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Synthesis and Mechanical Properties of Polyacrylamide Gels Doped with Graphene Oxide

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Abstract

We fabricated polyacrylamide (PAM)/polyethylene mine (PEI) gels doped with graphene oxide (GO). Their shape and residences had been systematically studied through X-ray diffraction (XRD), Fourier transition infrared spectroscopy (FT-IR), Raman spectroscopy, scanning electron microscopy (SEM), differential scanning calorimeter (DSC), and rheological experiments been appreciably researched. As a result, graphene oxide (GO) Nano sheets had been proven to facilitate the cross-linking response among the principle energetic element (PAM) and the cross-linker (PEI), functioning as multi-useful cross-linkers and powerful reinforcing Nano-fillers. I was. By growing the content material of the principle energetic element and the cross-linking agent, we've got efficiently advanced the power of the gel. Thanks to the advanced third-dimensional honeycomb shape with controllable pore size, GO should efficiently song the power and gelation time to show off susceptible gel residences. DSC showed that the PAM/PEI/GO gel has true thermal balance and does now no longer dehydrate above 170 °C. This painting gives theoretical guide for in addition optimization of polyacrylamide gels utilized in ultra-deep and excessive temperature reservoirs for water control.

Keywords: Polyacrylamide; Graphene oxide; Rheological properties; Mechanical behavior; Nano composite hydrogel; Microstructure

Introduction

After years of hydrophilic development, low-permeability reservoirs are typically during times of flooding or extra water, and oil manufacturing declines with inside the centre and overdue levels of oilfield development. As a sort of water manage chemical process, polyacrylamide polymer gel in particular enlarges the waft profile of crude oil through blockading water channels, stopping water from blockading oil channels, similarly enhancing oil restoration. It is characterised through smooth manage, smooth injection, and excessive selectivity to excessive aquifers, and is extensively utilized in oilfield development. However, traditional polyacrylamide gels are susceptible because of inadequate heat-stable (150 °C) reservoirs, making it tough for sturdy gels to attain deep and attain moisture manage effects. A gel with excessive temperature resistance is required. Therefore, it's miles of first rate significance to broaden polyacrylamide gels with mild power and excessive temperature resistance to enhance oil restoration in ultra-deep reservoirs. Extensive paintings have been completed on polyacrylamide gels to cope with this issue. Cross-linkers are vital for enhancing the thermal balance of polyacrylamide gels and may be divided into foremost categories, particularly, natural move-linking structures, which includes phenolic resin, polyethylene imine (PEI), hydroquinone (HQ), and hexamethylenetetramine (HMTA) and inorganic move-related structures, which includes Cr(III), Al(III), and Zr Bioinorganic move-linking structures are complexes with the carboxyl organization at the polyacrylamide [1,2], at the same time as natural move-linking structures in particular react with the amide organization at the polyacrylamide molecule move-linking to generate a third-dimensional community shape insoluble in water. Although maximum natural and inorganic polyacrylamide gels have superb thermal balance at 140 °C, and a few gels have precise cyclic compression overall performance with elongation at split to 1000% and compressive power as much as 0–2 MPa, their temperature resistance is usually much less than 150 °C, and their excessive power makes them tough to inject into deeper Wells. They are in particular utilized in low-temperature reservoirs with shallow intensity and feature bad overall performance for water manages in excessive-temperature deep wells. In current years, so that you can similarly enhance the thermal balance and power of gels, grafting copolymers of herbal polysaccharides and artificial polymers (particularly starch-grafted polymers) and the amendment of nanoparticles were used to achieve gels with higher bodily residences. Graft copolymerization of herbal and purposeful artificial polymers can adjust the shape of herbal polymers, making them appropriate for a lot of applications, which includes flocculants in mature reservoirs, managed drug releases, and oil extraction treatments. As polyacrylamide chains are connected to a inflexible polysaccharide spine and react with a lot of move linkers to shape third-dimensional (3D) hydrophilic community hydrogels, the grafted polymers show off residences which includes excessive thermal and shear balance. It has superb bodily residences. Some researchers have included nanoparticles into hydrogels to enhance their overall performance. Thermal balance may be similarly advanced through incorporating nanoparticles as compared to starch grafted polymers [3,4].

Material and Methods

Polyacrylamide (PAM) (quantity common molecular weight: 50,000) and polyethylene mine (PEI) (quantity common molecular weight: 10,000), each analytical grade, have been bought from Yemen Chemical Technology Co. Ltd., Shanghai, China. . TEM pics of graphene oxide (GO) aqueous answer (2 mg/mL) have been acquired from Suzhou Tanfeng Graphene Technology Co. Ltd., Suzhou, China. All concentrations given on this file are via way of means of weight. Fabrication of PAM/PEI/GO hydrogels [5,6].

