Supporting Information

A novel *α*-aminophosphonic acid modified acrylamide-based hydrophobic associating copolymer with superb water solubility for enhanced oil recovery

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1. The effects of the proportion of AA, AM, NAD and DMAAPA.

The effects of the proportion of AA, AM, NAD and DMAAPA were listed in Table S1. It could be found that the most proportion of AM, AA, NAD and DMAAPA was 60.0:39.0:0.8:0.2. In addition, the apparent viscosity of copolymer solution increased with the rising contents of NAD and decreasing contents of DMAAPA. Nevertheless, excess contents of NAD or too little contents of DMAAPA required more dissolution time, sometimes it even occurred to the phenomenon of partial insolubilization. So the entry 6 was selected instead of entry 7 and entry 8.

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Table S1. Effects of the proportion of AA/AM, dosage of NAD and DMAAPA

| Entry | Mass ratio of monomer (%) | | | | Apparent viscosity |
	AM	AA	NAD	DMAAPA	(mPa·s)
1	80.0	19.3	0.5	0.2	406.2
2	70.0	29.3	0.5	0.2	485.6
3	60.0	39.3	0.5	0.2	507.5
4	50.0	49.3	0.5	0.2	449.7
5	60.0	39.5	0.3	0.2	363.7
6	60.0	39.0	0.8	0.2	534.4
7	60.0	39.7	1.0	0.2	575.7
8	60.0	39.1	0.8	0.1	608.3
9	60.0	38.9	0.8	0.3	490.8
10	60.0	38.7	0.8	0.5	416.1

2. The effects of reaction temperature, the amount of initiator and pH.

The effects of reaction temperature, the amount of initiator and pH were shown in Table S2. It indicated that the highest apparent viscosity of the copolymer solution was 503.8 at 45 °C, and it would decline when the temperature was over 45 °C. The most suitable dosage of initiator was 0.3%, and the mole ratio between oxidizing agent and reducing agent was 1:1. The apparent viscosity of the copolymer solution increased with rising pH when it was less than 7. If the pH was greater than 7, it would not react.

Table S2. Effects of reaction temperature, the amount of initiator and pH

Entry	Temperature (°C)	Mass ratio of initiator (%)	pH	Apparent viscosity (mPa·s)
1	35	0.4	7	399.1
2	40	0.4	7	449.5
3	45	0.4	7	503.8
4	50	0.4	7	459.3
5	45	0.2	7	487.2
6	45	0.3	7	534.4
7	45	0.5	7	488.9
8	45	0.3	5	471.2
9	45	0.3	6	510.3
10	45	0.3	8	/

3. Dissolution time of the copolymers

Table S3. Dissolution time of the copolymers

Entry Copolymer	1	2	3	Avg.
P(AM-AA-NAD-DMAAPA)	0.70 h	0.78 h	0.75 h	0.75 h
P(AM-AA-NAD)	9.5 h	9.3 h	9.8 h	9.5 h
P(AM-AA-DBDAP)[a]	> 12 h	> 12 h	> 12 h	> 12 h
P(AM-AA-NAE)[b]	> 18 h	> 18 h	> 18 h	> 18 h
P(AM-AA-NIMA)[c]	> 24 h	> 24 h	> 24 h	> 24 h
AP-P4[d]	> 20 h	> 20 h	> 20 h	> 20 h

[a] DBDAP was the abbreviation of *N,N*-Diallyl-2-dodecylbenzenesulfonamide;[2]

[b] NAE was the abbreviation of *N*-allyloctadec-9-enamide;[3]

[c] NIMA was the abbreviation of 3-(2-(2-heptadec-8-enyl-4,5-dihydro-imidazol-1-yl)ethylcarbamoyl)acrylic acid;[4]

[d] AP-P4 which has been used in oilfields was the copolymerization of AM, AA and *N*-(2-(acryloyloxy)ethyl)-*N,N*-dimethylhexadecan-1-aminium bromide.

References

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