SYNTHESIS HYDROGELS BASED ON STARCH-GRAFTACRYLONITRILE

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Chemical context. The polymer hydrogel is a unique sorbent, a hydroheterogeneous sorbing system, the dispersed phase of which is a spatial network formed by polymer macromolecules, and the water distributed in it is a dispersed medium [1–2]. Synthetic hydrogels, after their use in agriculture, lead to environmental pollution, because synthetic hydrogels do not decompose in a short period of time. That is why there is a growing interest in the production of partially synthetic and partially natural SAP [3]. The most important challenge in the field of biodegradable SAP is the synthesis or manufacture of fully biodegradable polymer-based superabsorbent materials that will rapidly and reversibly absorb water with good mechanical strength. Polymer hydrogels based on starch: Starch occupies a special position in the group of natural polymers [4]. In recent years, hydrogels based on natural polysaccharides have been replaced by long-acting synthetic hydrogels. These hydrogels are highly water-absorbing and nontoxic in nature.

Preparation of superabsorbent hydrogel. The reaction was carried out in a laboratory reactor equipped with a mechanical stirrer, a refrigerator, a thermometer and nitrogen gas. In the reactor, 10 g of potato starch is mixed with 120 ml of distilled water. The solution was heated at 90 °C for 20 min to form a starch suspension. Then the starch suspension was mixed with an initiator for 10 minutes. Acrylonitrile, binding reagent and bentonite powder were added to the mixture. The reaction was then carried out at 50 °C with stirring for 3 h. The obtained product was transferred to 4% sodium hydroxide solution and hydrolyzed at 90^0C for 2 hours. After hydrolysis, the obtained product was filtered and washed several times with distilled water.

Fig 1 shows the IR spectrum of the obtained superabsorbent hydrogel St-g-PAN/BC. The absorption line at 3383.14 cm^{-1} shows slight shifts associated with the presence of –OH groups in it. In the regions of 2924.09 and 2852.72 cm^{-1}, the stretching vibration of the CH_2 and CH_2 groups, respectively, is observed. The absorption region at 1716.65 cm^{-1} is the absorption region relating to carboxyl (COOH) and its salts -(COONa). The region 1336.17 and 1556.65-1635,64 cm^{-1} is the stretching vibration of the $-COO^-$, $-CONH_2$, CONH groups. Area 1053.13 cm^{-1} represents the Si-O-Si group, area 989.48-950.91 cm^{-1} represents the Al-O-Al group, area 555.50 cm^{-1} indicates the presence of the Al-O-Si group. These functional groups represent the composition of bentonite added during hydrogel synthesis. The -CN group present in acrylonitrile is replaced by other hydrophilic functional groups (-COOH, $-CONH_2$, COO^-, COOK, CONH) during hydrolysis. Therefore, the absorption region of 2227.8 cm^{-1}, corresponding to the -CN group in acrylonitrile, is not observed in the resulting superabsorbent hydrogel.

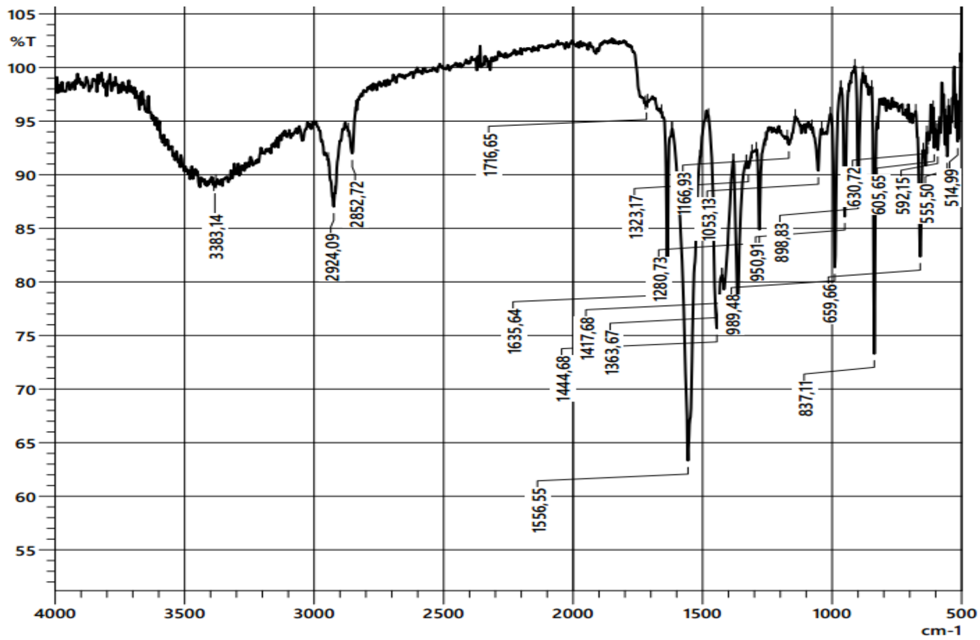

Fig. 1 FTIR spectrum of superabsorbent hydrogel

The morphology of bentonite and the resulting hydrogel was studied using a scanning electron microscope (SEM) (Fig 2).