Graphite oxide became produced via way of means of a changed

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Hummer method. Synthesis of the PAM/PEI/GO gel became as follows. Briefly, 20 mL of GO aqueous answer became introduced drop clever to 2 hundred mL of impartial deionized water below steady stirring. The diluted GO answer became then ultrasonically dispersed for 1 h. Then, precise concentrations of PAM and PEI have been slowly introduced to the GO answer at 60 °C below N2 safety and stirred for 30 min to put together a homogeneous gelator answer. Finally, about 50 ml of the organized gel answer became transferred to a sealed glass tube with the air changed with N2. A cross-linking response became initiated whilst the sealed glass tube became positioned in an oven at 80° C. and persisted for approximately forty eight hours. A PAM/PEI gel became additionally synthesized the usage of the identical technique without the GO Nano sheets. Test concentrations of PAM, GO, and cross-related PEI. The concentrations of PAM, PEI and GO on this take a look at have been decided as regards to preceding studies. We attempted to pick an awareness variety wherein the mechanical residences of the synthesized gels modified manifestly via way of means of switching from low to excessive concentrations [7].

Structural characterization of GO and GO-doped PAM gels the usage of XRD, FT-IR, and Raman spectroscopy techniques. The XRD consequences that GO has a outstanding top at 26.forty eight° and 0.08 wt% GO and 0.sixteen wt% GO gels haven't any apparent sharp peaks. This is the GO Nano sheet gel. As formerly defined the FT-IR spectrum of GO indicates the presence of -OH stretching bands at 3200–3400 cm-1. A polyacrylamide gel without GO is characterised for assessment and its foremost practical companies are indicated via way of means of yellow curves. Absorption bands at 1621, 1515, 1234, and 3278 cm-1 are related to amide I vibrational (C=O), amide II bending modes (N-H), and amide III (1165 and 1067 cm) forming C-O and N–H stretches, respectively. After GO is doped into the polyacrylamide gel, the height withinside the vicinity of 1600–a thousand cm progressively disappears with growing GO content. This is attributed to the formation of carboxylate ammonium complexes among the carboxyl companies of GO Nano sheets and the amino practical companies of polyacrylamide.

Result and Discussion

PAM-GO Nano composite hydrogels have been efficiently synthesized the use of PEI as a cross linker. Hydrogels containing specific quantities of PAM, GO, and PEI exhibited advanced mechanical electricity, stiffness, and advanced mechanical electricity, stiffness, and stiffness attributed to the 3-D community shape and the contribution of the GO movie as a multifunctional cross linker and powerful reinforcing Nano filler. Shows sturdiness. Rheological exams confirmed that the electricity and sturdiness of polyacrylamide gels expanded with growing content material of the primary energetic ingredient (PAM). There is an top-quality quantity of go linker PEI (0.three wt%) to get the most powerful and hardest gel. With growing GO content material (0–0.2 wt%), the stiffness reduced step by step and the electricity first reduced after which expanded at 0.12 wt. %, however became usually decrease than that without GO, ensuing in a weaker gel. confirmed the traits of On the opposite hand, the interplay among PAM and GO Nano sheets can obstruct the motion of PAM molecular chains and decrease the self-recovery overall performance of PAM/PEI/GO gels. Gelation time expanded with growing GO concentration. When GO Nano sheets have been brought to polyacrylamide gels, a honeycomb shape became observed, and the pore length of the 3-D community shape tended to be large as compared to the ones without GO. With growing GO content material, the pore length reduced and have become greater heterogeneous and shallow. The common pore sizes of 0.06 wt% GO, 0.08 wt% GO and 0.12 wt% GO gels are 18.4 ± 7.19 μm, 14.55 ± 5.21 μm and 6.08 ± 2.14 μm, respectively. DSC discovered that the molecular bonding electricity of polyacrylamide gels shaped with GO became more potent than without GO, due to the hydroxyl and carboxyl corporations of GO Nano sheets, in addition enhancing the thermal balance of the assembled gel system. The new Nano composite hydrogel PAM/PEI/GO has capability use in ultra-deep and high-temperature reservoirs for water control.

References

1. Fan TY, Song XM, Wu SH, Li QY, Wang BH, et al. (2015) A mathematical model and numerical simulation of waterflood induced dynamic fractures of low permeability reservoirs. Pet Explor Dev 42: 541-547.
2. Han YJ, Zhou CC, Yu J, Li CL, Hu FL, et al. (2019) Experimental investigation on the effect of wettability on rock-electricity response in sandstone reservoirs. Fuel 239: 1246-1257.
3. Chu HQ, Han WW, Cao WJ, Gu MY, Xu GJ (2019) Effect of methane addition to ethylene on the morphology and size distribution of soot in a laminar co-flow diffusion flame. Energy 166: 392-400.
4. Yang H, Hu L, Chen C (2018) Synthesis and plugging behavior of fluorescent polymer microspheres as a kind of conformance control agent in reservoirs. RSC Adv 8: 10478-10488.
5. Yang H, Kang W, Yu Y, Yin X, Wang P, et al. (2017) A new approach to evaluate the particle growth and sedimentation of dispersed polymer microsphere profile control system based on multiple light scattering. Powder Technol 315: 477-485.
6. Yang H, Shao S, Zhu T, Chen C, Liu S, et al. (2019) Shear resistance performance of low elastic polymer microspheres used for conformance control treatment. J Ind Eng Chem 79: 295-306.
7. Bai B, Zhou J, Yin M (2015) A comprehensive review of polyacrylamide polymer gels for conformance control. Pet Explor Dev 42: 525-532