Université Gustave Eiffel

Myriam Duc & François Lansac

Researcher Engineering Assistant

In this interview, Michael Jakob, European Product Manager for LECO's analytical product range, speaks with researchers from Université Gustave Eiffel about their work and the role of LECO instrumentation in their laboratory.

Michael Jakob:
First of all, thank you very much for taking the time to participate in this interview. We truly appreciate the opportunity to learn more about the work being carried out at Université Gustave Eiffel.

As mentioned previously, the purpose of this interview series is to show our customers and stakeholders how LECO instruments are being used in practice and to highlight the diverse applications in different laboratories. At the same time, it offers a great opportunity to introduce the interviewed laboratories and give readers insight into their work and areas of expertise.

My name is Michael Jakob, and I am the European Product Manager for LECO's analytical product range. To begin, I would kindly ask you to briefly introduce yourself and tell us who you are.

Myriam Duc (UGE):
My name is Myriam Duc. I am a researcher in physico-chemistry at Université Gustave Eiffel, working in the laboratory Soil, Rock and Geotechnical Structures (SRO). I 'm a specialist in soil behavior, with a particular focus on the link between micro-scale properties—such as mineralogy and microstructure—and macro-scale properties such as hydraulic and mechanical properties.

François Lansac (UGE):
Hello, my name is François Lansac. I am an engineering assistant at Université Gustave Eiffel, working in the same laboratory as Myriam. My work mainly focuses on chemical analyses of soils and construction materials.

Université Gustave Eiffel is quite a young university, founded through a merger a few years ago, correct?

Myriam Duc:
Yes, that's right. The university was officially created in 2020. However, it builds on a long history. Originally, we were the LCPC (Laboratoire Central des Ponts et Chaussées). Over time, we merged with other institutes and engineering schools, including an architecture school and the former Université Paris-Est Marne-la-Vallée.

Your laboratory mainly deals with soils and ground materials—essentially assessing whether and how construction can safely take place?

Myriam Duc:
Exactly. Our main activities focus on natural hazards, such as seismic risks and erosion, and how to fight against flood impact through protection measures using earth embankments and levees. Another major area is foundations dimensioning and in situ testing, including pile testing, deep or shallow foundations, and soil improvement techniques such as deep soil mixing with cement.

Our third main research field is eco-design of geomaterials, including earth-based construction materials for buildings, levees, and embankments.

At the micro-scale, François and I work on the characterization of materials— especially soils, and in particular clay-rich soils. In geotechnical engineering, clays are often problematic due to swelling and shrinkage, which can damage foundations. However, clays also have very useful properties, such as cohesion and waterproofing. For example, they can be used for sealing water reservoirs. So, we study both the harmful and beneficial properties of clays.

Could you give us a brief overview of the analytical techniques used in your laboratory?

Myriam Duc:
Of course. We use a wide range of techniques. Mineralogy and microstructure are mainly studied using scanning electron microscopy (SEM). We also use mercury intrusion porosimetry to characterize pore size and pore distribution.

Particle size analysis and standard geotechnical tests are used to determine mechanical and hydraulic properties, such as permeability in soils and rocks.

In physico-chemistry, we perform mineralogical analysis using X-ray diffraction (XRD), complemented by thermal analysis (TGA) and chemical composition analysis using ICP-OES and X-ray fluorescence (XRF). Petrography is also used to complete microstructural observations.

In addition, we analyze organic matter, total carbon, mineral carbon, sulfur, and sulfate contents. Sulfur analysis is particularly important, both for concrete applications and for soils, because of the presence of pyrite. When pyritic soils are excavated and exposed to air, they can generate acidic pollution and cause swelling problems, especially when used in concrete. With LECO SC832 we do TOC, Carbon, and Sulfur analysis.

You are using a LECO SC832 carbon and sulfur analyzer in your laboratory. Could you explain how you perform TOC measurements?

