KINETICS OF ESTONIAN PHOSPHORITE DISSOLUTION IN HYDROCHLORIC ACID

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Estonian phosphorite samples obtained from different locations of Estonia were dissolved using HCl. Identifying the dissolution mechanism at the fundamental level of this kind of system is important, hence, kinetic quantification was carried out [1]. The widely used shrinking particle model for heterogeneous leaching process was applied to study dissolution kinetics [2].

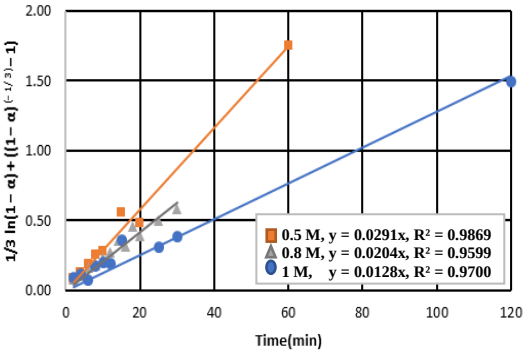

Fig.1 The product layer model for P leaching at different acid concentrations

Two samples with different size of particles, fine (<300 µm) and coarse (-2 + 1 mm) were used and dissolved at different acid molarities. The pH was measured throughout the reaction duration of 120 min. A known amount of reaction mixture was collected in different time intervals and the dissolved amount of P and Ca was analyzed. To analyze the leaching kinetics, three integral equations were used to clarify the rate controlling mechanism, describing namely chemical reaction, diffusion, and product layer diffusion control.

Dissolution of P and Ca of the coarse sample in 1 M HCl followed chemical reaction control up to 10 -12 min and, after that, diffusion layer control. Fine samples reacted with acids of different molarities (Fig.1) followed product layer diffusion limitation due to fast interaction and rapid blocking of pores in the solid. In summary, reaction kinetics change at some conversion level from chemical reaction to diffusion layer control in the system with larger particles while in the systems with fine particles, dissolution process immediately (within 1-2 min) shifts to product layer diffusion limitation.

References

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2. Z. Li, Z. Xie, J. Deng, D. He, H. Zhao and H. Liang, 2021, *Metals,* 11, 239

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