Supplementary Material

Effects of Graphene on the Transport of Quinolones in Porous Media

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Table S1. Zeta potential of QS and GN

Electrolyte	IS (mM)	Zeta potential values (mV)	
		SS	GN
Na^+	0.1	-22.3	-53.5
	1	-18.5	-38.4
	10	-14.8	-32.8
Ca^{2+}	0.1	-10.7	-22.5
	0.5	-5.20	-15.6
	5	1.11	-5.36

Table S2. Parameters of adsorption kinetics models

NO.	Absorbate	Adsorbent	Pseudo first order			Pseudo second order			Elovich		
			k_1(min^{-1})	F_1(mg·g^{-1})	R^2	k_2(g ·mg^{-1}·min^{-1})	F_2(mg·g^{-1})	R^2	k_3(mg ·g^{-1}·min)	F_3(mg·g^{-1})	R^2
1	CIP	GN	0.0204	142	0.975	1.01 x10^{-4}	161	0.981	16.9	5.26 x10^{-2}	0.954
2	NOR	GN	0.00795	114	0.970	8.40 x10^{-5}	128	0.988	5.04	4.31 x10^{-2}	0.968

Table S3. Fitting parameters of isothermal models

NO.	Absorbate	Adsorbent	Langmuir			Freundlich			Temkin		
			K_L(L·mg^{-1})	S_{max}(mg·g^{-1})	R^2	K_F(L·mg^{-1})^n	1/n(mg·g^{-1})	R^2	A_T(L·mg^{-1})	b_T(J·mol^{-1})	R^2
1	CIP	SS[1]	0.202	3.49	0.983	1.17	0.237	0.882	2.31	3.99 x10^3	0.957
2	CIP	GN	0.0220	271	0.991	7.19	0.736	0.972	0.741	63.7	0.900
3	NOR	SS	0.691	4.50	0.964	2.01	0.214	0.921	26.5	4.25 x10^3	0.959
4	NOR	GN	0.0269	179	0.980	13.7	0.482	0.970	1.84	1.04 x10^2	0.764

[1]SS represents SS

Table S4. The fitted equations of BDST parameters and mass recovery rate of CIP

Paremeter	k_b [1](mg^{-1}·min^{-1}·L)	N_0 [2](mg·L^{-1})	RE_{CIP} [3](%)
P_{GN}[4] (%)	$k_b = -5.52 \times 10^{-2} P_{GN} + 6.78 \times 10^{-3}$ (R^2=0.714)	$N_0 = -3.12 \times 10^6 P_{GN} + 9.14 \times 10^4$ (R^2=0.921)	$RE_{CIP} = -1.03 \times 10^3 P_{GN} + 76.4$ (R^2=0.952)
ν[5](cm·min^{-1})	$k_b = 2.74 \times 10^{-2} \nu + 1.96 \times 10^{-4}$ (R^2=0.999)	$N_0 = -5.34 \times 10^3 \nu + 4.55 \times 10^4$ (R^2=0.992)	$RE_{CIP} = 55.2\nu + 51.9$ (R^2=0.998)
IS_{NaCl}[6](mM)	$k_b = 4.86 \times 10^{-5} IS_{NaCl} + 5.72 \times 10^{-3}$ (R^2=0.543)	$N_0 = -4.70 \times 10^2 IS_{NaCl} + 4.44 \times 10^4$ (R^2=0.998)	$RE_{CIP} = 1.02\ IS_{NaCl} + 66.0$ (R^2=0.726)
IS_{CaCl2} (mM)	$k_b = -2.13 \times 10^{-4} IS_{CaCl2} + 6.34 \times 10^{-3}$ (R^2=0.671)	$N_0 = 1.75 \times 10^2 IS_{CaCl2} + 4.58 \times 10^4$ (R^2=0.925)	$RE_{CIP} = 8.27 \times 10^{-1}\ IS_{CaCl2} + 63.8$ (R^2=0.798)

