Activated microporous microcarrier for heavy metal removal from wastewaters

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MAX 400 words

Heavy metals in water bodies represent a serious environmental and human health threat [1]. Heavy metals are known for their utility in industrial processes such as industrial welding, dyes and pigments manufacturing, electroplating processes, leather tanning and wood preservation [2]. Since bacteria interact with metals by passive adsorption processes and active enzymatic reactions, they can be proposed in water bioremediation strategies [3]. The biological activation of adsorbing biomaterials (i.e. agro-wastes, biochar, activated carbon, lignite) with specific metal-removing bacterial strains is under study in order to obtain microporous microcarriers activated with bacterial biofilms. These systems are characterized by selective heavy metal extraction while providing cells with higher resistance to environmental stress [4].

The present study investigates the feasibility of *Serratia plymuthica* strains SC3I(2) and As3-5a(5) and *Rhodococcus quingshengii* strain SC26 to be used in the removal of Nickel, Copper and Hexavalent Chromium from industrial wastewaters. *S. plymuthica* strain SC3I(2) was able to remove 89.4% of Ni(II) from a 50 mg L^{-1} solution, and showed maximum biosorption capacity of 33.5 mg g^{-1} in non-proliferating planktonic cell condition. *S. plymuthica* strain As3-5a(5) removed up to 91.5% of Cu(II) from a 200 mg L^{-1} solution, yielding maximum biosorption capacity of 80.5 mg g^{-1}. *R. quingshengii* strain SC26, able to resist to Cr(VI) (MIC of 300 mg L^{-1}), reduced 51.14 mg L^{-1} Cr(VI) to Cr(III) in active growing-cell condition. The heavy metal biosorption/reduction of *S. plymuthica* strains SC3I(2) and As3-5a(5) and *R. qingshengii* strain SC26 was assessed on real electroplating wastewaters. The strains were able to reduce metals concentration in different ratios, As3-5a(5) and SC3I(2) removed respectively 8.89 mg L^{-1} and 2.37 mg L^{-1} of Cu(II) from Cu contaminated wastewaters and 222.23 mg L^{-} and 116.16 mg $L^{-1}$of Ni(II) from Ni contaminated wastewater. The biosorption capacity of As3-5a(5) and SC3I(2) were respectively of 0.12 mg g d.w.$^{-1}$ and 0.16 mg g d.w.$^{-1}$ of Cu(II) and 3.24 mg g d.w.$^{-1}$ and 8.13 mg g d.w.$^{-1}$ of Ni(II). The activity of bacterial strains was monitored in mini-column experiments by inoculation of different microporous microcarriers. Once colonization occurred, cell-activated microcarriers were subjected to Ni(II), Cu(II) and Cr(VI) solutions and real contaminated electroplating wastewater flow, demonstrating their activity also in high specific surface biofilm-based system.

Further characterization will provide information regarding possible metal removal and recovery in a full-scale bioremediation system. However, some knowledge gaps still need to be filled to further improve the adsorption capacity of heavy metals when present in wastewaters contaminated by different metals and organic pollutants.

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