

POLITECHNIKA ŚLĄSKA

Wydział Górnictwa, Inżynierii Bezpieczeństwa
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PRACA DOKTORSKA

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**Modyfikacja metody ograniczania
przepuszczalności skał z zastosowaniem cieczy na
bazie krzemianu sodu**

Dyscyplina: Inżynieria Środowiska, Górnictwo i Energetyka

PROMOTOR:

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Abstract

The aim of the conformance control treatments using sodium silicate systems is to limit the hydraulic connectivity of the pores by destabilizing the colloidal solution injected into the pores of the rock. This property can be used in all branches of mining (hydrocarbon exploration, surface mining, underground mining) and geoengineering. Due to the fact that sol-gel transition in sodium silicate solutions occurs as a result of a change in pH, it can also be used to control fluid migration during the geological sequestration of carbon dioxide and other acid gases.

As part of the research, from among products available on the domestic market, a selection of water glass, its concentration, and salt content, which allow the preparation of a stable base fluid, was performed. Furthermore, characterization of the sol-gel transition at a wide range of pH was conducted. As a result, the optimal, for technical reasons, pH of the sol-gel transition was determined. Moreover, the method of sample preparation for measuring the mechanical strength of the gel was developed, and gel shrinkage was determined.

Inorganic acid, organic acid, and gaseous CO₂ were used as the factors initiating the gelling process. The gelling agent determined the gel structure at the molecular level, which was also reflected in the storage and loss modulus.

Due to the brittleness and shrinkage of the gel, the obtained colloidal solution was modified with a biopolymer, salts of the amphoteric metals, and bentonite. Based on the results of dynamic mechanical analysis, the optimal composition of the fluid was determined. Subsequently, detailed rheological characteristics of the selected treatment fluid were performed. Finally, tests on rock samples were carried out, which showed the high efficiency of rock permeability modification.