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Vanadium speciation by chromatographic separation of V(IV) and V(V) in acidic solution followed by ICP-OES determination

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Two new methods for vanadium speciation, a cationic exchange and an anion exchange method, have been developed for application to minerals processing samples.

The cation exchange method is based on the chromatographic separation of vanadium(IV) and vanadium(V) in acidic medium followed by the determination with ICP-OES. Vanadium species exist in acidic solution (pH < 3) as VO^{2+} for vanadium(IV) and VO_2^+ for vanadium(V). The two vanadium species were chromatographically separated using a cation exchange column, Dionex IonPack CG10, and eluant120 mmol/ℓ H_2SO_4 at a flow rate of 1.5 mℓ/min. The detection limits for vanadium(IV) and vanadium(V) are 40 μg/ℓ and 30 μg/ℓ, respectively. Among common anions, only nitrite, NO_2^- which may act as oxidant for vanadium(IV) and reductant for vanadium(V) can cause interference. Interference from common cations has not been observed for concentration levels not exceeding 40 mg/ℓ. The method has been successfully applied to the determination of vanadium(IV) and vanadium(V) in synthetic and minerals processing samples.

The anion exchange method used a low concentration eluent, 10 mmol/ℓ EDTA and 14 mmol/ℓ sodium carbonate, for the ion chromatographic separation of vanadium species at a flow rate of 1.2 mℓ/min. The quantitative detection limits were 0.14 mg/L for V(IV) and 0.20 mg/L for V(V) using ICP-OES detection.. The method was successfully applied to the analysis of synthetic samples and mineral processing samples.