Best Practice in Wastewater Technology: Phosphorus Recycling by Electroflotation

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The phosphate purification of wastewater via electroflotation first made us aware of phosphorus recycling and its importance in averting a global fertilizer crisis, which is currently threatening to intensify as a result of the Ukraine war. Following electroflotation, last year we tried to harvest the redissolved phosphate as fertilizer salts in the form of magnesium ammonium phosphate (MAP) or calcium phosphate (Ca-P). This year, we experimentally compared the electroflotation method with the conventional precipitant method, confirming the advantages of electroflotation by investigating the influence of the amount of substance on the optimum precipitation of aluminum phosphate and the target products and by determining the recovery rates, which are about 30% higher with electroflotation. When examining the quality of the fertilizer salts obtained, the precipitated Ca-P turns out to be a phosphate-containing lime with the main components hydroxyapatite, portlandite and calcite. In the harvested MAP, the pure MAP content is about 75%. The precipitant method with Al2(SO4)3 is also about 12 times more expensive than electroflotation with Al-electrodes. Finally, we developed a new recovery strategy with phosphoric acid as the target product of recycling. The process is reduced to electroflotation with Fe-electrodes, digestion of the precipitate and separation of the metal ions with ion exchangers. The concentration of H3PO4 obtained is 0.07 wt% with a recovery rate of 60-70% based on the original input. This concentration is primarily due to the small scale of the process on the school laboratory scale. Higher concentrations should be possible as part of process management.

Awards Won:
American Chemical Society: Fourth Award of $1,000