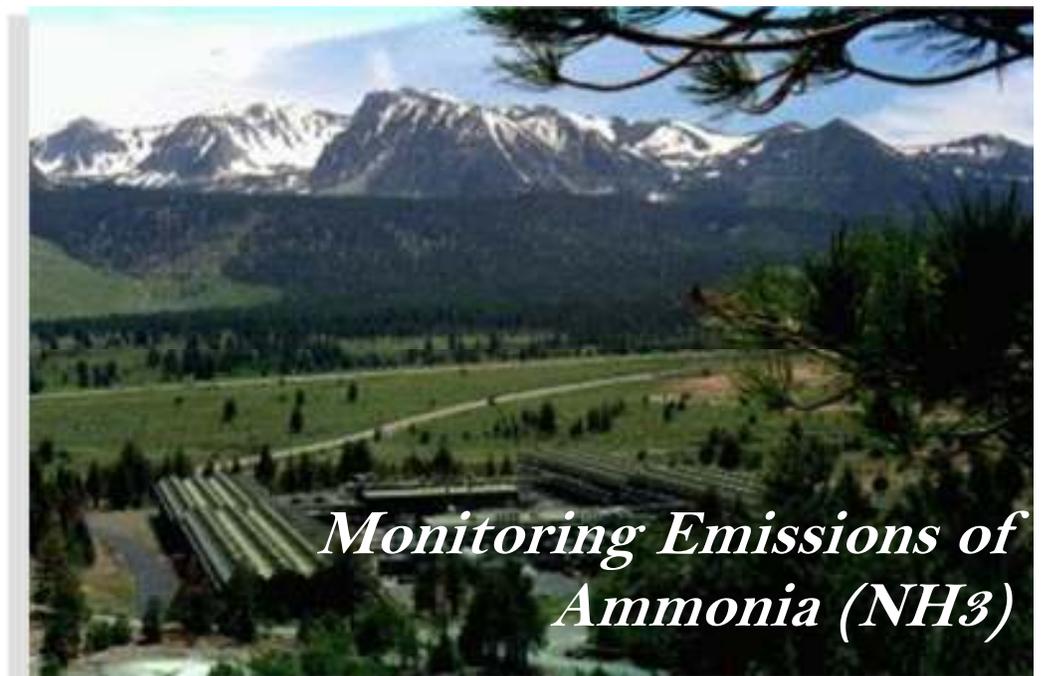




LasIR®



*Monitoring Emissions of
Ammonia (NH₃)*



1. INDUSTRIAL EMISSIONS OF AMMONIA

Ammonia (NH_3) is a colorless gas with a strong irritating odour. It is lighter than air and diffuses relatively quickly.

Ammonia acts principally on the upper respiratory tract, where it exerts an alkaline, caustic action. It produces respiratory reflexes such as coughing and arrest of respiration. It affects the conjunctiva and cornea immediately. Inhalation causes acute inflammation of the respiratory organs, cough, edema of the lungs, chronic bronchial catarrh, secretion of saliva and retention of urine¹.

Ammonia is extensively used in various industrial processes including refrigeration, preparation of soil fertilizers, to neutralize acid constituents of crude oils, extracting metals as copper, nickel and molybdenum from their ores, for stabilization of raw latex in the rubber industry and more recently flue gas emission remediation.

Most of the Ammonia present in the air depends on human activities. An important source is from DeNO_x scrubber operations to reduce the NO levels in the emissions at, for instance, municipal waste and special waste incinerators, cement production and fossil fuel Power Plants.

Many of the above listed processes and industries are requested to monitor their NH_3 emissions.

An instrument that uses a tunable diode laser, such as LasIR[®] from Unisearch, represents a perfect NH_3 **analyzer** (ammonia analyzer). When configured for ammonia monitoring, LasIR[®] is able to provide continuous updates on the concentration of the gas in a given area. It can be employed for both process monitoring and process control.



Unisearch has pioneered the use of Optical Spectroscopy in monitoring toxic gases for more than 30 years, and provided world-wide industries with effective gas monitoring systems.

The **LASIR[®]** technology has proven to be universally applicable in relation to gases that have a signature in the near infrared region. With NH_3 emission and process control monitoring at Coal Fired Power Plants, Incinerators and Cement Kilns, the application of the LASIR[®] to NH_3 has just begun.

