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Comparison of bimetallic and trimetallic catalyst in reductive dechlorination of PCBs in aqueous solution

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Iron in its oxidation state (so called zero valence iron Fe(0)) as a reducing agent with combination of various noble metals as carriers has been applied for reductive dechlorination of chlorinated hydrocarbons for last 20 years. Such combinations of base and noble metals are known as bimetallic catalysts. The application of bimetallic catalysts has been focused on chlorinated aliphatic or aromatic hydrocarbons. Efficiency of reduction of PCBs in aqueous solution was examined with the help of bimetallic catalyst Fe-C/Pd consisting of palladized grey cast iron and with a newly designed trimetallic catalyst (Cu-Fe-C/Pd) consisting of a copper metal plate with embodied microparticles of palladized grey iron (bimetallic catalyst). PCB solutions were prepared using DELOR 103. The trimetallic catalyst was significantly more efficient than bimetallic one. Trimetallic catalyst (reduced the concentration of PCB to approximately 1% of its initial value during 70 minutes and bimetallic during 240 hours). Moreover, more than 20% of unreacted PCBs were found adsorbed on the surfaces of the bimetallic catalysts. Contrary, presence of metal copper accelerates formation of the oxidation products and their release from the catalyst surface as the individual flocks which recovers activity of the trimetallic catalyst. These facts significantly can change the previous belief, widely published for decades, that the reductive dechlorination of PCB is the only decisive control step in the reduction of their content in water by zero valence metals.

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