

TECHNICAL DATASHEET

Analysis of Quaternary Ammonium Herbicides in Water

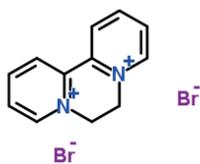
Overview

ALS Environmental can provide analytical testing for quaternary ammonium herbicides in water with reporting limits of less than 14ng/l. On the basis of their toxicity, the World Health Organization (WHO) has classified diquat as moderately hazardous and is considered a priority pollutant, chlormequat and mepiquat are classified as slightly hazardous. Due to this, there is concern about the presence of these compounds in different matrices such as fruits, soils and waters. In response to this issue, ALS Environmental has developed, validated and accredited a method capable of analysing these compounds in water at ultra-trace levels using state of the art instrumentation.

Quaternary Ammonium Herbicides Background

Quaternary ammonium herbicides and plant growth regulators, commonly known as “quats”, constitute an important group of pesticides. Included in this group is the herbicide diquat and the two plant-growth regulators chlormequat and mepiquat.

Diquat is widely used as fast-acting non-selective contact herbicide for the control of weeds.

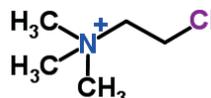


Structure of Diquat dibromide

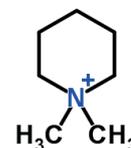
Diquat is suitable for many agricultural uses because of its high solubility in water, its low production of vapours during application and its ability to bind rapidly and tightly to clay materials in soils and when absorbed are biologically inactive. Many incidents of accidental and intentional exposures to this compound has been reported. The primary route of exposure is ingestion, although in rare occurrences, inhalation and dermal exposure has caused toxic effects.

Diquat accumulates in the lungs, liver, and kidneys. Diquat targets the central nervous system, with most effects seen in the brain stem.

Chlormequat and mepiquat are used as plant growth regulators to reduce unwanted longitudinal shoot growth without lowering plant productivity. Chlormequat and mepiquat are used on several food crops, especially in cereals and in some fruit and vegetables.



Structure of Chlormequat cation



Structure of Mepiquat cation

Quaternary Ammonium Herbicides Regulatory Guidelines

The United States Environmental Protection Agency's (EPA) has established a health advisory level of 20 µg/L for diquat in drinking water. The European Union directive (98/83/EC) on the quality of water intended for human consumption declares maximal acceptable concentrations for individual pesticides and their metabolites to 0.1µg/L while the sum of all pesticides and metabolites must not exceed the value of 0.5 µg/L.

Analysis Of Quaternary Ammonium Herbicides

Quaternary ammonium herbicides are a particularly difficult group of compounds to analyze. Their high solubility in water, non-volatile and cationic character makes extraction and detection difficult. Ion-pair high performance liquid chromatography (HPLC) using ultraviolet (UV) detection has been the quantitative method of choice for these ionic species in the past. However, UV detection is susceptible to interferences from water matrices and lacks the detection specificity to provide unequivocal analyte identification.



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To overcome the problems of quantification and identification ALS have developed a weak cation exchange solid phase extraction HPLC-triple quadrupole tandem mass spectrometry (MS/MS) method for the simultaneous determination of three quaternary ammonium herbicides. Use of this sensitive and selective instrumentation enables ALS to achieve detection limits (LoQs) of less than 14ng/L for chlormequat, diquat and mepiquat in treated and raw water. The range of application for this method is up to 150ng/L.

General Sampling & Preservative Requirements

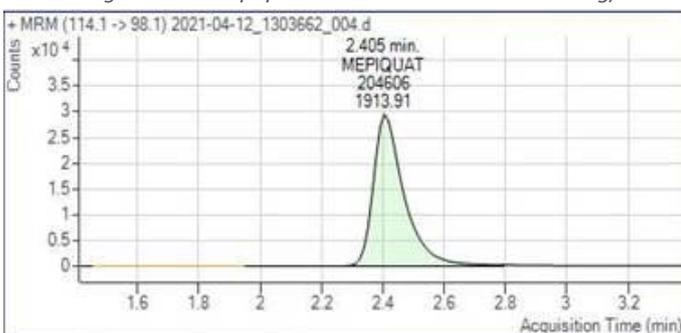
Bottle: 125ml PE/HD bottle preserved with sodium thiosulphate.
 Storage: Stored at 3 +/- 2°C.

Holding Time: Samples are stable for at least 21 days under these storage conditions.

Quats Performance Summary for ALS Method WPC51.

Compound	CAS Number (of reference Material)	Limit of Quantification (LoQ) (ng/L)	Recovery from water at 100 ng/L
Chlormequat	999-81-5	2	102.29%± 1.05%
Diquat	85-00-7	14	100.99%± 1.34%
Mepiquat	24307-26-4	3	100.47%± 0.89%

Chromatogram of a Mepiquat calibration standard at 120 ng/L.



Accreditation

ALS quaternary ammonium herbicide analysis of treated and raw water is UKAS accredited under ISO/IEC 17025:2017 to the Drinking Water Testing specification (DWTS) to provide our customers with additional confidence in the analytical data provided.