

Mono- and Di-methyl Arsenic(V) Adsorption on Iron Oxides

B.J. Lafferty, R.H. Loeppert

Dept. of Soil and Crop Sciences, Texas A&M University, College Station, TX 77843-2474, USA (E-mail: blafferty@tamu.edu r-loeppert@tamu.edu)

INTRODUCTION

Arsenic is a toxic element that is widely distributed throughout the earth's crust as a result of both natural geologic processes and anthropogenic activities (Cullen and Reimer, 1989). In virtually all environments, methylated forms of arsenic can be found (Cullen and Reimer, 1989). As a result of some recent studies, it is now known that some methyl arsenic species can be as toxic or more toxic than inorganic As^{III} or As^V (Styblo *et al.*, 1997; Zakharyan *et al.*, 1999; Lin *et al.*, 1999; Petrick *et al.*, 2000; Mass *et al.*, 2001). Because of the widespread distribution and toxicity of arsenic and methyl arsenic, their adsorption behavior on soil minerals is of great interest. Although considerable work has been done on the behavior of inorganic arsenic in soils (Jain *et al.*, 1999; Raven *et al.*, 1998) very little research has been conducted regarding soil interactions of the methyl arsenic forms.

MATERIAL AND METHODS

The objective of this study was to compare the adsorption and desorption behavior of arsenate (As^V), monomethyl arsenate (MMA^V), and dimethyl arsenate (DMA^V) on iron oxide minerals (goethite and ferrihydrite) by means of adsorption isotherms and adsorption and desorption envelopes. Isotherms were conducted in a batch experiment by maintaining a constant pH (pH 4) and oxide concentration, while increasing the amount of arsenic (MMA^V, DMA^V, or As^V) in each sample. Adsorption envelopes were obtained in a batch type experiment within the pH range of 3 to 10. Desorption equilibrium and kinetics were also evaluated within the pH range of 3 to 10, using sulfate and phosphate as competitive ligands. Arsenic was measured by flow injection analysis using hydride generation and AAS.

RESULTS AND DISCUSSION

MMA^V and As^V were adsorbed at much higher amounts than DMA^V on goethite and ferrihydrite at pH 4 (Fig. 1 and 2). Although MMA^V and As^V were adsorbed quantitatively at lower concentrations on goethite and ferrihydrite, DMA^V was not quantitatively adsorbed at any concentration on goethite or ferrihydrite. MMA^V and As^V exhibited high adsorption affinities for both goethite and ferrihydrite at pH values ranging from 3 to 10, while DMA^V was strongly adsorbed only at pH values below 8 on ferrihydrite and below 7 on goethite (Fig. 3 and 4).

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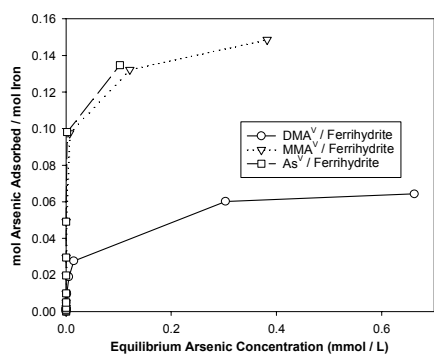


Fig. 1. Adsorption isotherm with DMA^V, MMA^V, and As^V on ferrihydrite.

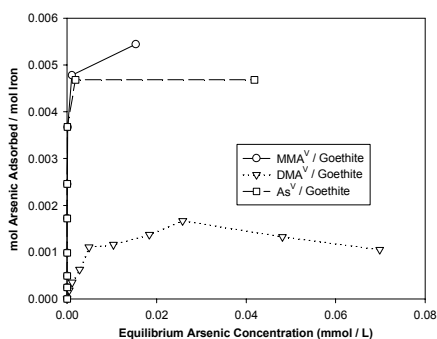


Fig. 2. Adsorption isotherm with DMA^V, MMA^V, and As^V on goethite.

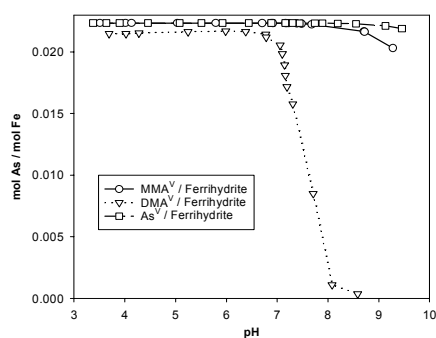


Fig. 3. Adsorption envelope with DMA^V, MMA^V, and As^V on ferrihydrite.

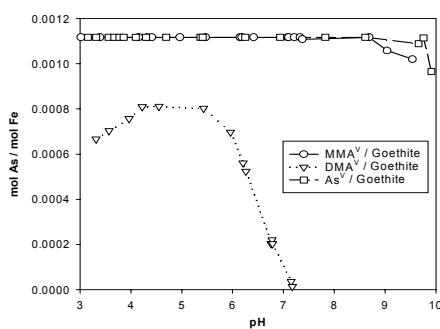


Fig. 4. Adsorption envelope with DMA^V, MMA^V, and As^V on goethite.