Electronic Supplementary Information

Complex calcium carbonate/polymer microparticles as carriers for aminoglycoside antibiotics

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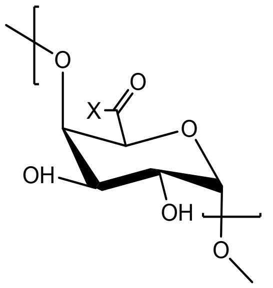
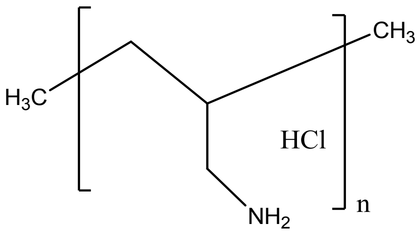
Abstract

Composite microparticles of $CaCO_3$ and two pectin samples (which differ by the functional group ratio) or corresponding nonstoichiometric polyelectrolyte complexes with different molar ratios (0.5, 0.9 and 1.2) are obtained, characterized and tested for loading and release of streptomycin (STR) and kanamycin (KAN) sulphate. The synthesized carriers were characterized before and after drug loading in terms of morphology (by SEM using secondary electron and energy selective backscattered electron detectors), porosity (by water sorption isotherms) and elemental composition (by elemental mapping using the energy dispersive X-Ray and FTIR spectroscopy). The kinetic of the release mechanism from microparticles was investigated using Higuchi and Korsmeyer-Peppas mathematical models.

Keywords: calcium carbonate, pectin, polyelectrolyte complexes, streptomycin, kanamycin

Scheme 1S. Chemical structure of polymers [pectins – PCTxx, and poly(allyamine hydrochloride) – PAH] and drugs [streptomycin (STR) and *kanamycin* (KAN)] used in this study



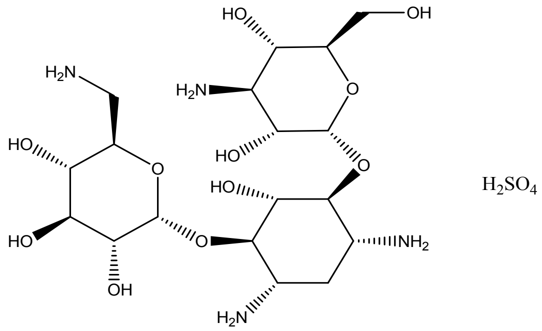


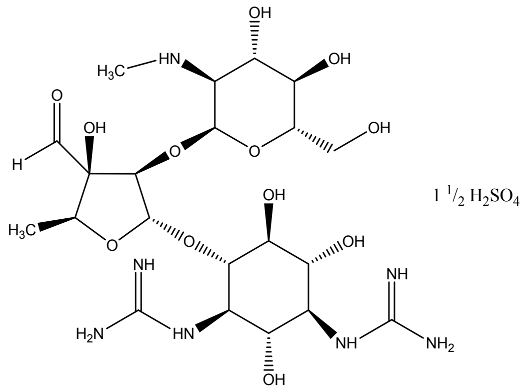
X = O^-, OMe, NH_2

PCT49: 49% O^-, 51% OMe, 0% NH_2

PAH

PCT53_A21: 53% O^-, 26% OMe, 21% NH_2





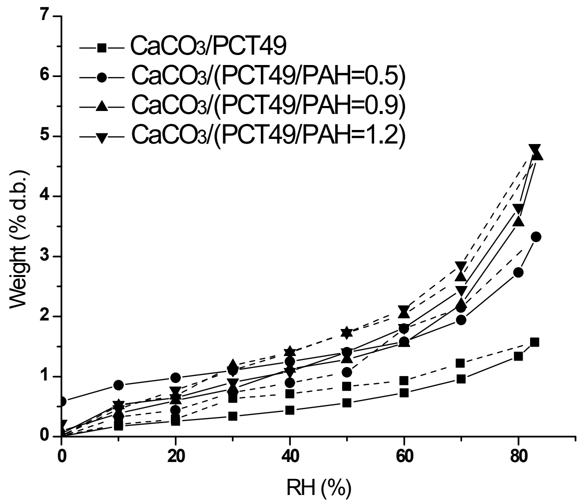
KAN

STR

Table 1S. Diffusion coefficients for pectin-$CaCO_3$ and NPEC-$CaCO_3$ composite microparticles, determined from sorption-desorption experimental data

