

# Eliminate TKN and Get Better Total Nitrogen Data

**Pittcon 2015** 1855-10P

William Lipps and Dan Davis;  
Shimadzu Scientific Instruments, Columbia, MD, USA

## Eliminate TKN and Get Better Total Nitrogen Data

### Introduction

Nitrogen is a principle element referred to when discussing nutrient pollution and, along with phosphorus, is largely responsible for the occurrence of algal blooms. Two different techniques, wet chemical oxidation that determines nitrogen colorimetrically and

high-temperature oxidation that determines nitrogen by chemiluminescence, can provide laboratories with efficient, cost-effective alternatives to Total Kjeldahl Nitrogen (TKN) for the determination of total nitrogen.

### Discussion

The EPA approved method for Total Nitrogen, Total Kjeldahl Nitrogen (TKN) plus nitrate/nitrite, is cumbersome, time consuming, hazardous, and not very effective at determining total nitrogen in ambient water. The TKN method does not measure nitrate or nitrite nitrogen; TKN measures organic nitrogen and the ammonium ion. TKN is sufficient in POTW or municipal influents because these samples rarely have nitrate, however, sewage treatment, industrial plant effluents, and ambient water consist predominantly of inorganic nitrogen (nitrate) with only traces of organic nitrogen.

them as a single result. The methods rely on alkaline persulfate digestion (PO) followed by colorimetric detection of nitrate nitrogen, or high temperature catalytic combustion (HTCC) with chemiluminescence detection.

Alternative methods used for the determination of total nitrogen measure all nitrogen compounds and report

Nydaahl studied the persulfate oxidation method extensively and determined the results of 10 sewage treatment plant effluents were equivalent to the results obtained by the TKN method (Figure 1). Nitrate was measured colorimetrically on a visible spectrophotometer similar to the Shimadzu UV-1800 (Figure 2).

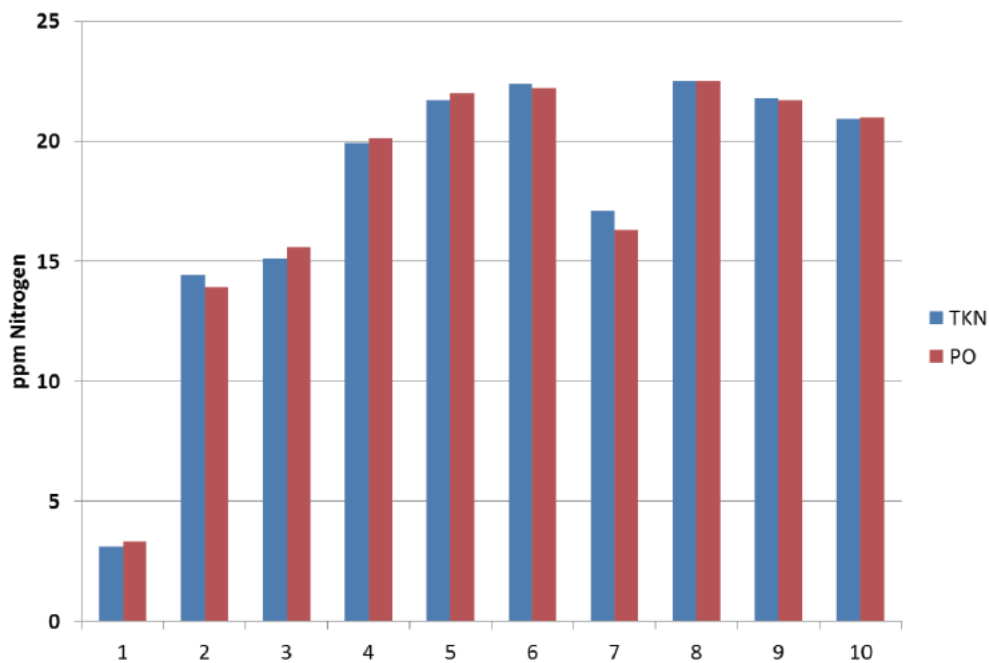


Figure 1: Comparison of TKN with persulfate digestion

## Eliminate TKN and Get Better Total Nitrogen Data



Figure 2: Shimadzu UV-1800 UV-Visible spectrophotometer

Kroon compared TKN with an automated UV PO method and found no significant differences in surface waters or wastewaters. Bronk, and others, compared the PO method with the HTCC method and found that they provide reproducible results that are consistent with each other.

Chen, in comparing HTCC with chemiluminescence detection (on an instrument similar to Figure 3) with PO in soil extracts found the results were highly correlated (Figure 4), with the exception of greater values by HTCC when nitrogen concentrations were high.