[1]k_b is the rate constant (mg^{-1}·min^{-1}·L);
[2]N_0 is the adsorption capacity of GN (mg·L^{-1});
[3]RE_{CIP} is the mass recovery rate of CIP (%);
[4]P_{GN} represents the mass fraction of GN (%);
[5]ν represents flow velocity (cm·min^{-1});
[6]*IS* represents ionic strength (mM)

Table S5. The fitted equations of BDST parameters and mass recovery rate of NOR

Paremeter	k_b ($mg^{-1}\cdot min^{-1}\cdot L$)	N_0 ($mg\cdot L^{-1}$)	RE_{NOR} [1](%)
P_{GN} (%)	$k_b = -1.10 \times 10^{-2} P_{GN} + 7.30 \times 10^{-3}$ (R^2=0.173)	$N_0 = -1.67 \times 10^6 P_{GN} + 7.62 \times 10^4$ (R^2=0.800)	$RE_{NOR} = -7.44 \times 10^2 P_{GN} + 78.7$ (R^2=0.964)
ν($cm\cdot min^{-1}$)	$k_b = 4.02 \times 10^{-2} \nu - 1.24 \times 10^{-3}$ (R^2=0.999)	$N_0 = -9.77 \times 10^3 \nu + 2.39 \times 10^4$ (R^2=0.958)	$RE_{NOR} = 49.7\nu + 50.4$ (R^2=0.949)
IS_{NaCl}(mM)	$k_b = 2.03 \times 10^{-4} IS_{NaCl} + 7.45 \times 10^{-3}$ (R^2=0.755)	$N_0 = -1.87 \times 10^2 IS_{NaCl} + 2.14 \times 10^4$ (R^2=0.977)	$RE_{NOR} = 1.38\, IS_{NaCl} + 60.9$ (R^2=0.898)
IS_{CaCl2} (mM)	$k_b = 3.02 \times 10^{-5} IS_{CaCl2} + 5.88 \times 10^{-3}$ (R^2=0.165)	$N_0 = 5.42 \times 10^2 IS_{CaCl2} + 2.37 \times 10^4$ (R^2=0.283)	$RE_{NOR} = 1.70 IS_{CaCl2} + 59.2$ (R^2=0.976)

[1]RE_{NOR} is the mass recovery rate of NOR (%)