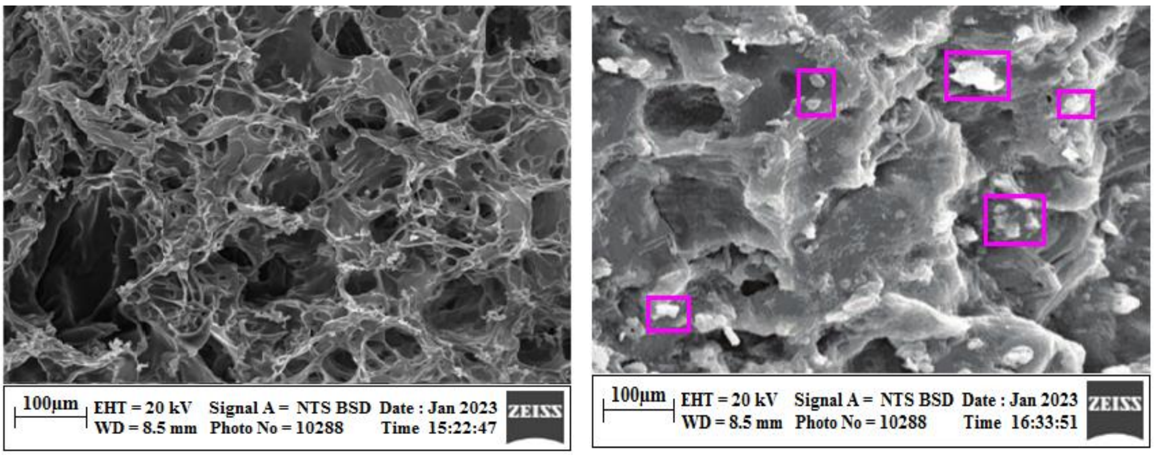

Fig. 2 Starch-g-PAN/Bentonite/$NaHCO_3$ hydrogel and (d) hydrogel swollen in water (Starch-g-PAN/Bentonite/$NaHCO_3$).

During the synthesis of hydrogels, changes were observed after the addition of bentonite and sodium bicarbonate, so the morphology of the superabsorbent hydrogel was studied using SEM. Fig. 2 bentonite hydrogel obtained without bentonite and sodium bicarbonate, SEM image of a hydrogel based on superabsorbent hydrogel (Starch-g-PAN/Bentonite/$NaHCO_3$) preparation reactions by copolymerization of starch-acrylonitrile, bentonite and sodium bicarbonate. From the SEM image of the hydrogel in Fig. 2 it can be seen that the pores in it are small. When adding bentonite and sodium bicarbonate during the synthesis of superabsorbent hydrogel, micro and macropores increase. It can be seen from Figure 2 that the hydrogel contains microparticles of bentonite, and this is clearly seen from the SEM analysis of the hydrogel swollen in water.

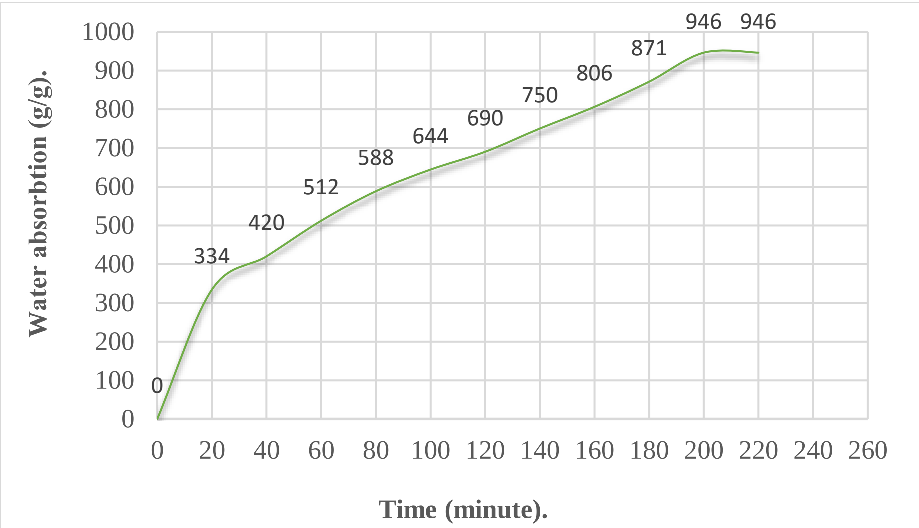

Fig. 3 Determination of the swelling time of the hydrogel in distilled water.

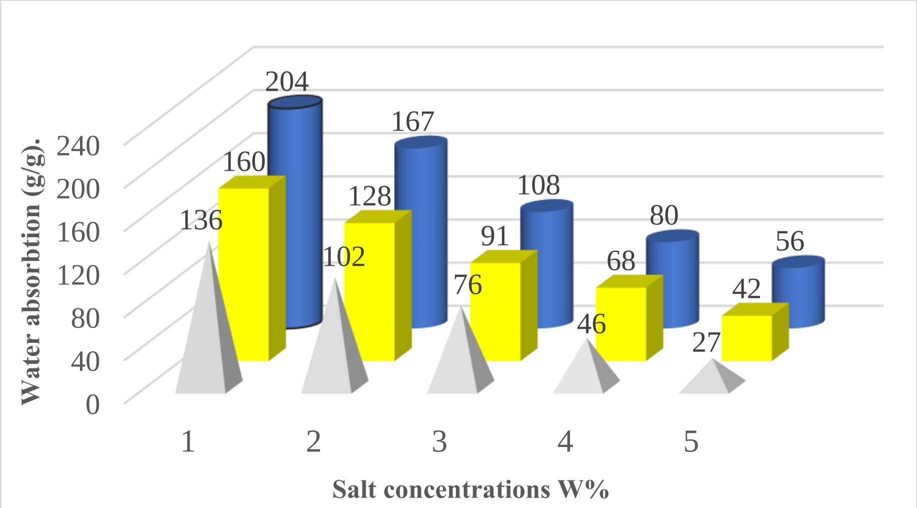

Fig 4. For hydrogel swelling sodium chloride (NaCl), calcium chloride ($CaCl_2$), aluminum chloride ($AlCl_3$) effect of concentrations.

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