

TITLE: Selective Removal and Detection of Trace Copper from Background of Other Heavy Metals Using Chelating Exchangers

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ABSTRACT

Copper is toxic to fish and similar aquatic biota even at ultra-low concentration. The criteria maximum concentration of copper for fresh water is $13\mu\text{g/l}^*$ which ultimately sets a very stringent limit for copper in wastewater discharge. Often, chelating ion exchanger (imino-diacetate/amino-phosphonate functionality) is used for selective removal of trace heavy metal cations[Cu(II), Pb(II), Ni(II), Zn(II)] in preference to common cations(Na^+ , Ca^{2+}). However, such removal is not metal specific, capacity is adversely affected at low pH(~ 2) and in presence of chelating agent such as EDTA. A special class of chelating exchanger(DOWEX-M4195) with multiple nitrogen donor atoms exhibits significant heavy metal selectivity at highly acidic pH. Also, interference of EDTA(or similar ligand) is overcome at low pH. Relative selectivity of copper is further enhanced by lowering pH to 1.5 approximately. Figure-1 demonstrates preferential uptake of copper at pH 1.6 from other heavy metal cations which is unattainable with other chelating-exchangers. An effective regeneration is achieved with NH_3 (2-4%) while acid regeneration is ineffective. Ultra-low copper

concentration is detected through pre-concentration in M4195, subsequent elution by ammonia and passing through chelating fiber(FIBAN-X) which produce blue color characteristic to copper-ammonia-iminodiacetate complex(Figure-2). Using M4195, both selective separation and detection of low concentration of copper is achieved.

* National recommended water quality criteria from US EPA sets the limit for fresh water (river/ lake). The limit for saltwater is further stringent.

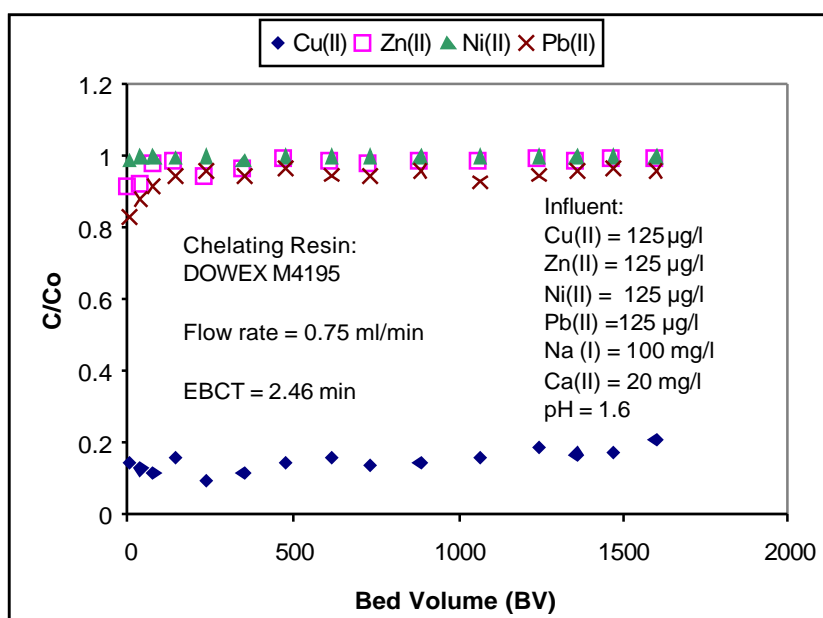


Figure-1. Selective copper removal in preference to other heavy metal cations and common cations (Na^+ , Ca^{2+}) at highly acidic condition by DOWEX-M4195

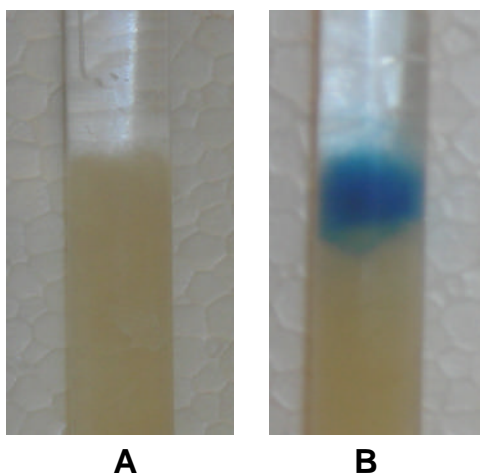


Figure-2. **A.** No color change for chelating fiber (FIBAN-X) for control solution with other heavy metals but no copper. **B.** Change of color of FIBAN-X from pale yellow to blue for 10 ppb copper pre-concentrated through M4195 from background of other heavy metals, eluted by ammonia and passed through chelating fiber