Environmental Laboratory Services

Testing the Waters

Outdoor and Indoor Air Quality Monitoring

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Cover Photo: Air pollution

Introduction

Environmental Laboratory Services is one of New Zealand's leading experts in the areas of:

- Air quality monitoring
- Boiler water
- Environmental water
- Landfills
- Meat industry services
- Potable water for councils
- Sample Integrity
- Swimming pools
- Biological fluids
- Ceramicware and metal food containers
- Food and Dairy Products
- Legionella
- Metals
- Potable water for small communities
- Sewage and effluent
- Trade waste

The company has its origin as part of the Hutt City Council Laboratory and became a private enterprise in 1994. In 1998 the laboratory acquired the Wellington City Council Laboratory. In September 2001, ELS further expanded with the purchase of the Inorganic Chemistry section of AgriQuality New Zealand. This section was previously part of ESR, which before that was the DSIR.

We are based in a purpose built facility of 1450 m^2 at 85 Port Road, Lower Hutt. ELS is comprised of four separate laboratory areas – Instrumental Chemistry, General Chemistry, Biological Fluids, and Microbiology. The latter is further split into three separate rooms with clean, cleaner and ultra clean capabilities. The ultra clean lab is used for pathogenic bacteria determinations.

ELS is privately owned by scientific people committed to the science industry in New Zealand. We continue to be one of the few major laboratories in the country with such a broad microbiological and chemical analysis capability. We provide high quality, fast turnaround analyses at competitive prices.

Who should read this brochure?

This brochure has been developed to assist people and companies involved with the health of their staff or of the general public. It details the ELS capability to determine air quality for both indoor and outdoor settings.

Whether you are a consultant who investigates outdoor air quality or a company manager who has sick office staff, ELS has a testing capability to assist you.

Indicators of Air Quality in New Zealand

There are many contaminants in the air that we breathe. As we drive our car, walk through the streets, and exercise in the park, we are constantly breathing in contaminants. Some are important to life, but others can harm our health and the environment.

It is impossible to monitor all the contaminants in the air so councils select key contaminants that provide a representative picture of air quality. These priority contaminants are commonly referred to as indicators.

When air quality indicators are measured and reported by local and regional councils they provide the following key information:

- the state of New Zealand's air quality and potential health impacts
- changes in air quality over time
- whether we are progressing towards national and regional goals
- regional and international comparisons.

ELS is IANZ accredited to perform a wide range of air quality tests at both indoor and outdoor sample points. For outdoor samples we work with local and regional councils to monitor the following parameters.

- Fumes and emissions
- Atmospheric pollution
- Air (filters, extracts, or impinger solutions)

We work with air quality professionals, and local building owners to measure the air quality within buildings. The tests we perform on these samples include:

- Particulate matter
- Yeasts and moulds
- Bacteria
- Physical parameters
- Carbon monoxide

Particulate Monitoring

PM_{10} particles are less than 10 microns in diameter and are easily inhaled into the lungs. The main sources vary significantly between regions. For example in Auckland the main source is motor vehicles, while in Christchurch the main source is home heating fires. Other sources include industry, sea spray, and agricultural activities.

Health effects of PM_{10} include eye, throat and lung irritation and, for those with existing respiratory conditions, worsening asthma or bronchitis. Particles also reduce capacity to resist infection and cause increased hospital admissions, mortality, school absences, and lost workdays. Fine particles in the air reduce visibility and contribute to smoggy haze, which is occasionally seen over some towns and cities.

Particulate measurements using high-volume and mini-volume air samplers

Manual particulate methods form the mainstay of much of the particulate monitoring in New Zealand. The process involves the pumping of particulate laden air through a standard filter and for a standard period of time, and determining the particulate matter retained on that filter.

Our service provides pre-numbered, pre-conditioned and pre-weighed filters, which are placed into our clients sampling devices. Upon return they are conditioned and re-weighed. The difference in weight is then attributed to the particulate trapped on the filter during the sampling period.

Results can be reported per filter, or if you provide us with pump calibrations and times, we can calculate the concentration of particulate by air volume.

Particulate concentration in ug/m3

$$\frac{\text{Particulate measurement}}{\text{(Pump time off-Pump time on) x pump rate}}$$

In order to achieve this we need the following information for each sample.

- The time the sample collection started
- The time the sample collection ended
- The calibrated pumping volume in litres per minute

50 ug/m3 is the ambient air quality guideline value for PM_{10} in any 24-hour average period.

Sulphur dioxide and nitrogen dioxide measurement

Sulphur dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless gas, which forms sulphuric acid when combined with water. Sources include the combustion of fossil fuels containing sulphur, eg. coal and diesel, and industrial processes such as fertiliser manufacturing, aluminium smelting and steel making. Sulphur dioxide also results from natural sources such as geothermal activity.