Pectin type	NPEC n^+/n^-	10^{-5} K_1*, $M_t/M_\infty<0.5$	10^{-4} K_2*, $M_t/M_\infty>0.5$	*l* (cm)	D_1 (10^{-8} cm²/s)	D_2 (10^{-7} cm²/s)
PCT49	0	3.00	-5.26	0.1	5.89	5.33
	0.5	2.76	-6.88	0.1	5.41	6.98
	0.9	2.44	-6.33	0.1	4.79	6.41
	1.2	2.49	-6.99	0.1	4.90	7.09
PCT53_A21	0	3.71	-5.08	0.1	7.28	5.15
	0.5	2.94	-6.44	0.1	5.76	6.53
	0.9	5.18	-8.92	0.1	5.18	9.04
	1.2	2.06	-5.38	0.1	4.04	5.45

**K_1 is slope of linear regression between $(t-t_R)$ and $(M_t/M_\infty)^2$ for $(t-t_R)\geq 0$ and $(M_t/M_\infty)^2 < 0.2$ where t_R is time correlation (minus intercept/slope) for $M_t/M_\infty=0$; K_2 is slope of linear regression between t and $\ln(1-M_t/M_\infty)$ for $-1.2>\ln>-3.0$*



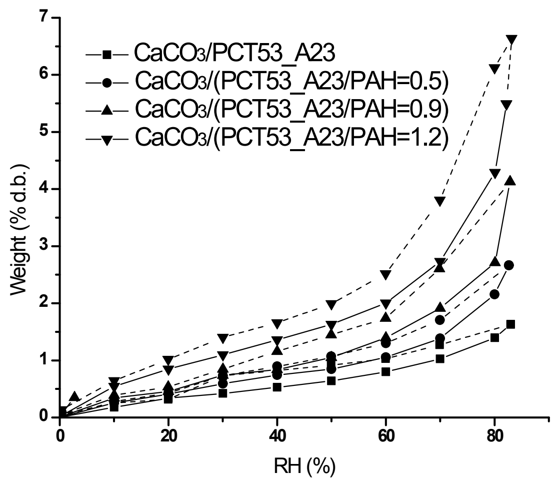


Figure 1S. Sorption/desorption isotherms as relative humidity (RH) *vs.* weight variation

