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## The role of biopolymer on the stability of Colloidal Gas Aphrons

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Numerous studies [1] have been conducted on using surfactant solutions for soil remediation, but their implementation has been limited by the high cost and consumption [2] of surfactant solutions. Moreover, CGA fluids have been shown to be more effective than surfactant solutions in terms of contaminants eliminated per gram of surfactant [3]. An innovative approach to address these challenges is the use of colloidal gas aphrons (CGA) fluid, which aims to reduce the cost of the operation compared to traditional surfactant-based soil remediation. The first investigation into the stability of CGA fluid for soil remediation was done in 1994, where volume fraction and bubble size distribution of microbubbles in sample solutions were measured over time [4].

CGAs were first introduced by Sebba in the 1970s [5] as a new form of dispersion characterized by gas bubbles dispersed in a continuous liquid phase. Colloidal gas aphrons are stabilized by a viscous water layer and surfactant shells, creating a microbubble system [6]. However, CGA-based fluids must remain stable to prevent the destruction of bubbles when injecting them into porous media for soil remediation purposes. This ensures their effectiveness and benefits [7]. The size of the bubbles, which is determined by the surfactant, is one of the most critical factors influencing CGA stability. Although previous studies have examined the use of CGA for oil industry applications such as drilling fluid or injection into depleted reservoirs, its application for soil remediation studies is not yet clear [8]. Furthermore, the impact of additional stabilizers and thickeners, such as polymers, has not been thoroughly investigated. Therefore, it is crucial to investigate how quantitative parameters like surfactant and polymer concentrations at high levels affect the stability of CGA.

The primary objective of this research study is to investigate the impact of a particular biopolymer and anionic surfactant at high concentrations on the stability of CGA using image analysis based on microscope images at varying concentrations.

The stability of CGA dispersion was analyzed by quantifying the bubble diameters using microscopic observation. Zeiss CCD camera was placed on a microscope slide to capture images of CGA fluid samples. Our study incorporated varying concentrations of xanthan gum polymer (ranging from 1000 to 10,000 ppm) and sodium dodecyl sulfate surfactant (ranging from 1 to 10 CMC). Subsequently, ImageJ software was used to analyze the images and determine the bubble size distribution (BSD) over time. Our evaluation involved determining the BSD at intervals of 0 to 10 minutes over 60 minutes.

The effects of SDS surfactant concentrations and XG polymer concentrations on BSD CGA were investigated experimentally using optical microscopy. The findings demonstrated that while the BSD of CGAs decreased at first with increasing XG polymer concentration, it eventually increased slowly. On the other hand, the diameter of CGAs increased with the concentration of SDS surfactant. Furthermore, the greater viscosity of the base fluid due to higher polymer content led to reduced air penetration and smaller bubbles, resulting in slow gas diffusion and a lower gas fraction.

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### References

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