In the northern hemisphere sulphur dioxide causes acid rain but not in New Zealand because concentrations are lower. However, sulphur dioxide deposition can affect vegetation around industrial discharges and in cities, and it affects lichen growth. It can also form secondary particles (sulphates) that cause haze and reduce visibility.

Sulphur dioxide can cause respiratory problems such as bronchitis and can irritate noses, throats, and lungs. It may cause coughing, wheezing, phlegm and asthma attacks.

350 ug/m3 (1-hour average) and 120 ug/m3 (24-hour average) are the ambient air quality guideline values for sulphur dioxide. They are set to protect people against adverse effects, particularly those suffering from asthma and other respiratory diseases.

Nitrogen dioxide (NO_2)

Nitrogen dioxide (NO_2) is a reddish-brown gas. It is not usually released directly into the air but forms when nitrogen oxide (NO) and other nitrogen oxides (NOx) react with other chemicals. Nitrogen oxide is released from combustion, especially of petrol in cars. It also comes from the production of nitric acid, welding, and explosives. Natural sources of nitrogen oxides include volcanoes and bacteria.

Nitrogen dioxide in the human respiratory system can decrease lung defences against infection and aggravate asthma. The presence of nitrogen dioxide reduces plant growth, and when sulphur dioxide and ozone are also present, the effects worsen. Nitrogen dioxide also forms acids that can corrode buildings and nitrates that cause a brownish haze.

Nitrogen dioxide can be a local problem around congested roads and an urban-wide problem caused by a variety of combustion sources.

200 g/m3 (1-hour average) and 100 g/m3 (24-hour average) are the ambient air quality guideline values for nitrogen dioxide. The guideline values are set to protect asthmatics, particularly children with asthma and adults with chronic respiratory and heart disease.

Analysis

ELS provides you with treated filters for use in your passive and active samplers. We can also provide a small number of passive samplers if required. Upon receipt we wash the filter with de-ionised water then analyse the liquid by either Ion Chromatography or by Autoanalyser. As part of the process we include field blanks, and field spikes as quality control measurements.

We also run laboratory spikes and blanks to ensure a high level of quality.

It is also common practice to run spike recovery tests and adjust the final reported results based on the recovery we obtain. This is an important step as it overcomes some of the problems associated with long-term field sampling. In particular, the filters are coated in a special solution that assists in absorbing the chemical we are testing for. Under some circumstances the filters may not work as expected, so please contact us if the filters are older than six months.

Our test method analyses the chemical under examination and is then converted to the final value, using a complex equation based on air resistance and molecular weights.

For calculating sulphur dioxide from sulphate data

$$\frac{\text{Sulphate value x dilution x molecular weight x air resistance}}{\text{Time in seconds x diffusion coefficient}}$$

For calculating nitrogen dioxide from nitrite data

$$\frac{\text{Nitrite value x dilution x molecular weight x air resistance}}{\text{Time in seconds x diffusion coefficient}}$$

The final values are then compared to the national quality criteria for compliance.

Metals

ELS is IANZ accredited to perform metals analysis on filters used in air monitoring. The filters are the same as those used in the particulate test, and one filter can be used for both tests.

- Aluminium
- Antimony
- Arsenic
- Barium
- Bismuth
- Boron
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Tungsten
- Vanadium
- Zinc

ELS can report the results in many ways, depending on client requirements.

Metal content per filter

In this format the result is reported as recorded. We digest the whole filter and measure all the metals and report as µg/filter.

Metal content per square centimetre

In this format we measure the area of filter used in the metals digest and record the metal content by filter area. The units used are $\mu g/cm^2$.

Metal content per cubic metre

In order to successfully record the metals content by air volume, we require a series of values that are used in a complex formula. These values are used to calculate the volume of air sampled.

- Air resistance
- Sampling Period
- Pump flow rate

Once the air volume is known, we can use the measured metal content to determine the final volume per cubic metre of air. The units used for this measurement are $\mu g/m^3$.

Sick Building Syndrome

What Is Sick Building Syndrome?
Sick building syndrome (SBS) is a situation in which occupants of a building experience acute health effects that seem to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localised in a particular room or zone, or may be widespread throughout the building.

What Are the Symptoms of SBS?
Building occupants complain of symptoms associated with acute discomfort. These symptoms include headaches; eye, nose, and throat irritation; a dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odours. With SBS, no clinically defined disease or specific chemical or biological contaminant can be determined as the cause of the symptoms. Complainants often feel relief soon after leaving the building.

What Causes SBS?
While specific causes of SBS remain unknown, the following have been cited as contributing factors to sick building syndrome. These elements may act in combination or may supplement other complaints such as inadequate temperature, humidity, or lighting.

Chemical contaminants from outdoor sources
Outdoor air that enters a building can also be a source of indoor pollution. Pollutants from motor vehicle exhausts, plumbing vents, and building exhausts (bathrooms and kitchens) can enter the building through poorly located air intake vents, windows, and other openings.

