Development of software for characterization of C in soils using LIBS with applications for embedded systems

Stenio K.[1]*, Cerna M.[2], Villas-Boas P.[3], Milori D.[3]

[1]Master's Student in Biotechnology, Federal University of São Carlos, Brazil

[2]Doctoral Student in Mechanical Engineering, USP São Carlos, Brazil

[3]Researcher, Embrapa Instrumentation, São Carlos, Brazil

Introduction

Analysis of the soil chemical composition is of fundamental importance. The standard method for soil analysis is made getting random samples from an area at different depths, and sending to a laboratory for elemental determination, using analytical techniques (e.g. ICP, CHNS and AAS). The mains problems of this type of characterization are: chemical waste, cost and long time for sample preparation. Laser-induced breakdown spectroscopy (LIBS) is a technique which allows real time evaluation of the elemental composition of solid, liquid and gaseous samples.

In this work, software for analyzing LIBS spectra were developed using Python, and a quantification of C in a test sample and actual soil was made.

Development

The output from the equipment OceanOptics LIBS2000Plus is a text file with two columns: wavelength and counts. Using Python library Numpy, we were able to write software that reads those data and process it, giving a corrected area of a peak. That area can be correlated with the value of some reference technique, giving a model of quantification. For C, we used the peak in 193.04nm, but since this one is interfered with Al emission, we also used the Al peak in 193.53nm for correcting the line [1]. Two sets of samples were used: a test set, with 10 samples of KBr mixed with a well know C%; and an actual soil set, with 16 samples taken from sandy and clay soil. CHNS was used as reference.

Results and conclusions

The software was used for analyzing both samples sets, giving as result the correlation model.

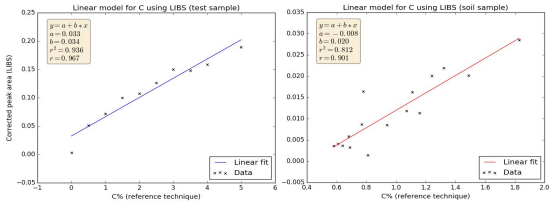

Figure 1: Linear model for C% using the KBr samples (left) and the soil samples (right).

KBr samples have high correlation (r=0,967), meaning that the software is working properly. For soil samples, we have a little bit lower (r=0,901), but yet a good result, since the sample set is very heterogeneous. The software ran in a Raspberry Pi 2 computer, giving evidence that it can be used for embedded apps.

Acknowledgements

The authors would like to thanks CAPES, CNPq and Embrapa for promoting the research.

References

[1] NICOLODELLI. Applied Optics, Nova York, v. 53, n. 10, p.170-2176, 2014.

[2] MARAGONI. Analytical Methods, 8, 78, 2016

[3] SACCHI. Journal of the Optical Society of America B. 8, 337, 1991.

* Email: kstenio@ufscar.br