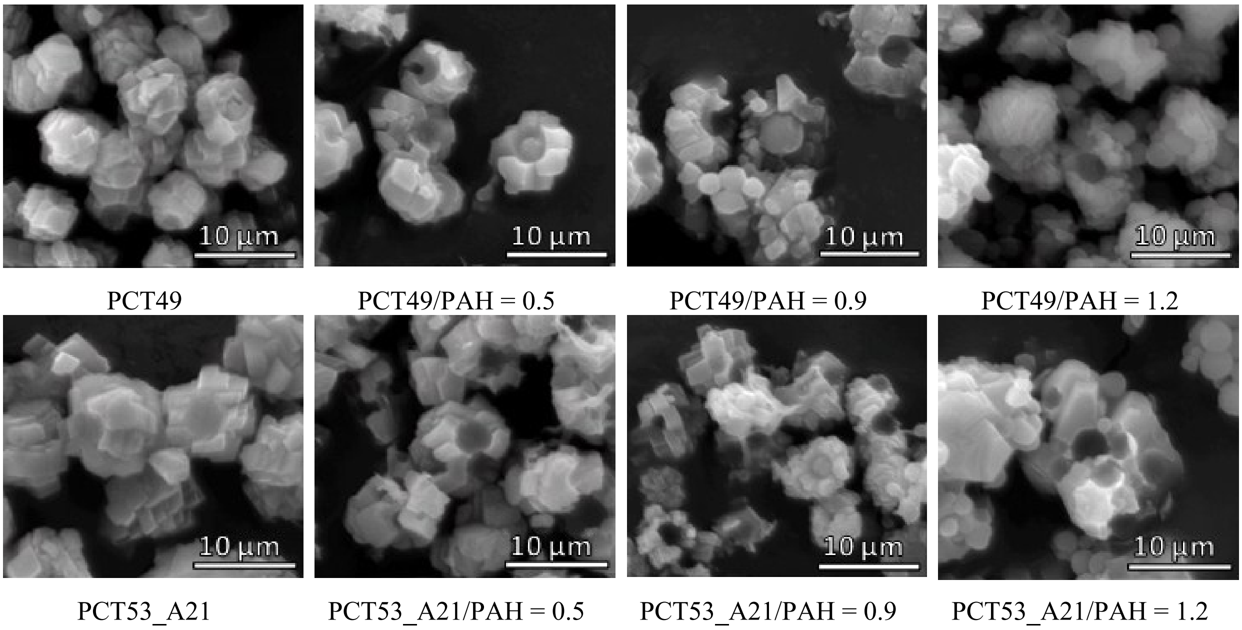


Figure 2S. SEM micrograph of pectin-$CaCO_3$ and NPEC-$CaCO_3$ microparticles after STR retention

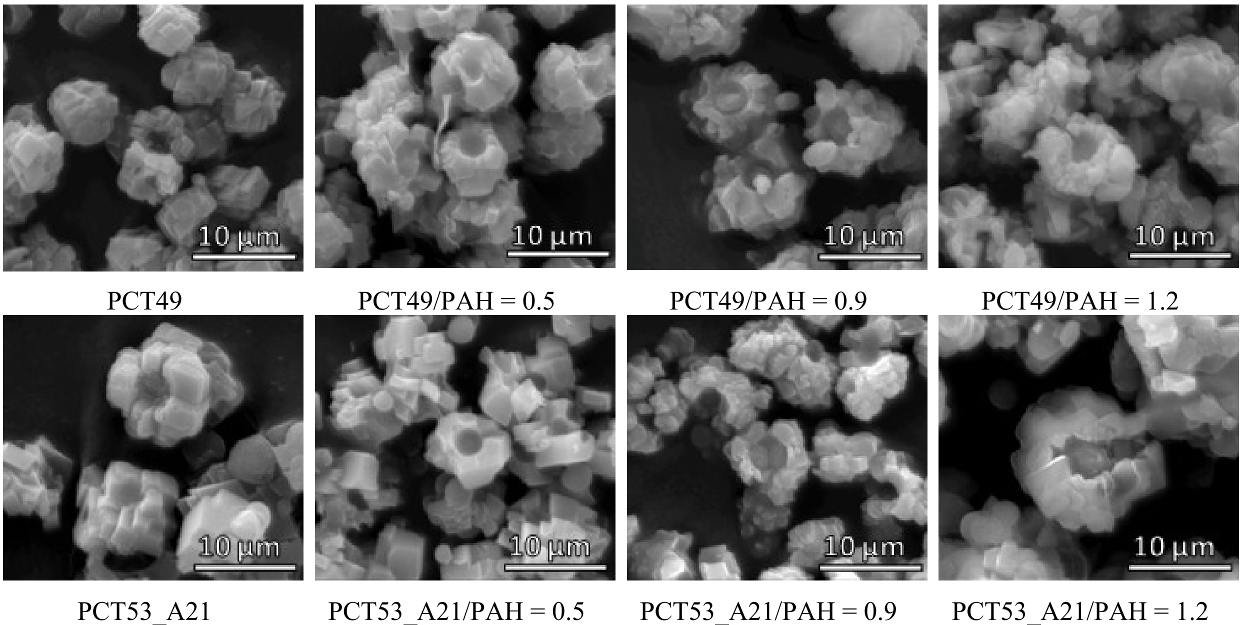


Figure 3S. SEM micrograph of pectin-$CaCO_3$ and NPEC-$CaCO_3$ microparticles after KAN retention