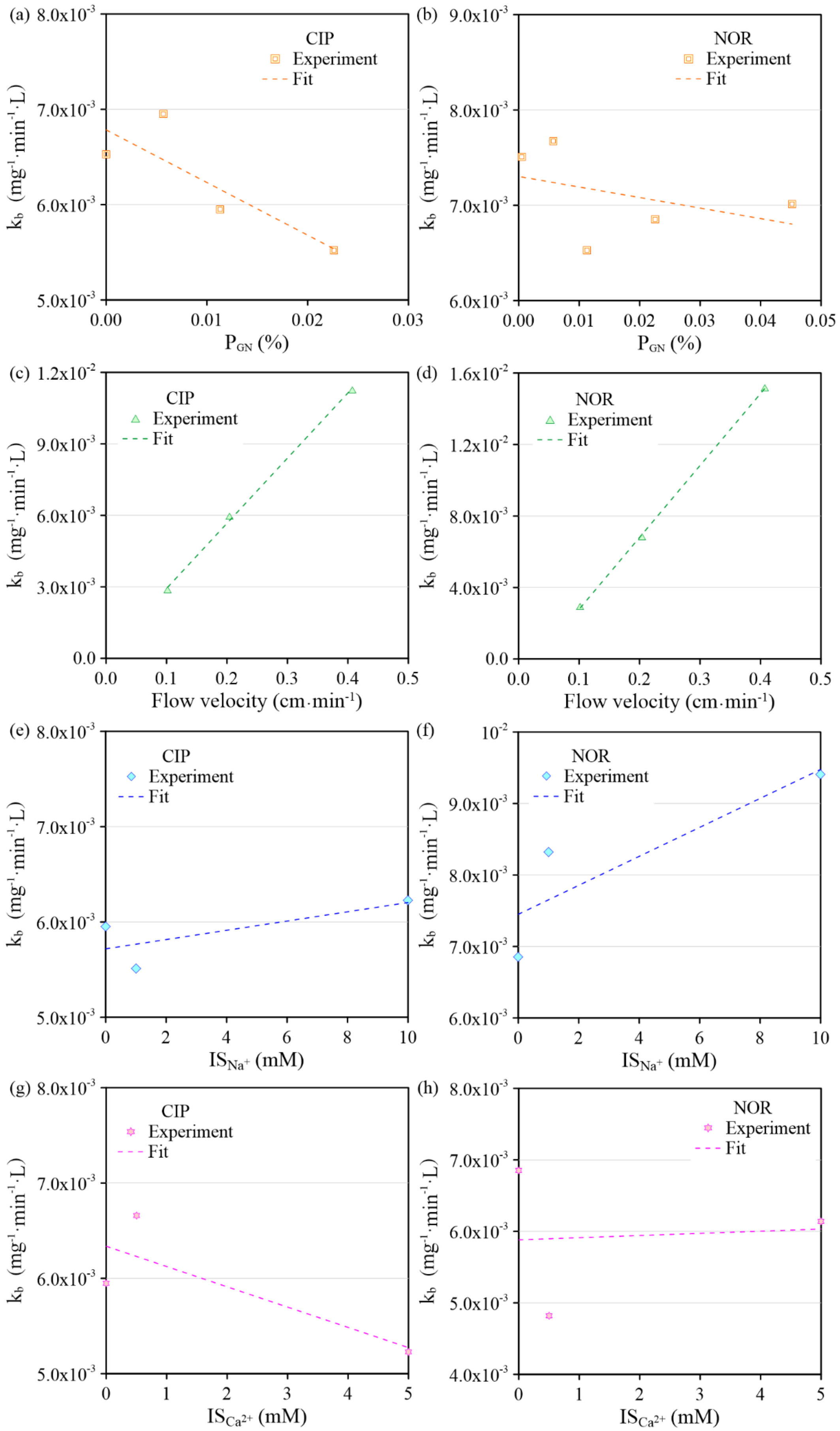

Figure S1. The value of k_b under different physicochemical conditions: (a) Variation of k_b with the mass fraction of GN for CIP; (b) Variation of k_b with the mass fraction of GN for NOR; (c) Variation of k_b with flow velocity for CIP; (d) Variation of k_b with flow velocity for NOR; (e) Variation of k_b with ionic strength (Na^+) for CIP; (f) Variation of k_b with ionic strength (Na^+) for NOR; (g) Variation of k_b with ionic strength (Ca^{2+}) for CIP; (h) Variation of k_b with ionic strength (Ca^{2+}) for NOR