François Lansac:
Yes. We first measure total carbon. Then we treat the samples with hydrochloric acid to remove inorganic carbon and perform a second measurement. This allows us to determine the organic carbon content. In this way, we obtain both mineral and organic carbon values. (TC/TOC/TIC)

Myriam Duc:
What was less common was applying a similar approach to sulfur. Existing standards dealing with sulfur mainly focus on coal but not soils. So, we combined and adapted different standards to develop a methodology suitable for soils and other geomaterials containing sulfur/sulfate species, and we now transferred this method to professional applications.

LECO SC832 – illustrative image

Approximately how many TOC measurements do you perform per year?

François Lansac:
When we first acquired the analyzer, we analyzed around 300 to 340 samples within about eight months. Now the pace is a little slower. Each sample is measured twice.

I found your sulfur determination approach particularly interesting. Could you briefly explain how you differentiate between sulfate sulfur and sulfide (pyritic) sulfur?

Myriam Duc:
The procedure consists of two main steps. First, we measure total sulfur and total carbon using combustion at high temperature (around 1450 °C) with a combustion catalyst.

Then, apply an acid treatment at boiling temperature to dissolve sulfates. After filtration, we collect all solid material retained on the filter, including the filter itself, and analyze it using the LECO instrument.

François Lansac:
Only the solid phase is analyzed, ensuring that no sulfur-containing particles are lost.

Myriam Duc:
This approach is particularly suitable for soils, where sulfate is often present as gypsum (which dissolves), while sulfide sulfur is mainly present as pyrite, which remains on the filter by carefully collecting all solids including the filter below, we ensure accurate sulfur quantification.

The main advantage of this method is speed. Traditional methods can take several days or even more than a week. With our approach, we typically obtain results within two days—and in a professional lab platforms, even within only one day.

So, using the LECO SC832, you can measure total carbon, organic carbon, total sulfur, and pyritic sulfur in just two analytical steps?

Myriam Duc:
Yes, exactly.

Do you have any wishes or ideas for future developments from LECO?

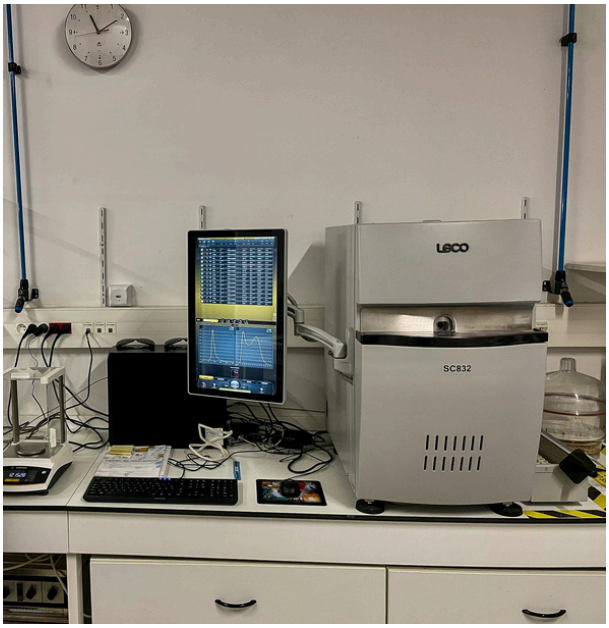
François Lansac:
Like many researchers, we always wish to analyze more elements. Recently, we have become interested in nitrogen, and especially ammonium.

Myriam Duc:
Yes, initially carbon and sulfur were sufficient, but now nitrogen analysis would be very useful for our work.

Michael Jakob:
That is certainly possible with LECO carbon–nitrogen–sulfur analyzers like CNS928 series.

Michael Jakob:
Thank you very much for this insightful discussion. It would also be great to receive a few photos of the instrument and your institute. Thank you again, and I wish you a very nice weekend.

Myriam Duc & François Lansac: Thank you very much. Goodbye.



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