Chemical contaminants from indoor sources
Most indoor air pollution comes from sources inside the building. For example, adhesives, upholstery, carpeting, copy machines, manufactured wood products, cleaning agents and pesticides may emit volatile organic compounds (VOCs) including formaldehyde. Environmental tobacco smoke and combustion products from stoves, fireplaces, and unvented space heaters all can produce chemical contaminants such as carbon monoxide.

Biological contaminants
Biological contaminants include pollen, bacteria, viruses, and moulds. Biological contaminants can cause fever, chills, cough, chest tightness, muscle aches, and allergic reactions. One airborne bacterium, Legionella, causes Legionellosis.

Inadequate ventilation
In the 1970s the oil embargo led building designers to make buildings more airtight, to improve energy efficiency. These reduced ventilation rates have often found to be inadequate to maintain the health and comfort of building occupants.

ELS sick building analyses

ELS samplers have a set of purpose built equipment to check for SBS. The analyses we perform provide building owners with a comprehensive air-quality report that can identify problems within the building. Professional treatment companies can then take these reports and provide solutions to any problems that are found.

ELS uses three different air-sampling devices to collect the samples, these are Gillian air sampler, Surface Air Sampler, and Q-Trak™ sampler.

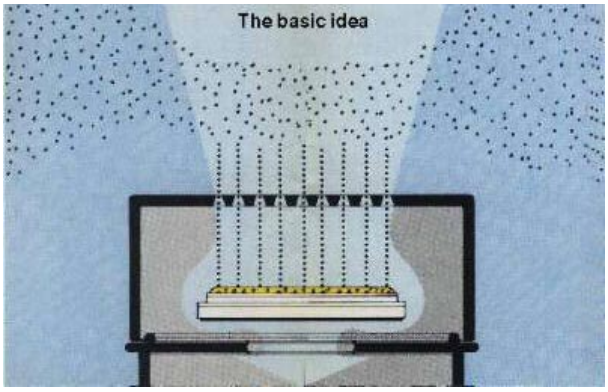
Particulate Matter

The Gillian air sampler collects airborne particles on a pre-weighed filter. The difference in weight shows the total particle count for the sampling period.

Yeast and Moulds

The Surface Air Sampler draws air through a grid, and onto agar within the sampler.

We use rodac contact plates containing a special laboratory agar that is incubated and then checked for the presence of yeast and mould.



Bacteria

The same pump is used with a different laboratory agar to determine the presence of bacteria in the air. This test shows the total aerobic bacteria in the air.

Physical parameters

While collecting the samples to take back to the laboratory, we also monitor the temperature and humidity of the room using the Q-Trak™ sampler. This records data in real time and displays the data as a graph.

Carbon monoxide

Because this is such a toxic chemical, the Q-Trak™ also analyses for this contaminant. The data are recorded in real time.

Ventilation Efficiency

The ELS tests are designed to measure chemical and microbiological problems within the building. An air conditioning professional must be employed to check the ventilation efficiency.

Other air monitoring tests

ELS offers a wide range of specialised air quality tests which utilise the analytical capability of our laboratory facility. The tests include any water-soluble compound that can be eluted from a filter used to collect air samples. The tests include but are not necessarily limited to the following:

Fluoride

Air samples are collected using pre-treated filters and analysed at ELS using special buffering agents and equipment. The filters must be impregnated with special solutions prior to sampling, and ELS will provide these to fit with your sampling program.

Anions

The equipment in the ELS laboratory can detect a wide range of anions in eluted samples. These include:

- Bromide
- Chloride
- Nitrate
- Nitrite
- Phosphate
- Sulphate

Cations

Different equipment can be used to analyse cations form the eluted samples. Most common of these are:

- Ammonium
- Calcium
- Magnesium
- Potassium
- Sodium

Total Reduced Sulphur

We regularly perform this analysis.

Legionella

Legionella is a bacterium that can be spread through aerosols passed around a buildings air conditioning system. It is important that any air conditioning systems attached to your building are routinely monitored for this pathogen.

Please ask for a copy of our Legionella brochure for further information.

Contact Details

Please feel free to contact ELS by any one of the methods shown below.

TELEPHONE

Main lines to Central Services

Main Telephone	(04) 576-5016
Facsimile	(04) 576-5017
Free Phone	(0800) 576-5016

Direct Lines

Joanne	Accounts	(04) 568-1205
Rob Deacon	General Manager	(04) 568-1203
Sue Meiklen	Occupation Health	(04) 568-1207
Sunita Raju	Microbiology	(04) 568-1206
Terry Manning	Managing Director	(04) 568-1204
Tracy Morrison	Instrumental Chemistry	(04) 568-1200
Jacinta Hira	General Chemistry	(04) 568-1209

Email can be directed to staff using "first initial last name"@els.co.nz

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new zealand accredited laboratory

NZFSA Laboratory Approval Scheme
Accreditation Number 905

IANZ Accreditation Numbers:
Biological 639, Drinking Water 787,
Chemistry 414, Dairy L1921