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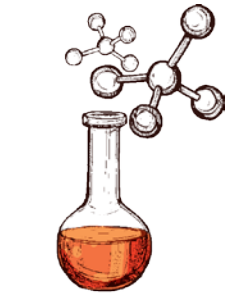

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DETERMINATION OF LIGNOSULFONATES IN HUMATE FERTILIZERS BY INFRARED SPECTROSCOPY

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Abstract: Lignosulfonates (LS) are wood-processing by-products. They serve as stabilizers of fertilizers and plant-growth stimulants based on humic substances (HS) due to similar properties but show lesser effects on plant growth. Thus, HS-based fertilizers require standardization and control procedures, as the final properties depend on the HS source and other components including LS contents. However, the analytical procedure development for this task is hindered as both HS and LS are complex macromolecular mixtures of variable composition, molecular weights, and irregular structure.

Existing gravimetric, chromatographic, and spectrophotometric techniques are not selective and sensitive enough and require labor- and time-consuming sample-preparation stages to separate the components. For functional-group identification and assessment of both HS and LS, FTIR-spectroscopy is used; however, their quantification in a single sample was not proposed.

The aim of this study was to develop a procedure for LS assessment in aqueous HS samples by ATR-mid-IR spectroscopy as it is suitable for solid and aqueous samples with minimum sample preparation. Several commercial preparations of HS, LS, and fertilizers were investigated. A Bruker Vertex 70 spectrometer with a diamond-crystal ATR attachment was used.

ATR-IR spectra of dry fertilizer samples and their aqueous solutions have multiple characteristic but overlapping bands. LS-only bands selected for the quantification are 1266, 1192, 1093, and 1042 cm^{-1}. Silicate impurities in humates interfere with LS quantification; thus, they were precipitated by centrifugation. Different-ratio LS/HS solutions were prepared. LS bands at 1192 and 1093 cm^{-1} show the maximum sensitivity and precision: up to 25 g/L and for LS:HS = 1:2, the determination error reaches 50%; for a 1:1 ratio, 20%; and for a 4:1 ratio, it does not exceed 10%. It is possible to assess both LS and HS from a single sample by the bands than corresponds to S=O and C-O-C vibrations.