Figure 3: Shimadzu TOC-L Total Organic Carbon Analyzer with Nitrogen Module installed

## Eliminate TKN and Get Better Total Nitrogen Data

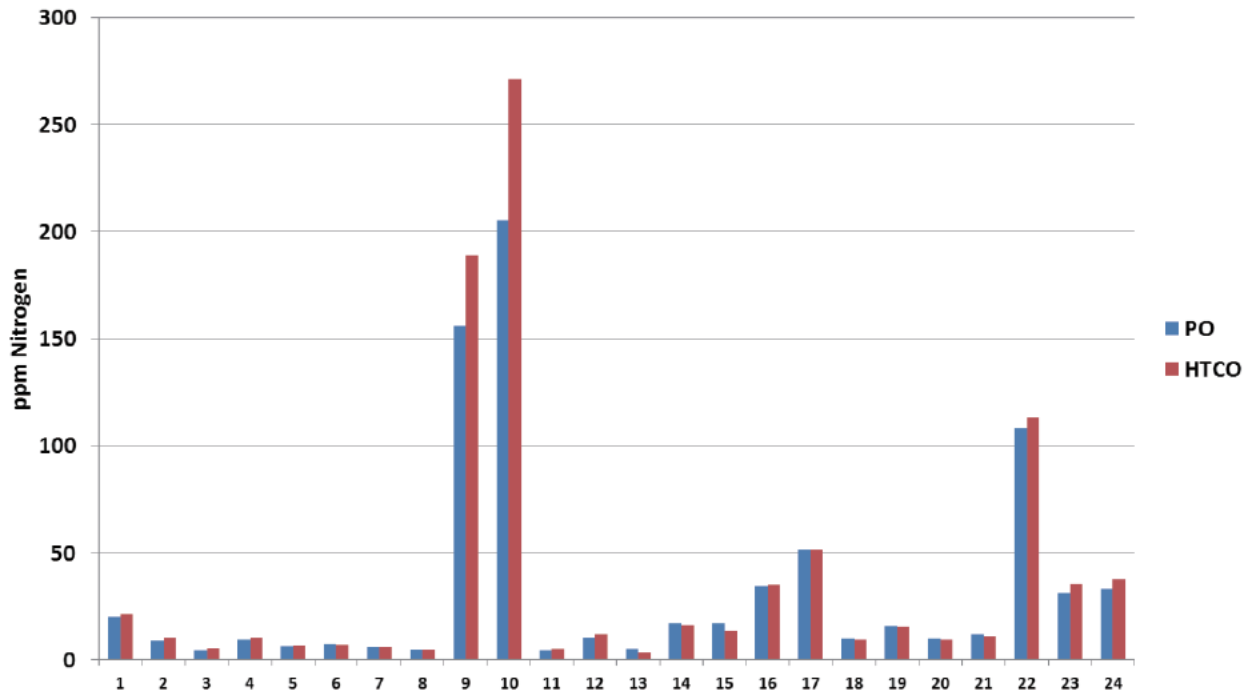


Figure 4: Comparison of persulfate and HTCC TN in soil extracts

## Conclusion

Values of total nitrogen by TKN, PO, and HTCC are highly correlated, making both PO and HTCC suitable alternatives to TKN. Results by HTCC may be slightly higher than those by PO in samples containing high concentrations of TN.

## Eliminate TKN and Get Better Total Nitrogen Data

### References

- <http://nwwl.usgs.gov/pubs/WRIR/WRIR-03-4174.pdf>, accessed July 16, 2014
- Method 4500-P J, Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus, Standard Methods for the Examination of Water and Wastewater 22 ed, 2012
- <http://www.astm.org/DATABASE.CART/WORKITEMS/WK46665.htm>, accessed July 16, 2014
- Nydahl. F, On the Peroxodisulfate oxidation of Total Nitrogen in Waters to Nitrate, Water Research Vol 12, 1123-1130, 1978
- Kroon H., Determination of Nitrogen in Water; comparison of a continuous-flow method with on-line UV digestion with the Original TKN method, Analytica Chimica Acta, 276, 287-293, 1993
- Bronk D.A, Lomas W.L, Gilbert P.M, Schukert K.J, Sanderson M.P; Total Dissolved nitrogen analysis; comparisons between the persulfate, UV and high temperature oxidation methods; Marine Chemistry 69 (2000) 163-178
- Chen, C.R., Xu Z.H., Keay P., and Zhang S.L., Total soluble nitrogen in forest soils as determined by persulfate oxidation and high temperature catalytic oxidation, Australian Journal of Soil Research, 2005, 43, 515-523