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Flocculation of Industrial Water in the Presence of Carboxide-Amidecontainingpolyelectrolytes

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Abstract: The process of water flocculation in the presence of industrial water carboxide, amide containing water-soluble polyelectrolytes - flocculants. It was revealed that the flocculation of industrial water depends on the added concentration, form, density, location and the quantitative ratios of functional groups of water-soluble polyelectrolytes in the chain of the macromolecule, which have a significant effect on the conformational state and the interaction of macromolecules with solid particles.

Key words: Flocculation · Carboxide · Amide · Polyelectrolytes

INTRODUCTION

The process of separating solids from a liquid medium of industrial water (IW) depends on the particle size and surface properties [1,2]. Since the IW is composed of useful elements in the form of dissolved ions, as well as empty hardwoods in suspension. In the technology chain it is very important to accelerate the separation of the solid phase and to improve the purity of concentrate, as the productivity and quality of selected useful metals,largely depends on the purityof the concentrate [3].

To accelerate the separation of the solid phase and to improve the degree of clarification of the liquid medium in recent yearsvarious water-soluble polyelectrolytes (WSPE) - flocculants, having in its composition free active hydrophilic, ionizable and nonionizable functional groups along the macromolecular chain are applied [4]. However, the flocculation ability of WSP largely depends on the type, density and quantitative ratio of functional groups in the chain of macromolecules.

MATERIALS AND METHODS

In this aspect, some theoretical and practical relevance has the study of the separation process of solid phase PRV from liquid medium in the presence of new carboxide-, amide containing water-soluble polyelectrolytes (WSPE) - MAAA-5-H, obtained in the aqueousmedia by copolymerization in optimal conditions, of α-and β-cis-unsaturated, dicarboxylic - maleic acid (MA), with acrylic acid amide - acrylamide (AA) at a molar ratio of 1.0:8.0 [5] and polyacrylamide (PAA) produced in the industry, widely used for this purpose [6] and hydrolyzed polyakrilnitril (PANH) under mild conditions [7], which differ in quantitative ratio, density and location carboxide groups in the chain of the macromolecule. The separation process under the influence ofWSPhas been determined viathe change of the sediment volume (V_s)accumulated over time (t),and thickness of the liquid medium ($V_{t.l}$)calculated by the formula: $V_{s.l.} = V_e - V_s$, as well as the optical density (D) of the liquid above the sediment and the relative speed (U_r) of filtrationof IW. The character of the interaction ofWSPE with solid particles was determined by the PRV specific viscosity (η_s), electrical conductivity (χ_s), on the pH and optical density (D) of filtrates.

RESULTS AND DISCUSSIONS

The results of the experimental data suggest that changes in the volume of accumulated sediment, thickness and the optical density (D) of the clarified liquid above the sediment depends on the time, concentration, the type of added WSPE - flocculants (Figure 1a,b).

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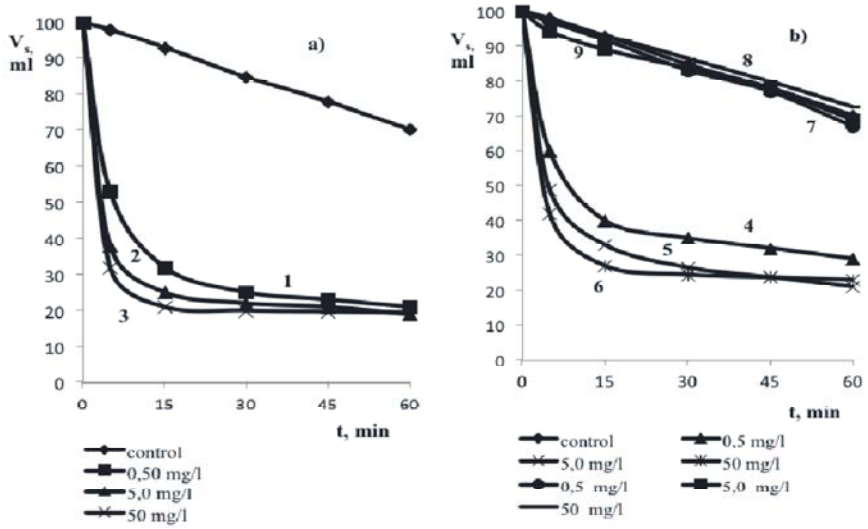

Fig. 1: The change in the sediment volume over time IW in the presence of various concentrations of WSPE: a) 1, 2, 3 - MAAA-5-H; b) 4, 5, 6 - PAA, 7, 8, 9 – PANH.

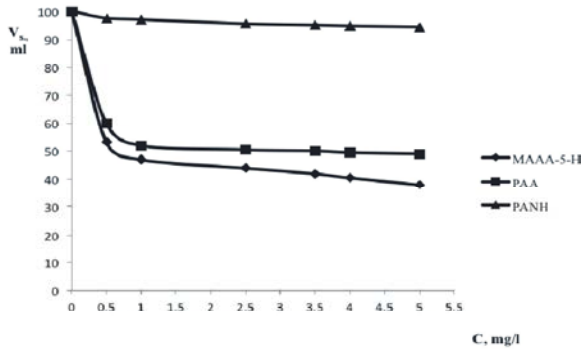

Fig. 2: Changing of residue volume IW depending on the concentration of WSPE (MAAA-5-H, PAA, PANH) after 5 minutes of settling.