Unisearch offers a wide range of technologies to provide the right solution for all your gas measurement needs. The **LasIR[®]** is the technology (TDL spectroscopy) of choice for NH_3 and other gases such as HF, HCl, H_2S , H_2O , CH_4 , CO and CO_2 . Unisearch also offers **mid-infrared TDL** systems for other gases such as NO, SO_3 , perfluorocarbons, and a dedicated ultraviolet system (**DOAS**) as the best instrument for measuring SO_2 .

¹ Matheson Gas Data Book, Sixth Edition

2. THE EMISSIONS MONITORING SOLUTION

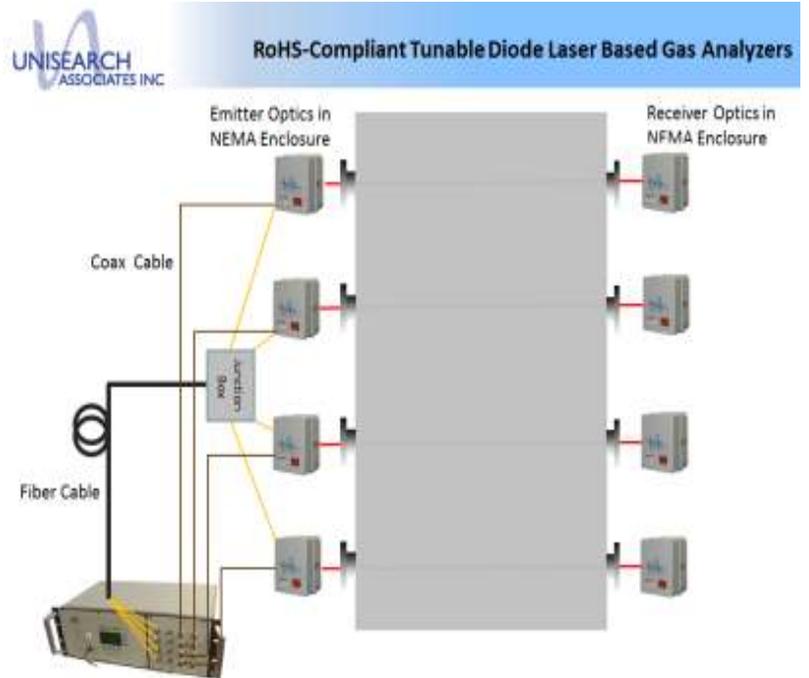
LasIR® Description:

The LasIR® is a gas monitoring system based on the absorption of light emitted by Tunable Diode Lasers, which emit monochromatic laser light at very precise wavelengths. The Tunable Diode Lasers used for the LasIR® are similar to those used in telecommunication. For NH₃ measurements, the TDLs selected emit a very narrow beam of light that is specific to NH₃ and the laser is tuned on the absorption band by applying a specific electrical current. The laser is fiber coupled to single mode optic fiber allowing for remote monitoring of gases in open path ambient monitoring and/or stacks and from up to 16 different locations with a single controller.

Gas concentrations are determined by proprietary software that allows for a high accuracy and sensitivity: the employed techniques provide sensitivities from the part per billion-volume meter to high concentrations of the target gas.

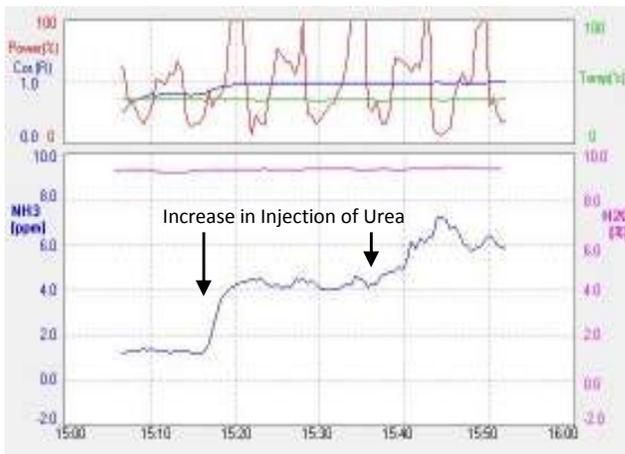
This provides a dynamic range for the measurements of more than 6 orders of magnitude.

The hardware allows for non-intrusive measurements directly in the stack or ambient air. Extractive cells can also be used when required by the application.



