INFLUENCE OF THE PREPARATION CONDITIONS ON THE COAGULATION AND ADSORPTION PROPERTIES OF Fe-MONTMORILLONITE

MALIKOV, A. S.,[1] RYAZANTSEV, A. A.,[1] BATOEVA, A. A.[2]

[1] Water Supply Department, Siberian Transport University [Кафедра гидравлики и водоснабжении, Сибирский университет путей сообщения], D. Koval'chuk 191, Novosibirsk, 630049, Russia

[2] Baikal Institute of Nature Management [Байкальский институт природопользования], Sahyanovoy 8, Ulan-Ude, 670047, Russia

E-mail: raastu@irs.ru

Versatile properties of Fe-modified montmorillonite as well as its role in a treatment of sewage are discussed. Especially coagulation and adsorption properties were used for the pollutants removal from various effluents.

The availability of such active centres as ion exchange cations, hydroxyl groups, coordinated non-saturated ions and interlaminar water make clay inviting material in water treatment processes.

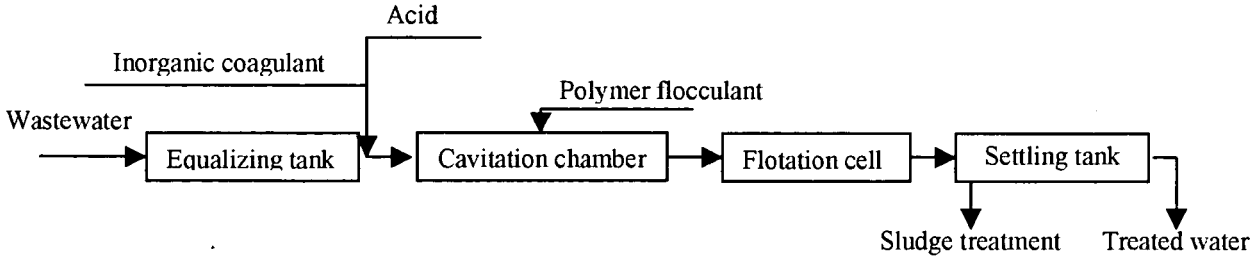
Main task: to develop the recipe for preparation of modified clay able to be scaled up at competitive prices. Refinement and preexchanging of clay have not employed. The activation as well as affinity of montmorillonite to anionic substances was achieved by displacement of ion exchange cations on hydrolysed iron cations using the cavitation bubbles processing of clay in $FeCl_3$ solution. High-speed agitation (3000 rpm) of liquid was employed by a patented device to reduce pressure resulting in hydrodynamic cavitation. The combination of cavitation effect and the shear effect in the chamber causes the clay to reduce to fine particles size of < 60 μm. Moreover the cavitation decomposes water into extremely reactive hydrogen atoms and hydroxyl radicals, which recombine to form hydrogen peroxide and molecular hydrogen. Numerous reduction and oxidation reactions may occur under these conditions.

Coagulation and adsorption properties of Fe-montmorillonite suspension (Fe-MM) were tested during treatment of tanning effluent. The wastewater from this process is characterised by high alkalinity and contains high concentration of both suspended solids (skin, hair-mud) and oil-grease. In addition, chemicals used in this production step, such as lime, soap, ammonia, sulfides and bacteria are discharged with the wastewater.

1st step: the treatment of effluent from liming and unhairing, in which a very high pollution load is generated. About 9 m^3 of wastewater per ton of raw hides are generated, having the following characteristics: chemical oxygen demand (COD) 7,000–35,000 mg/l, pH 12–13, sulfides 1,000–7,000 mg/l. The high content of sulfides in this wastewater is of particular concern. The results indicate on high performance removing of pollutants in COD and S^{2-} values. At dose of Fe-MM 100–120 g/l (clay 10 g/l, Fe^{3+} 0.5–0.7 g/l) the level of contamination is reduced on 80–95%. The similar result was obtained at usage of $FeCl_3$ or mechanical mixture of $FeCl_3$ and clay, however dose of a coagulant in Fe^{3+} values was three-four times more, and the quality of a sedimentation sludge was worse.

2nd step: cavitation air flotation (CAF) process for removal of suspended solids, oils and greases from integrated effluent (liming and unhairing after precipitation of sulfides and COD reduce, fleshing, deliming and bating effluents). This process is based on the formation of a precipitate of the ionic species, using a suitable reagent, and its subsequent removal by attachment to air bubbles to form a flotation scum. CAF device utilises an aerator (rotating disc), which draws ambient air down a shaft and injects micro bubbles directly into the wastewater. The same cavitation cell, as for processing of Fe-montmorillonite, was utilised. It is important to ensure that the coagulant and flocculant must be added at right point and time.

It is necessary to note, that processes of precipitation and flotation generate a voluminous sludge, which has to be taken for further treatment. Since this sludge is not suitable straight on for agricultural purposes the treatment and disposal costs are quite high.



	Raw wastewater	After flotation (cavitation treatment time, min. –4)	
		Coagulant $FeCl_3$ (Fe^{3+} = 0.3 g/l)	Coagulant Fe-MM (Fe^{3+} = 0.3 g/l)
COD, mg/l	7,350	1,650	370