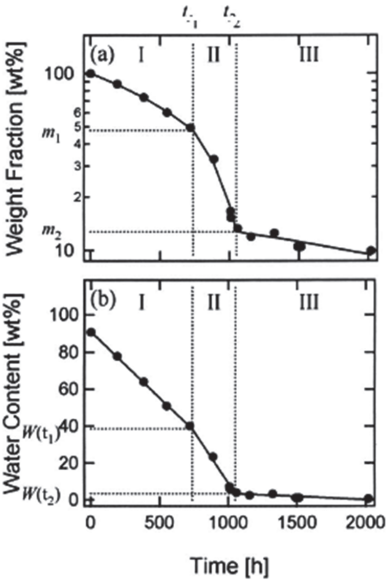


**Fig. 22.** Weight fractions (a) and fraction of water content (b) of PDMAA hydrogel versus time during the dehydration.

to the water content (Takushi et al. 1990; Koshoubu et al. 1993) and depends on the structure of the polymer network (Fig. 22). Sekine and Ikeda-Fukazawa (Sekine and Ikeda-Fukazawa 2009) analyzed the changes in the Raman scattering spectra of poly-N,N-dimethylacrylamide (PDMAA) hydrogel with natural drying and showed the process of structural changes of water and polymer network with dehydration.

They found that the strength of the hydrogen bonds formed by water decreases with decreasing water content. The bound water in the PAA hydrogel is isolated from the surrounding water, and it primarily forms four strong hydrogen bonds with hydrophilic groups in the side chain of PAA. In contrast, the water in the PDMAA hydrogel coheres and forms a networked structure with weak hydrogen bonding (Fig. 23). It was therefore concluded that the water structure depends on the structure of the functional groups in the polymer side chains, and the effect of the functional groups structure is an important factor for determining the properties of the gel materials.

Using differential scanning calorimetry (DSC) (Ikeda-Fukazawa et al. 2013) it was also observed that the melting temperature of the water in PDMAA hydrogel decreased as the water content decreased Tanaka and Kishi (Tanaka and Mochizuki 2010; Kishi et al. 2009) investigated the thermal properties of several hydrated polymers, including poly(2-methoxyethyl acrylate) and poly(ethylene glycol), and found that the melting temperature of water depended on the molecular species. Furthermore, Kitano (Kitano et al. 2006) analyzed the Raman spectra of amphoteric random copolymers of methacrylic acid (MA) and N-[3-(dimethylamino)propyl] methacrylamide (DMAPMA) with varying ratios of MA and DMAPMA, and found that the water structure changes with the components of the copolymer. These results