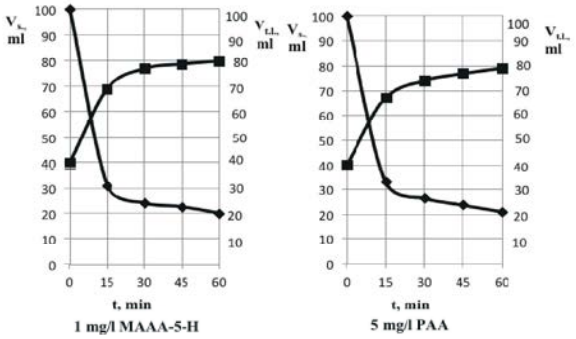

Fig. 3: Changing of residue volume (V_s) and the thickness of the liquid layer ($V_{t.l.}$).

It is revealed that with increasing of the added the concentration process of separating of the solid phase is gradually accelerated, reaching a maximum value in the presence of the optimal dose WSPE (Figure 2). Further growth of the added WSPE above the optimum does not lead to significant changes in residue volume and the thickness of the liquid medium of the residue (Figure 3). This character of changes in the residue volume and the thickness of the liquid layer is due to the fact that the addition of lower concentrations of macromolecules WSPEis not enough for aggregation most of small solid particles of solid phase IW, therefore in this interval theof separation of the solid phase is slow, along with this the thickness of the liquid overresidue and the value of optical density of the liquid medium is changed slightly.

It was revealed that the highest rate of separation of the solid phase takes place when adding of MAAA-5-H, especially in the presence of optimal concentrations. For example, the addition of 0.5 mg/lMAAA-5-H volume of accumulated sediment (V_s) after 15 minutes reaches the level of 32 ml and the thickness of the clarified liquid ($V_{t.l.}$) reaches the level of 68 ml, the value of the optical density decreases to 1.10.The same amount of sediment volume and the thickness of clarified liquid above the sediment in the presence of PAA arereached by adding of 10 mg/l.In the presence of PANHa significant acceleration of separation of the solid phase all over the investigated concentration range is not observed even after 120 minutes of settling.

The process of flocculation IW in the presence of studied WSPE also leads to a change in the relative filtration rate, which depends on the type, amount of the added dose of WSPE. It was established that the addition of lower concentrations the relative speed (U_r) filtration

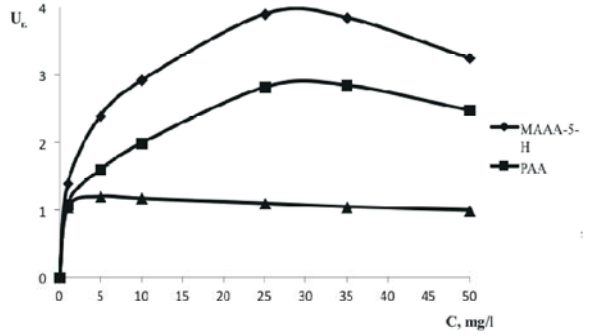

Fig. 4: Effect of different concentrations of WSPE on the specific filtration rate IW.

does not change significantly (Figure 4).With increasing of the doses of added WSPE, relative filtration rate gradually is increased, reaching a maximum value at optimal concentrations.

Further increaseof added concentration of WSPE process of filtering, makes it slower. This regularity is due to the fact that at lower doses the size of the formed floccules remains small, as a result a dense layer of sediment above the filter is formed, which prevented to the process of filtering and atoptimal concentrations range relatively densely packed large hydrophobic floccules, are produced especially in the presence of MAAA-5-H, with positive effects on the passage of liquid through a layer of sediment. A slowdown in the rate of filtration over optimal concentrations may be associated with some refinement of floccules formed and partial hydrophilizationof the surface, which leads to a slowing of the flow of fluid through the sediment layer. The identical character of the change of rate of filtration IW hasin the presence of MAAA-5-H and the PAA and PANH.As well is observed, with the absolute maximum value of the relative velocity (U_r)of filtering in all the studied range of concentrations in the presence MAAA-5-H. This regularity is due to the fact that in the presence of MAAA-5-H more a densely packed large hydrophobic floccules are formed that leads not only to the increase of the separation process of solid phase from a liquid medium, but also contributes to the acceleration of the relative velocity (U_r) filtering. It was found that the change in the residue volume and the thickness of the liquid layer and the relative filtration rate IW correlateswith the concentration of added WSPE.

CONCLUSIONS

pH values, depending on the concentration of added polyelectrolyte snows that the interaction of macromolecules with small particles of solid phase IW has identical nature.

As a consequence between these values, depending on the type of added WSPE significant difference was not observed. Thus, the results showed that the rate of separation of solids from a liquid medium depends on the added concentration and type WSPE, also density, location and quantity ratios of functional groups that have a significant effect on the conformational state and interactions of the macromolecule WSPE with small particles of solid phase IW.

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