Determination of REE in phosphate-containing fertilizers and agricultural gypsum by Synchronous Vertical Dual View ICP OES

<u>R. C. Machado</u>¹, C. D. B. Amaral¹, D. Schiavo², J. A. Nóbrega¹ and A. R. A. Nogueira³

 ¹ Group of Applied Instrumental Analysis, Department of Chemistry, Federal University of São Carlos, São Carlos, SP, Brazil
² Agilent Technologies, Barueri, SP, Brazil
³ Embrapa Southeast Livestock, São Carlos, SP, Brazil

E-mail: raquelcm.quim@gmail.com

Agricultural inputs, such as mineral fertilizers and gypsum, are essential for ensure crop grown and development, and to replenish natural nutrients depleted from soils. However, these external inputs can also be a source of inorganic contaminants and rare earth elements (REE's) from phosphate rocks used in fertilizer production. The monitoring of these specific elements is important in order to know the basal-level and anthropogenic effects caused by its addition into the soil [1,2]. This work describes an analytical method for determination of REEs in phosphate-containing fertilizers and agricultural gypsum using an inductively coupled plasma optical emission spectrometer ICP OES (Agilent Technologies, Australia), in radial and new Synchronous Vertical Dual View (SVDV) viewings. Three emission lines with more intensities for each analyte were selected for determination, but results are presented only for the ones below mentioned. Samples were microwave-assisted digested with diluted HNO3 and H2O2. Limits of detection (LODs) were: 0.14, 0.61, 0.10, 2.60, 0.49, 0.81, 0.46, 0.43, 1.02, 0.02, 0.05, 1.27, 0.71, 1.59, 0.08, 8.48, and 1.59 mg kg⁻¹ in SVDV viewing for Ce (446.021 nm), Dy (340.780 nm), Er (269.265 nm), Eu (397.197 nm), Gd (335.048 nm), Ho (338.895 nm), La (408.671 nm), Lu (307.760 nm), Nd (401.224 nm), Pr (422.532 nm), Sc (335.372 nm), Sm (360.949 nm), Tb (350.914 nm), Th (283.730 nm), Tm (346.220 nm), Y (371.029 nm) and Yb (289.138 nm), respectively. Comparing different viewings, LODs were slightly better in SVDV. Accuracy was evaluated by addition and recovery experiments in two spike levels (0.1 and 1.0 mg L⁻¹) for all elements and in both viewings. Recoveries in SVDV viewing ranged from 90 to 111 % for evaluated samples. Best results for gypsum samples were reached in radial viewing owing to higher concentrations of REEs. On the other hand, best results for fertilizers were obtained in SVDV view because these samples contained lower amounts of REEs. It may be concluded that careful choice of viewing position and dilution factors led to proper accuracy and sensitivities for REEs determination in both viewing modes and concentrations ranged from 10 to 477 mg kg⁻¹ and 2.5 to 3392 mg kg⁻¹ for phosphate-containing fertilizers and agricultural gypsum, respectively. Dy, Ho, Lu and Tm were not found in any mineral samples. Instrument capability for simultaneous measurements in both views allows fast data acquisition without increasing argon consumption.

References

[1] Spectrochimica Acta Part B, 96, 1-7 (2014).

[2] Microchemical Journal, 96, 247-251 (2015).