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Biosorption of Arsenic(V) by Methylated Activated Sludge

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ABSTRACT

Biosorption is potentially an attractive technology for treatment of municipal or industrial wastewaters for the separation and recovery heavy metal ions. It includes a fast and reversible reaction of the heavy metals with biosorbents such as fungi, algae, and bacteria. Activated sludge play an important role in the research development of new biosorption materials due to their high capacities and selectivity. Sağ *et al* showed that activated sludge was a promising material for the removal of copper from wastewater by adsorption. The use of waste activated sludge obtained from sewage treatment plant is of particular economically interested in its application, because the biomaterials are used in the same way as synthetic adsorbent or ion exchangers and repeated generation is possible.

Arsenic is a widespread contaminant in soils and waters. It is a toxic metalloid present in the environment due to both geochemical background and anthrophogenic activities. The predominant form of inorganic arsenic in aerobic aqueous environments is arsenate, As(V) which can be reduced into more toxic arsenic, As(III). Therefore, the main objective of the present study was to investigate the biosorption characteristics of As(V) by activated sludge in contaminated groundwater.

The methylation applied to the activated sludge was supplied by a sewage treatment plant (Cheonan city, Korea) for biosorption of arsenic. It has been shown that this treatment causes esterification of the negatively charged groups present on the biomass In the case of carboxylic groups the reaction occurs as follows:

$$RCOOH + CH_3OH \xrightarrow{H+} RCOOCH_3 + H_2O$$

The metal binding ability of carboxylic groups will be significantly reduced as a result

of esterification. From this reaction it can be assumed that the negatively charged groups in the activated sludge prevented the permeation of As(V) anions into the cells, while the neutralization of the groups by methylation allowed the permeation of As(V) anion. Figure 1 shows the effect of methylation onto activated sludge for the biosorption of arsenic. The amount of adsorbed As(V) was increased when negatively functional groups of activated sludge were esterified for 24 h. The result suggest that positively charged adsorption sites take part in the biosorption of As(V) after methylation of biomass. Also, biosorption of As(V) by methylated activated sludge depends on initial pH of solution. The As(V) uptake in higher pH levels (e.g., pH 7, 9) was relatively low due to competition with the OH^- ions for binding sites on the surface of bacteria.

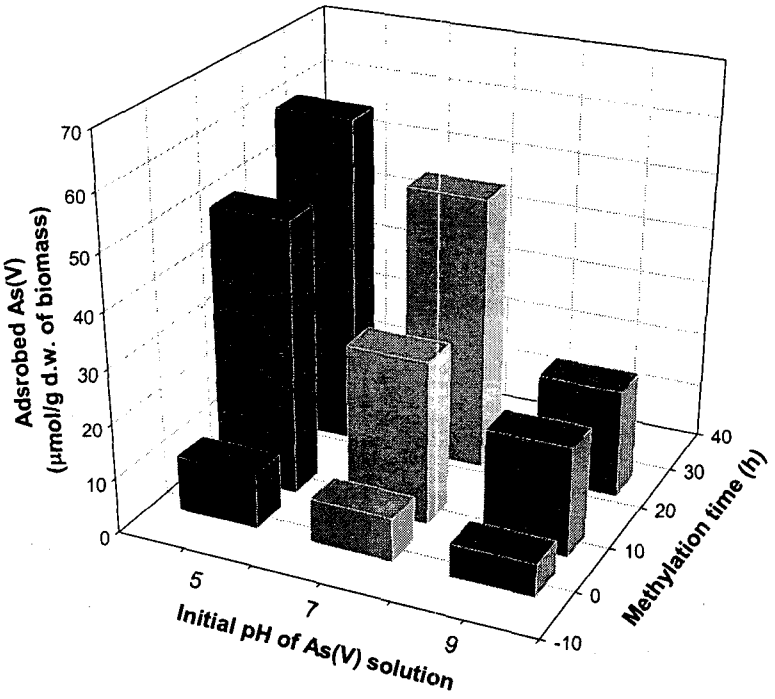

Figure 1. Influence of the solution pH and methylation time on As(V) uptake by methylated activated sludge: concentration of each solution = 250 μmol/L; dry weigh of biomass= 1 g/L

Key words biosorption, arsenic, methylated activated sludge, pH