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PHOSPHORUS REMOVAL FROM SYNTHETIC WASTEWATER USING SPENT ALUM SLUDGE.

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EXTENDED ABSTRACT

In the present study, phosphorus removal was studied using as coagulant spent alum sludge from a water treatment plant of EYDAP (Athens Water Supply and Sewerage Company). It was found that this sludge consisted mainly of $Al(OH)_3$ and a mechanism was proposed for its formation.
Also, freshly precipitated spent alum sludge and pure alum ($Al_2(SO_4)_3$) were
compared. Comparison was based on their efficiency to remove phosphorus in synthetic wastewater consisting of 10 mg/l P as potasium dihydrogen phosphate and 50 mg/l N as ammonium chloride.
The experiments were carried out using a jar-test apparatus and the measurements were performed according to the Standard Methods for the Examination of Water and Wastewater (20th ed. 1998).
Pure alum demonstrated much better results in phosphorus removal, being up to 5 times better than the sludge for the same amount of aluminum.
On the other hand, the effect of aging on the efficiency of the spent sludge to remove phosphorus in synthetic wastewater was studied. Aging of sludge was conducted at two temperatures (25 and 10 ^{0}C) and for a time interval of one and two months.
The sludge demonstrated a high decrease in its efficiency on P removal through aging, while the temperature seemed not to affect the aging process. During the second month of aging the decrease in P removal was less compared to that of the first month.
The decrease in the efficiency of the sludge to remove phosphorus is explained by a polymerisation reaction of $Al(OH)_3$ through the hydroxyl bridge. The degree of polymerization is slow and as the polymer increases in size, the attraction for further phosphate on the sludge becomes weaker. pH and XRD measurements support this mechanism.
The pH decrease is a result of the deprotonation reaction while XRD measurements show that the major constituent of the sludge, aluminum hydroxide, has increased the size of its primary crystallites during aging which is a change typical to polymerization.
The conclusion of this study is that although pure alum is much more efficient in phosphorus removal than the spent alum sludge, the low cost and the high availability of the later makes this method applicable for an effective wastewater treatment, especially when this sludge is freshly precipitated.

Key words: spent alum sludge, alum, phosphorus removal, water treatment, wastewater treatment, gibbsite, aluminum hydroxide, aging, XRD.