VALUE(S) ADDED 7-24-85

FACT SHEET REVISED _____

VALUE(S) REMOVED _____

Date: September 20, 1984

Surface Water Quality
Standard Documentation

Chemical: Silver

C.A.S, No.(s): NA

Basis (Human/Aquatic): Aquatic

Standard by Water Classification:

	ug/l	Notes
Classes AA,AA-s;A;A-s;B;C	0.1, ionic silver	I
Class D	*	H
Classes SA;SB;SC;I		
Class SD	2.3	H

Remarks: * exp (1.72 [ln(ppm hardness)]-6.52)

Summary of Information

1. IJC. 1978. Group 2. New and revised specific water quality objectives proposed for the 1972 agreement between the United States and Canada on Great Lakes water quality by the Great Lakes Water Quality Board. International Joint Commission, Regional Office, Windsor, Ont. 195 pp.

   -recommended objective: "Concentrations of total silver in an unfiltered water sample should not exceed 0.1 micrograms per litre to protect aquatic life."

   -0.1 ug/l represents a value between effect and no-effect concentrations from chronic toxicity tests with rainbow trout.

2. EPA. 1980. Ambient water quality criteria for silver. USEPA, Wash., D.C.

   -no criteria derived to prevent chronic toxicity.

   -using national guidelines to derive AWQC, recommended maximum criteria:

   -in freshwater AWQC (ug/l) = exp(1.72[ln(hardness)]-6.52)

   -at 50, 100, and 200 ppm hardness the AWQC are 1.2, 4.1, and 13 ug/l, respectively.

   -in salt water AWQC = 2.3 ug/l

3. IJC. 1982. Report of the Aquatic Ecosystems Objectives Committee. International Joint Commission, Regional Office, Windsor, Ont. 31 pp.

-reaffirmed recommended objective for silver in IJC (1978).

-noted that, even though it is clear that ionic silver is the toxic specie, equilibrium with all complexing agents may not occur near effluents, sulfide may occur in very low concentrations in natural waters, and weak inorganic complexes may permit 'free' silver to occur at concentrations close to 0.1 ug/l.

-until such time that a reliable method is available to measure 'free' silver at concentrations as low as 0.1 ug/l IJC recommends limiting as total silver.

4.a. -Lytle, P.E. 1984. Fate and speciation of silver in publicly owned treatment works. Envir. Tox. & Chem 3(1):21-30.

b. -LeBlanc, et al. 1984. The influence of speciation on the toxicity of silver to fathead minnow (Pimephales promelas). Envir. Tox. & Chem. 3(1): 37-46.

-both papers report measuring ionic silver as low as 0.00000012 ug/l in toxicity tests and as high as 0.05 ug/l below effluents using the pAg method, citing Chudd for the methodology.

-LeBlanc et al. (1984) concluded that free silver ion was 300 times more toxic than the most toxic of other silver complexes tested.

Standard Derivation

The criterion proposed by IJC is scientifically sound and satisfies the requirements of NYS protocol. Acute toxicity has been observed at concentrations less than ten times the IJC criterion which precludes the usefulness of the protocol for deriving a Class D standard. Therefore, 0.1 ug/l should be adopted as the standard for ionic silver for all freshwater classes. The EPA maximum criteria for salt and fresh water, derived using national guidelines, are appropriate for class SD and as an alternative standard for Class D, respectively.

Toxicity tests with silver in soft fresh water and under conditions such as described in LeBlanc et al. (1984) indicate that chronic toxicity to aquatic life occurs at greater than 0.1 ug/l ionic silver virtually irrespective of the total silver concentration. It is implicit in the relationship established by EPA (1980) between hardness and acute toxicity that the calculated criteria should be expressed as total silver, reflecting the complexing of silver as hardness increases. Likewise in salt water silver complexes with a number of substances which have not been accounted for in tests. Therefore, NYS criteria for Classes D & SD should be expressed as total silver, unless the value of 0.1 ug/l ionic silver is used in Class D.

The reservations expressed by IJC (1982) regarding the pAg methodology appear to have been overcome as evidenced by Lytle (1984) and LeBlanc (1984). However, other concerns expressed by IJC regarding the potential for the occurence of ionic silver in ambient surface water at concentrations approaching the standard are well founded. Therefore, when the ionic silver standard is used in the regulation of silver in wastewater discharges it may be necessary to consider the environmental fate of silver released into ambient waters in order to ensure compliance with the standard.