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### Kinetics of the Kola Apatite Rock Interaction With $H_3PO_4$

L. Komissarova<sup>ab</sup>; A. Bobylev<sup>ab</sup>; L. Golubina<sup>ab</sup>; P. Melnikov<sup>ab</sup>

<sup>a</sup> Chemical Faculty, Moscow State University, Moscow, Russia <sup>b</sup> Institute of Chemistry, UNESP, Araraquara, SP, Brazil

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## KINETICS OF THE KOLA APATITE ROCK INTERACTION WITH $H_3PO_4$

L. Komissarova, A. Bobylev, L. Golubina, P. Melnikov  
 Chemical Faculty, Moscow State University, Moscow, 117234, Russia and  
 Institute of Chemistry, UNESP, CP 355, Araraquara - 14800-900 - SP, Brazil

Besides the production of fertilizers, Kola phosphate rock may be used as a source of lanthanides, strontium and fluorine. It implies the necessity to carry out a study of kinetics and mechanisms of the process in order to choose optimal conditions for the realization of the technological scheme [1]. The fluorapatite concentrate used had the following composition:  $\Sigma Ln_2O_3$  - 0.89;  $Y_2O_3$  - 0.04;  $SrO$  - 2.80;  $CaO$  - 45.40;  $Fe_2O_3$  - 0.42;  $Al_2O_3$  - 0.86;  $MgO$  - 0.10;  $F$  - 2.80;  $SiO_2$  - 1.80;  $P_2O_5$  - 39.40 weight %; molar ratio  $CaO : P_2O_5 = 1.5$ ; the content of the apatite - 98.5%. The reaction of  $H_3PO_4$  with fluorapatite was studied using a laboratory reactor with a stationary layer. The following parameters were varied:  $H_3PO_4$  concentration (20, 30 and 50 weight %  $P_2O_5$ ), temperature (20, 75, 150, 200 and 250°C) and time of contact (1 - 180 min.). A multimethod approach was used. X-ray diffraction, electron probe microanalysis and paper chromatography were applied to follow the bulk structural aspects of the apatite powders. It was shown that at the first stage of reaction a thin film of calcium monophosphate  $Ca(H_2PO_4)_2 \cdot H_2O$  is deposited on the apatite particles (avg. diameter 150 nm). The reaction is thought to proceed at the interphase solid/liquid and its kinetics may be described by the equation

$$H(\alpha) = (1 - \alpha)^{-2/3} - 1 = k_R \tau,$$

where  $\alpha$  is the fraction reacted. At higher temperature (175 - 200°C) calcium monophosphate  $Ca(H_2PO_4)_2 \cdot H_2O$  is transformed into calcium diphosphate  $CaH_2P_2O_7$  forming a blocking layer on the apatite surface and thus making access to the surface difficult. Consequently, the diffusion at the next stage is described by the equation:

$$I(\alpha) = 1 - 2\alpha/3 - (1 - \alpha)^{2/3} = k_D \tau$$

The relationship between the two rates may change with time. Graphic representations of both functions  $H(\alpha)$  and  $I(\alpha)$  vs time show the corresponding kinetic and diffusion areas. The best conditions of Kola apatite treatment with phosphoric acid are:  $T = 200^\circ C$  and  $H_3PO_4$  concentration 30%.

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