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Chemical speciation of metal – phosphate complexation in natural rubber latex

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Natural rubber (NR) latex from the *Hevea brasiliensis* tree is an unstable colloidal suspension and always tends to undergo spontaneous coagulation in a few hours at ambient temperatures. Pinholes in dipped products such as examination, household and surgical gloves are a main problem in NR dipped products industry. One of the main causes for this problem is the presence of magnesium ions in NR latex. In industrial process calculated amount of diammoniumhydrogen phosphate (DAHP) is used to remove magnesium present in NR but that process seems not efficient enough to remove magnesium to the desired level. Hence this study was focused on the study of the complexation of magnesium with phosphate in the presence of other metal ions present in latex.
The concentrations of magnesium, calcium, iron and copper ions were determined in serum and rubber phase separately by atomic absorption method for different rubber clones at different pH ranging from 1 to 14, with the addition of DAHP.

Experimental results showed that soluble magnesium is higher in serum than in rubber phase and it is highest between pH 8-10. The reduction of soluble magnesium by DAHP is highest at the pH 9.

The speciation behavior of Magnesium, Calcium, Copper, Iron and Phosphate was modelled using a chemical speciation computer program. Experimentally obtained total concentrations of metal ions were used and the system was allowed to equilibrate from pH 1 to 14.

Results showed that up to pH 11 magnesium is present predominantly as free aqueous ions in the system and then precipitates as hydroxide. Magnesium hydrogen phosphate formed in very low concentrations at $6 \leq pH \leq 10$. Free aqueous calcium ions predominate up to pH 8 and at higher pH it forms $Ca_3(PO_4)_2$. Copper combines with phosphate at $4 \leq pH \leq 9$. Iron dihydrogen phosphate forms even at very low pH and it predominates as the free aqueous ion. Then it converts to hydrogen phosphate and at higher pH values it forms the hydroxide. Hence the added DAHP combines with other metal ions present in the latex in addition to magnesium and pH plays an important role.

In this investigation computer modeling studies coupled with analytical methods have led to an increased understanding of the speciation of many chemical reactions with interesting conclusions.