

PERFORMANCE OF ACRYLAMIDE ANIONIC COPOLYMERS IN CLARIFICATION OF BENTONITE AND CALCIUM CARBONATE SUSPENSIONS*Jumaeva Gulniso Yulchi kizi,**Abdikamalova Aziza Bakhtiyarovna,**Eshmetov Izzat Dusimbatovich,**Mamatalieva Sayyora Sulaymonjonovna,**Kalbaev Alisher Maksetbaevich*

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Abstract: Background: High-molecular-weight polyelectrolytes play an essential role in the clarification of mineral suspensions and oil-water emulsions due to their ability to form interparticle bridges and generate mechanically stable flocs. Anionic copolymers of acrylamide with unsaturated acids are of particular interest for developing efficient and cost-effective flocculants.

Methods: In this study, novel acrylamide copolymers with acrylic acid (AA-AC) and maleic acid (AA-MC) were synthesized by free radical polymerization in aqueous medium. The copolymers were characterized by FTIR, thermal analysis, and powder X-ray diffraction. Bentonite and calcium carbonate were used as model mineral dispersions. Granulometric composition was determined by standard sieve analysis, and flocculation efficiency was evaluated by clarification tests.

Results: The granulometric distribution revealed that bentonite possesses a high proportion of fine fractions (<0.105 mm, 37.4%), maintaining colloidal stability, whereas CaCO_3 is dominated by coarse particles (>0.297 mm, 52.3%) leading to faster sedimentation. Flocculation experiments demonstrated that AA-AC copolymers were more efficient in smectite-rich bentonite suspensions, while AA-MC showed higher performance in CaCO_3 systems due to chelation with surface calcium ions. Both copolymers exhibited an optimal dosage window, beyond which restabilization occurred.

Keywords: Acrylamide, Anionic copolymers, Bentonite, Calcium carbonate, Flocculation, Polyelectrolytes, Suspension stability, Water treatment

Introduction

Polyelectrolytes of high molecular weight are widely used in water treatment because of their ability to destabilize suspensions and form strong flocs at low dosages. Among them, acrylamide-based copolymers attract considerable attention owing to their tunable charge density, chain conformation, and economic feasibility. The efficiency of anionic copolymers depends on the distribution of ionogenic groups along the polymer backbone, which affects bridging interactions and charge neutralization.

The present work focuses on the synthesis and performance evaluation of acrylamide copolymers with acrylic and maleic acids for flocculation of mineral suspensions. By comparing bentonite and calcium carbonate dispersions, structure-function-efficiency relationships were established to provide practical guidelines for water treatment applications.

Materials and Methods

The study was conducted at the Institute of General and Inorganic Chemistry, Academy of Sciences of the Republic of Uzbekistan during 2023-2024. Acrylamide copolymers with acrylic and maleic acids were synthesized under controlled aqueous radical polymerization. The obtained copolymers were structurally characterized by FTIR, TGA/DTA, and XRD.

Model substrates included bentonite (Navbahor deposit, Uzbekistan) and industrial CaCO_3 (calcite grade). Granulometric analysis was performed using sieve fractionation at cut sizes 0.42, 0.297, 0.105, 0.062, and 0.044 mm. Flocculation efficiency was evaluated through clarification tests by monitoring the volume of clarified water and optical density reduction over time.

Results and Discussion

Table 1. Granulometric composition of bentonite and CaCO_3 samples (%)

Sample	>0.42	0.42-0.297	0.297-0.105	0.105-0.062	0.062-0.044	<0.044
Bentonite	10.32	31.94	20.34	13.25	1.71	22.44
CaCO_3	9.94	42.35	34.14	5.24	0.74	7.59

Bentonite displayed a broad particle-size distribution with 37.4% of particles below 0.105 mm, contributing to colloidal stability and slow sedimentation. In contrast, CaCO_3 was dominated by coarser fractions (>0.297 mm, 52.3%), resulting in rapid settling under gravity.

These differences directly affected flocculation behavior. In bentonite suspensions, AA-AC copolymers demonstrated superior bridging due to more extended polymer conformations and moderate charge density, reaching 82-88% clarification at dosages of 0.25-0.5%. In CaCO_3 systems, AA-MC copolymers achieved up to 88% clarification at 0.125%, attributed to strong chelation of maleate groups with surface Ca^{2+} ions. Beyond optimal dosages, restabilization occurred in both systems as a result of surface saturation and electrosteric effects.

Conclusion and Acknowledgement

The study demonstrated that acrylamide-based anionic copolymers are efficient flocculants for mineral suspensions. The structure-mineral compatibility determined their performance: AA-AC was optimal for bentonite, while AA-MC was superior for CaCO_3 . These findings provide theoretical and practical foundations for substituting imported flocculants and scaling production at semi-industrial level in Uzbekistan.

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