and kinetic inertness of ClO_4^-. Among various treatment options, physical adsorption can provide fast, economic methods for perchlorate removal, but energy-efficient and eco-friendly ways without disposal problem should be developed. Here we demonstrated integrated process combining physical adsorption and catalytic decomposition for complete decomposition of perchlorate into non-toxic chloride by using Pd-supported ion-exchange resin as an adsorption/catalysis bifunctional material. This system showed significant ClO_4^- capacity and selectivity during the adsorption, the Pd-supported resin saturated with ClO_4^- could be permanently regenerated by the catalytic function of highly dispersed Pd clusters under H_2 atmosphere and significantly faster decomposition is achieved in ethanol medium enhancing diffusion of ClO_4^- from adsorption sites to Pd surface. The anion exchange resin with highly dispersed Pd showed >90% decomposition of adsorbed ClO_4^- at 373 K in 24 h (>99% decomposition within 36 h). The ClO_4^-- adsorption - catalytic decomposition cycle could be repeated up to five times without a significant loss of ClO_4^- adsorption capacity.