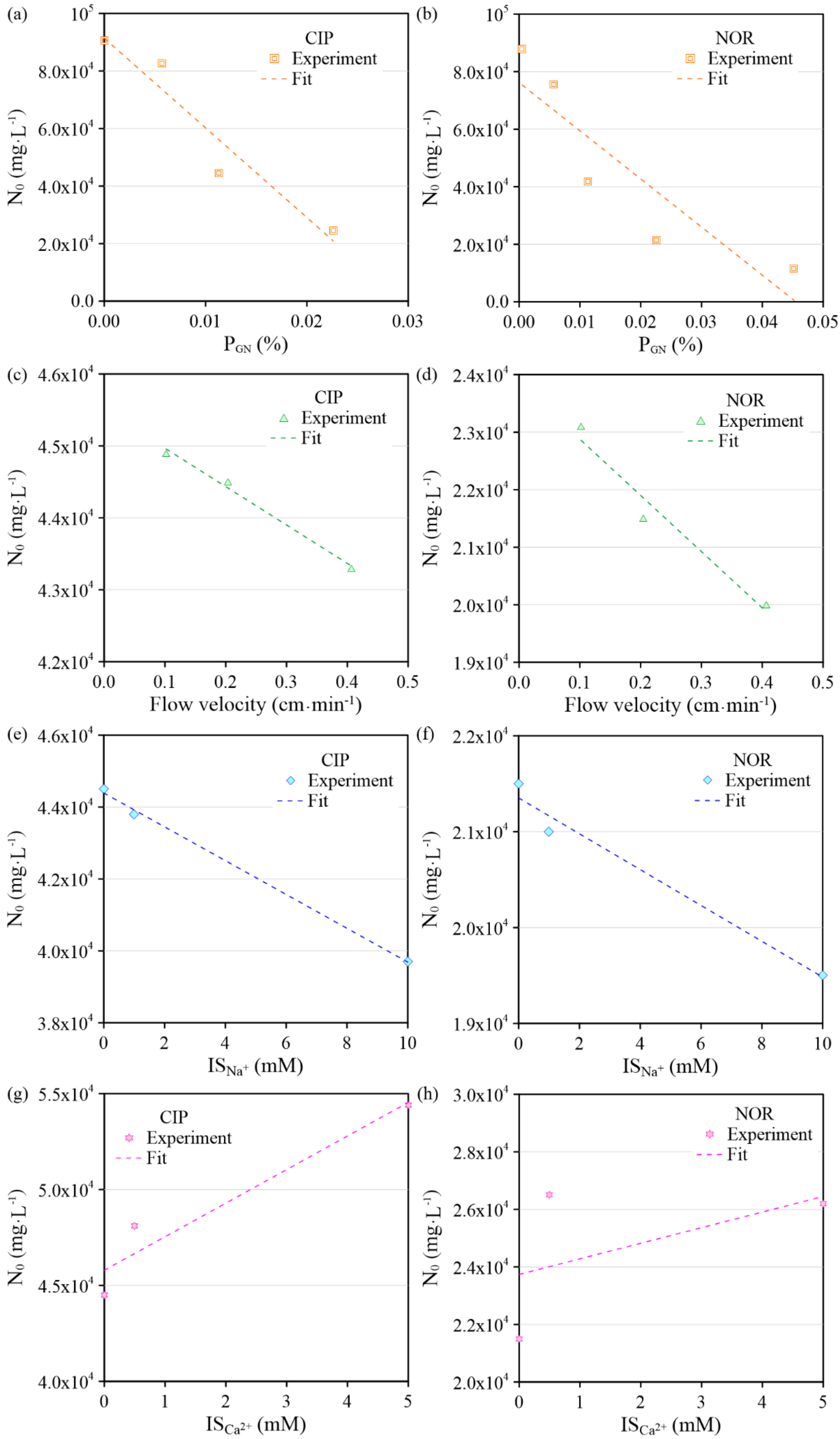

Figure S2. The value of N_0 under different physicochemical conditions: (a) Variation of N_0 with the mass fraction of GN for CIP; (b) Variation of N_0 with the mass fraction of GN for NOR; (c) Variation of N_0 with flow velocity for CIP; (d) Variation of N_0 with flow velocity for NOR; (e) Variation of N_0 with ionic strength (Na^+) for CIP; (f) Variation of N_0 with ionic strength (Na^+) for NOR; (g) Variation of N_0 with ionic strength (Ca^{2+}) for CIP; (h) Variation of N_0 with ionic strength (Ca^{2+}) for NOR

