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1 Recovery of phosphate and ammonia nitrogen from the anaerobic 2 digestion supernatant of activated sludge by chemical precipitation

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6 Abstract: This paper presents a study of the method used in recovering P_T (the total
7 orthophosphate) from the anaerobic digestion supernatant of sludge via chemical precipitation.
8 The P_T recovery efficiencies of three metal salts ($AlCl_3$, $CaCl_2$ and $MgCl_2$) at different pHs were
9 investigated. The results indicated that the pH of the solution exerts a significant effect on the P_T
10 recovery by chemical precipitation. The preference order of the three metal salts for the phosphate
11 recovery is $MgCl_2 > CaCl_2 > AlCl_3$ at the optimal pH range. Moreover, the phosphate precipitate
12 of $MgCl_2$ has a better settleability compared with those of $AlCl_3$ and $CaCl_2$. The alkalinity of the
13 supernatant exerts a significantly negative effect on the phosphate precipitation of $CaCl_2$ and
14 $MgCl_2$, especially on that of $CaCl_2$. When the alkalinity increased from 0 mg/L to 1968 mg/L, the
15 P_T recovery efficiency of $CaCl_2$ decreased from 94% to 85.4%. To overcome this problem, the
16 CO_2 degasification technique was used in the chemical precipitation. The effect of the alkalinity
17 was then found to be almost completely eliminated at an airflow rate of 8 L/min and a stripping
18 time of over 60 min. The results of the experiments of air stripping combined with struvite
19 precipitation using low-cost MgO showed that it is possible to recover approximately 100% of P_T
20 and 50% of the Total Ammonia Nitrogen (TAN) from the supernatant. An economic evaluation
21 revealed that the P_T recovery cost of the combined process was \$ 0.38 per kg P_T , which was far
22 lower than that of extracting P from phosphate rock.

23 Keywords: Phosphate recovery, anaerobic digestion, alkalinity, chemical precipitation.

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