Schematic of the in-situ monitor heads for continuous measurement of NH₃

LasIR® Performance:



Ammonia slip (blue trace) as a result of excess feed of urea in a coal-fired generation plant. Moisture level (purple trace) was also simultaneously measured

The LasIR® has proven to be a very useful tool for the measurement and control of industrial gas emissions. Unisearch LasIR® HF analyzer, differing only in the laser emission wavelength, has been tested and found to be suitable for use at combustion plants according to EC directive 2001/80/EC, at waste incinerator plants according to EC directive 2000/76/EC and other plants requiring official approval. Unisearch LasIR® NH₃ analyzer has participated in a number of EPRI sponsored studies to assist in determining the requirements for continuous NH₃ measurements in the Power Industry and is in the process of being submitted for TÜF certification. The LasIR® is factory calibrated and does not require field calibration. Auditing is performed in compliance with applicable norms by means of either an external sealed cell module or a flow-through gas cell, both of which are connected in-line via fiber optic cabling with the remote optical elements.

3. OPERATIONAL FEATURES OF UNISEARCH SYSTEMS

Advantages of TDL LasIR®

- Freedom from Interferences of other gases and particles.
- Fast real-time measurements: in milliseconds
- Sensitive: as low as sub-ppm levels.
- Versatile. Up to 16 different measurement points simultaneously with a single analyzer.
- Simple, compact, rugged, reliable, virtually maintenance free.
- Factory Calibration
- Remote Operation. The controller can be kept in the control room while measurements are taken across stacks and/or open path

For more information on the technology please consult the following articles:

1. Chuck Dene, John T. Pisano, Thomas D. Durbin, Kurt Bumiller, Keith Crabbe, and Lawrence J. Muzio, "Laboratory testing of a continuous emissions monitor for ammonia" Journal of the Air & Waste Management Association, 00(00):1-9, 2014. Copyright © 2014 A&WMA. ISSN: 1096-2247 print DOI: 10.1080/10962247.2014.880755
2. John T. Pisano¹, Lawrence J. Muzio², Thomas D. Durbin¹, Georgios Karavalakis¹, Ron Gaston³, and Tim Sonnichsen⁴, "OPTIMIZATION OF SNCR NO_x CONTROL FOR A WOOD-FIRED BOILER", Department of Chemical and Environmental Engineering, Bourns College of Engineering, Center for Environmental Research and Technology (CE-CERT) University of California, Riverside, CA 92521, ² Fossil Energy Research Corp., 23342-C South Pointe Drive, Laguna Hills, CA 92653, ³ Sierra Pacific Industries, Lincoln, CA 95648, ⁴ Sonnichsen Engineering, Snoqualmie, WA 98065, Western States Section of the Combustion Institute (WSSCI), Fall 2011 Meeting, October 16-18, 2011, University of California, Riverside (UCR)
3. Alak Chanda, Gervase I. Mackay, Keith L. Mackay, John T. Pisano, Jean-Pierre Gagne, Pierre Bouchard "LasIR[®]™-R – The New Generation RoHS-Compliant Gas Analyzers Based On Tunable Diode Lasers" TMS San Diego, Paper 29, February, 2011.
4. John T. Pisano, Claudia Sauer, Tom Durbin and Gervase Mackay "Measurement of Low Concentration NH₃ in Diesel Exhaust using Tunable diode Laser Adsorption spectroscopy (TDLAS)" Society of Automotive Engineers Conference, Paper 2009-01-1519, Detroit MI, February (2009).
5. H. A. Gamble¹, G. I. Mackay¹ J. T. Pisano² and R Himes "On-Line Ammonia Slip Process Monitoring in Post-Combustion NO_x Control Equipped Power Generating Stations"
6. Schiff, H.; Chanda, A.; Dwight, S.; Mackay, G.; Elfert M.; Anderson, W. 2002. "The Application Of Tunable Diode Laser System For Monitoring H₂S In A Wastewater Treatment Plant" IFPAC, January 2002.
7. Partin, J.K. 1997. "Real-Time H₂S Monitor for application in geothermal plants" Idaho National engineering and environmental laboratory.

Please contact us for more information on installed systems and their performance

UNISEARCH ASSOCIATES, INC.

www.unisearch-associates.com

NORTH & SOUTH AMERICA

96 Bradwick Drive Concord, ON Canada L4K 1K8

Tel: +1 (905) 669-3547

Fax: +1 (905) 669-8652

info@unisearch-associates.com

FOR EUROPE AND THE MIDDLE EAST

Köln, Germany

Tel: +49 (221) 8237678

Fax: +49 (221) 1696005

pviolino@unisearch-associates.com

FOR CHINA

www.unisearch-cn.com

Unisearch Instruments Nanjing Inc.

f809-810 Aoti Building, No. 130 Aoti Street

Jianye District, Nanjing 210019

Tel: +86-25-87763088

Fax: +86-25-87763099

wushimin@unisearch-cn.com