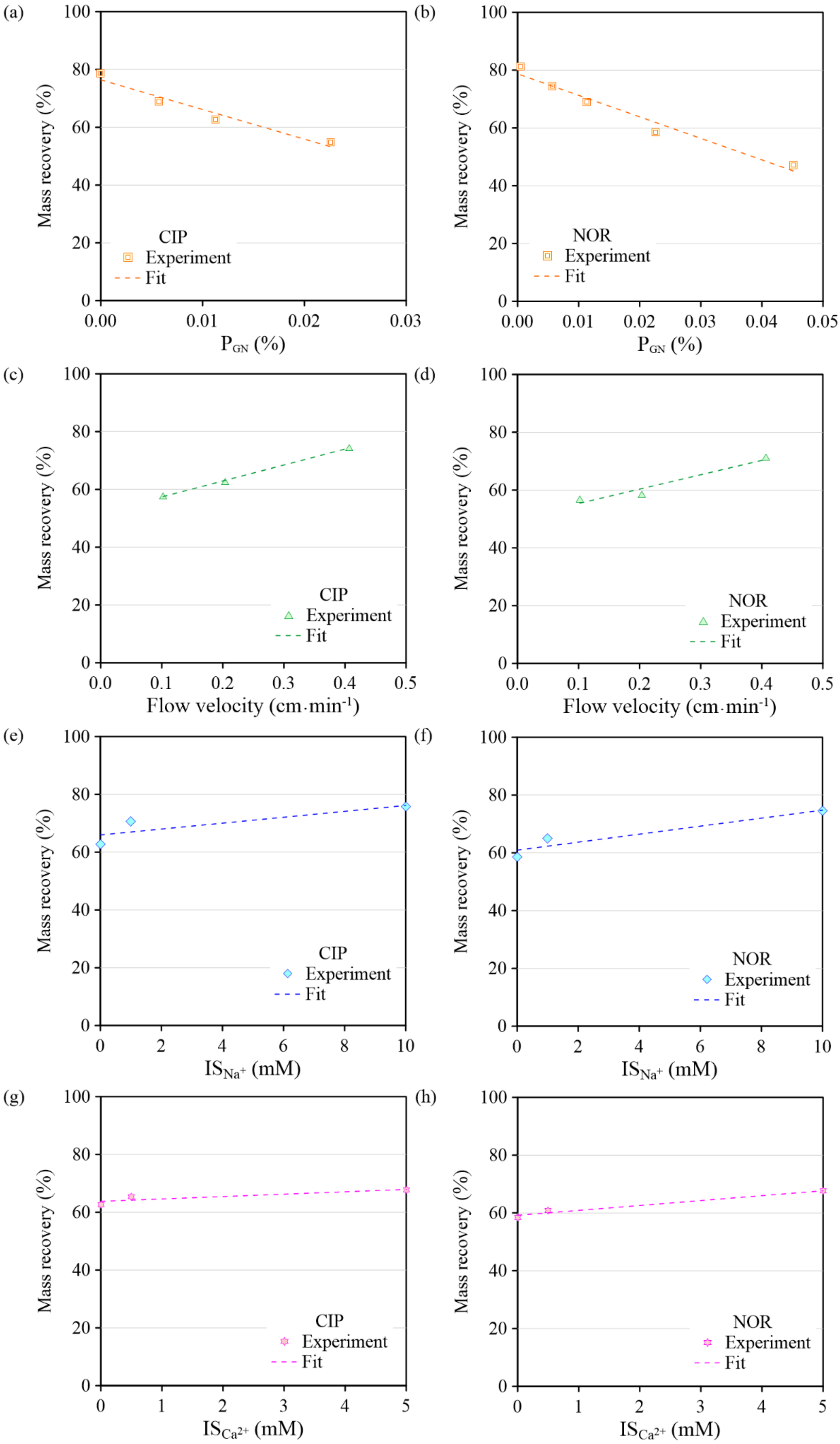

Figure S3. Mass recovery rate of CIP and NOR under different physicochemical conditions: (a) The change of mass recovery rate of CIP with the mass fraction of GN; (b) The change of mass recovery rate of NOR with the mass fraction of GN; (c) The change of mass recovery rate of CIP with flow velocity; (d) The change of mass recovery rate of NOR with flow velocity; (e) The change of mass recovery rate of CIP with ionic strength (Na^+); (f) The change of mass recovery rate of NOR with ionic strength (Na^+); (g) The change of mass recovery rate of CIP with ionic strength (Ca^{2+}); (h) The change of mass recovery rate of NOR with ionic strength (Ca^{2+})