

Molybdenum, Molybdate

For water

Mercaptoacetic Acid and Ternary Complex Methods

Introduction

Molybdenum (molybdate) salts are commonly used as corrosion inhibitors in cooling water systems. There are numerous procedures for determining molybdenum as molybdate (MoO_4^{2-}) in water. The Mercaptoacetic Acid Method is one of the most frequently referenced methods for determining molybdenum. The Hach procedure improves and simplifies this time-proven procedure.

Chemical reactions

Mercaptoacetic acid

The MolyVer™ (Mercaptoacetic Acid) Method utilizes three reagent powders. First, a MolyVer 1 Reagent Powder Pillow is added. MolyVer 1 contains a buffer to control the pH, in addition to a chelating agent to mask interferences.

Low test results can be caused from reduction of Mo^{6+} to Mo^{5+} , because the test is specific for Mo^{6+} . MolyVer 2 Reagent Powder is added to prevent reduction of the Mo^{6+} ion. Finally, mercaptoacetic acid, contained in MolyVer 3 Reagent Powder, is added. The reaction of MolyVer 3 with Mo^{6+} results in formation of a characteristic yellow color. Development of the yellow color follows Beer's Law over the range of the test.

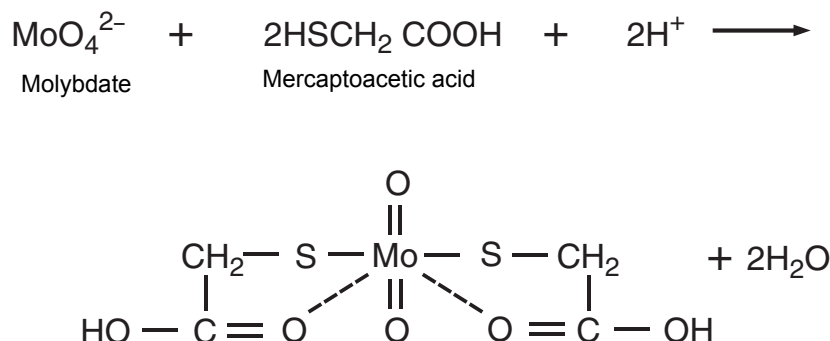


Figure 1 Chemical reaction for the Mercaptoacetic Acid method

Ternary complex method

The ternary complex method is a two-reagent method for molybdenum in the 0–3 mg/L range. First, the molybdenum-containing sample reacts with Molybdenum 1 Reagent, which contains colorimetric indicator, pH buffer, and reducing agent. The reducing agent counteracts interference by iron, a common contaminant in boiler and cooling water samples. The indicator forms a colored, binary complex with molybdenum. Depending on molybdenum levels, binary-complex color will range from pale yellow to rusty orange.

Second, Molybdenum 2 Reagent will combine with the binary complex to form an intensely colored, blue, ternary (three-part) complex directly proportional to sample molybdenum concentration. The eye perceives the color as ranging from yellow to green because the blue color is superimposed over a yellow background. These colors correspond to 0 mg/L Mo (yellow) up to 3 mg/L Mo (dark green).

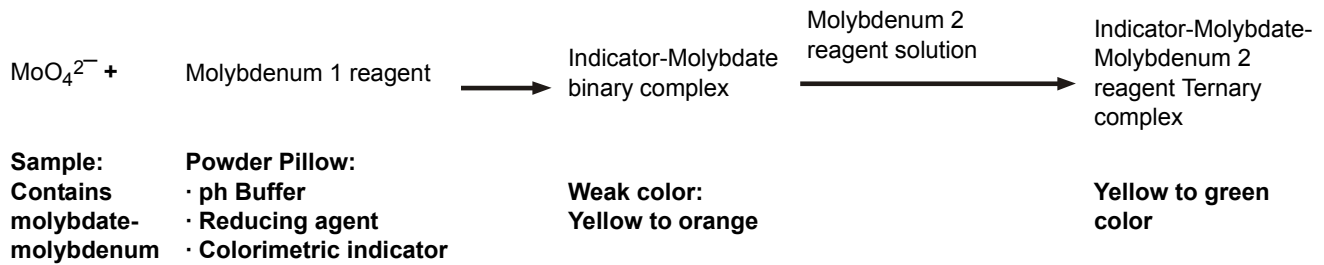


Figure 2 Chemical reaction pathway for the Ternary Complex method