

Supplementary Information

Synthesis of the polymers

A 250 mL three-necked round-bottom flask is equipped with a mechanical stirrer, nitrogen inlet, and a thermometer. Acrylamide (AM, 7.43g), and acrylic acid (AA, 2.0g), DMDCC (0.12g) and sodium dodecyl sulfate (SDS, 0.15g) were dissolved in some amount volume of deionized water. The total concentration of the monomers was kept at 1.0 M. The mixture solution was prudently adjusted by sodium hydroxide (NaOH) to pH 7.00~7.05. The detailed procedure of synthesis and purification of hydrophobically amphoteric polyacrylamide (HMPAM) was in accordance with the literature.⁴² For reference, HPAM was prepared under identical experimental conditions and purification method mentioned above.

The intrinsic viscosities (η) of the polymers were determined by an automatic capillary viscometer (Ubbelohds type) in 0.1M NaCl aqueous solution at room temperature (Table 1). The IR spectrum was carried out using a Shimadzu Model1800S spectrometer on KBr pellets (in the range of 4400–400 cm^{-1}). The peak intensities were characterized as follows: vs=very strong, s=strong, w=weak, ν corresponds to a stretching elongation and δ corresponds to a bending elongation (Fig. S1a). ^1H NMR spectra was measured with a Bruker AVance1-400NMR spectrometer using D_2O as a solvent at room temperature. Chemical shifts were determined by using TMS as an internal standard. The peaks multiplicities are characterized as follows: s=singlet, d=doublet, t=triplet, q=quartet, m=multiplet. Letter index refers to protons (Fig. S1b).

For HMPAM, IR (KBr, ν cm^{-1}): 3448 (vs, ν_s (NH_2)), 1637(s, ν ($\text{C}=\text{O}$)), 1562(s, ν ($\text{C}-\text{N}$)), 1030(s, ν (COO^-)), 617(s, δ ($\text{C}-\text{H}$)). ^1H NMR (400 MHz, D_2O , δ /ppm): 1.13 (q, 2 H_g ; CH_2), 1.58 (d, 2 H_a ; CH_2), 2.16 (d, 1 H_b , CH), 2.38 (t, 3 H_c , CH_3), 2.50 (s, 3 H_f , CH_3), 3.59 (m, 2 H_e , CH_2), 3.74(q, 2 H_d , CH_2). The (η) of HMPAM and HPAM were respective 2282.4ml g^{-1} ($M_w=1.53\times 10^7$), and 2642.5ml g^{-1} ($M_w=1.86\times 10^7$).

Surface Activity of APG1214

The surface tensions of different APG1214 concentration solutions in 0.1M NaCl water were conducted using the Wilhemy circle method on a (JYW-200A tensionmeter (China)) at 25 $^\circ\text{C}$. The critical micelle concentration (CMC) and the pC_{20} (the efficiency of surface tension reduction, (required to reduce the surface tension of the solvent by 20mN m^{-1})) were obtained from the surface tension to the logarithmic molar surfactant concentration. The HLB of APG1214 was measured by the optical emulsion method using Span 80 (4.3) reported in the literatures.^{29,33,35} The Krafft point was obtained utilizing aqueous solutions of APG1214 of varying concentration, which were placed in contact with equal volumes of hydrocarbons in test tubes end shaken vertically. Since the emulsion was usually not stable near the phase inversion temperature (from cloudy phase to transparent emulsion phase), the Krafft point visual observation was convenient and reliable.³⁴ The detailed surface properties of APG1214 was listed in Table 2.

Table 1. Structure parameters of synthesised polymers

sample ^a	polymer composition wt%			$10^{-7}\times M_w \text{ mol}^{-1}$	$(\eta) \text{ ml g}^{-1}$	$(\eta)_{\text{calc}} \text{ ml g}^{-1a}$
	AM	AA	DMDCC			
HPAM	77.8	21.2	0	1.86	2785.3	2642.5
HMPAM	77.8	20.9	1.3	1.53	2236	2282.4

^aIntrinsic viscosity calculated for HPAM²¹.

Table 2. Surface properties of APG1214 mixture at 25 $^\circ\text{C}$ in 0.1 M NaCl

alkyl chain (wt%:wt%)	HLB	CMC mol l^{-1}	pC_{20} (M)	γ CMC(mN m^{-1})	CMC/ C_{20}	Krafft point $^\circ\text{C}$
12/14/16 (68:30:2)	12.3	1.65×10^{-4}	4.59	28.6	6.4	22

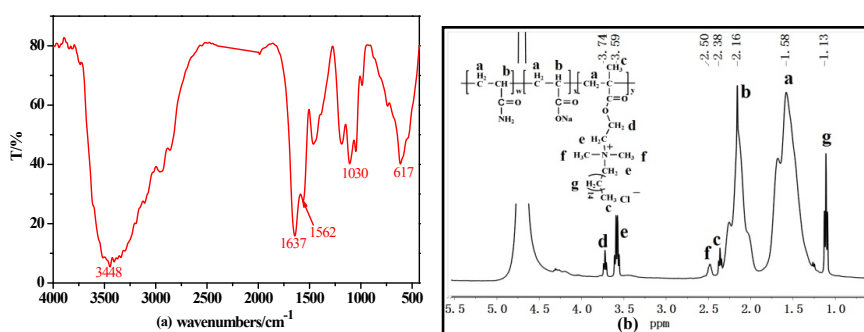


Fig. S1 IR spectra and ^1H NMR spectra of HMPAM.