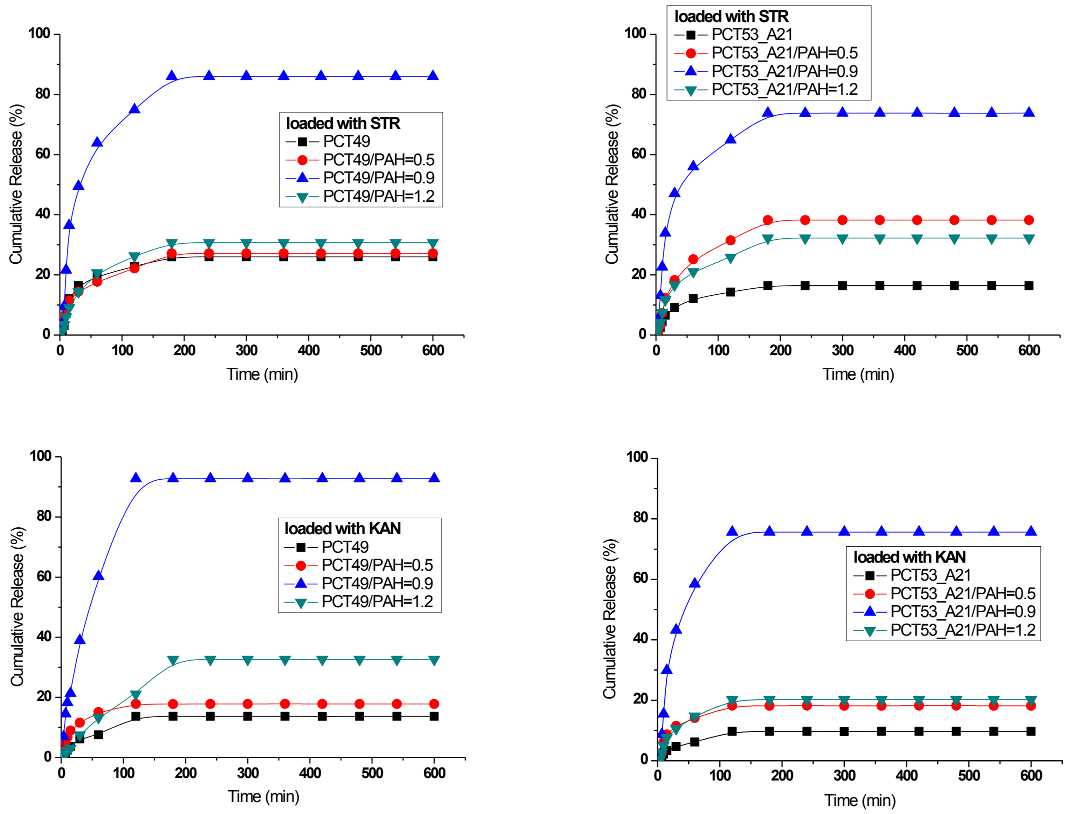


Figure 4S. STR and KAN *in-vitro* release

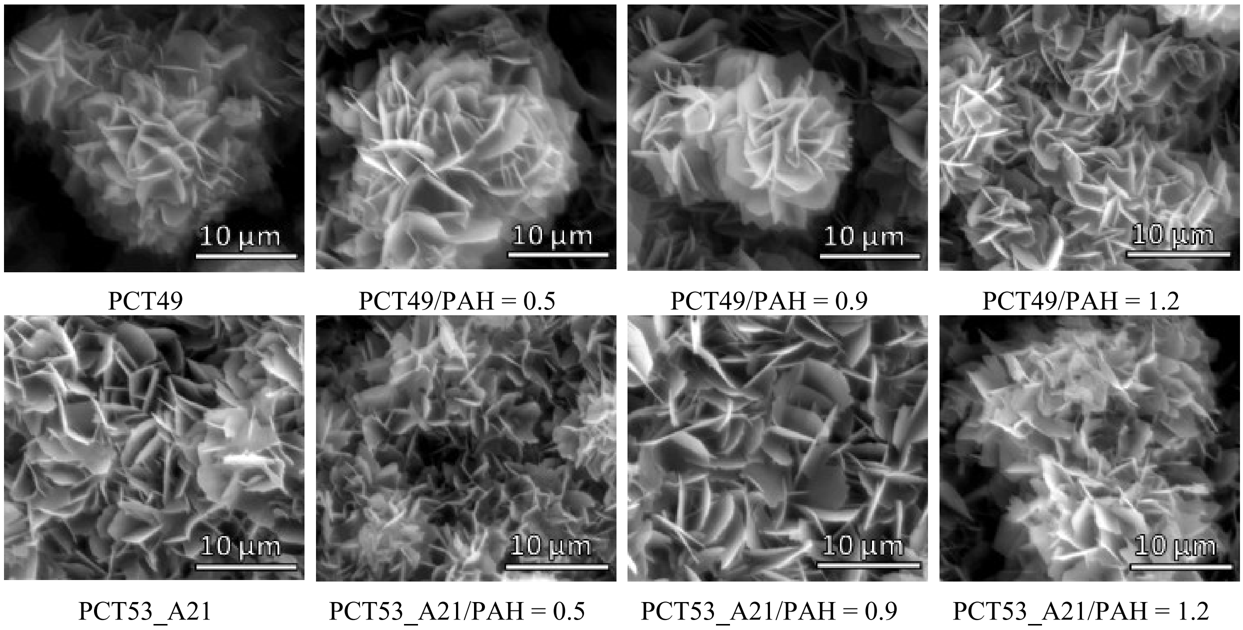


Figure 5S. SEM micrograph of composite microparticles after KAN release

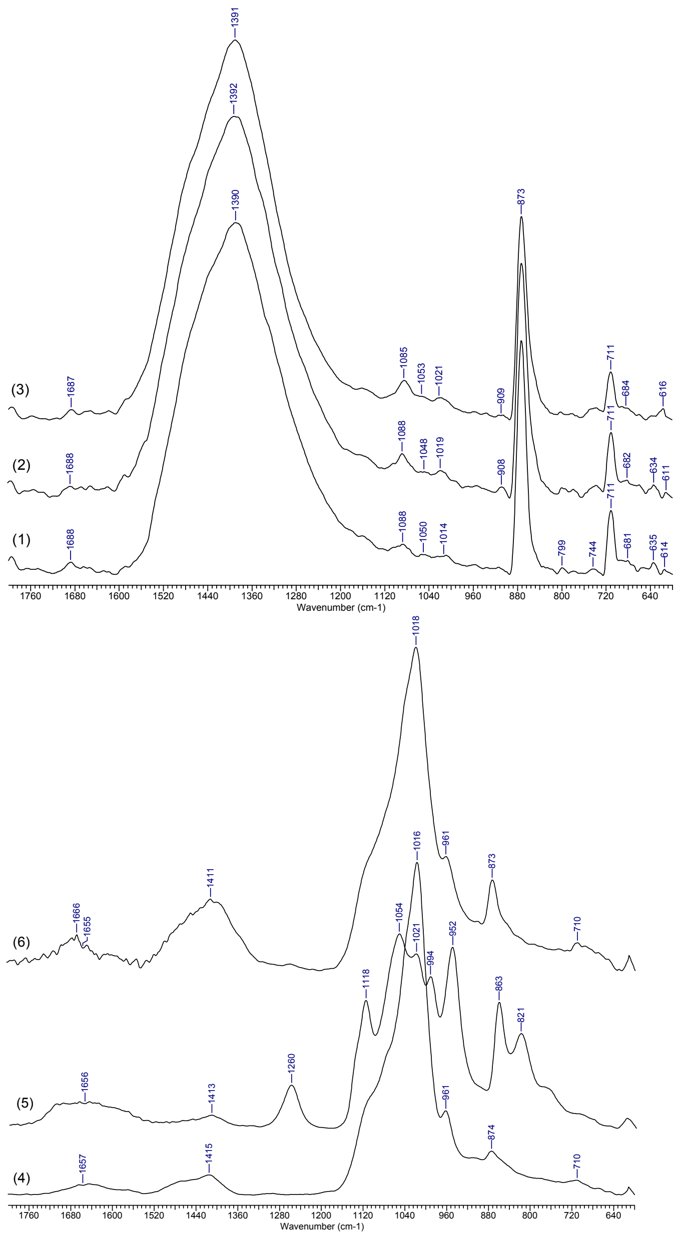


Figure 6S. FTIR spectra of STR loaded sample: (1) $CaCO_3$/(PCT49/PAH=0.5), (2) $CaCO_3$/(PCT49/PAH=0.9), (3) $CaCO_3$/(PCT49/PAH=1.2) and after STR release: (4) $CaCO_3$/(PCT49/PAH=0.5), (5) $CaCO_3$/(PCT49/PAH=0.9), (6) $CaCO_3$/(PCT49/PAH=1.2)

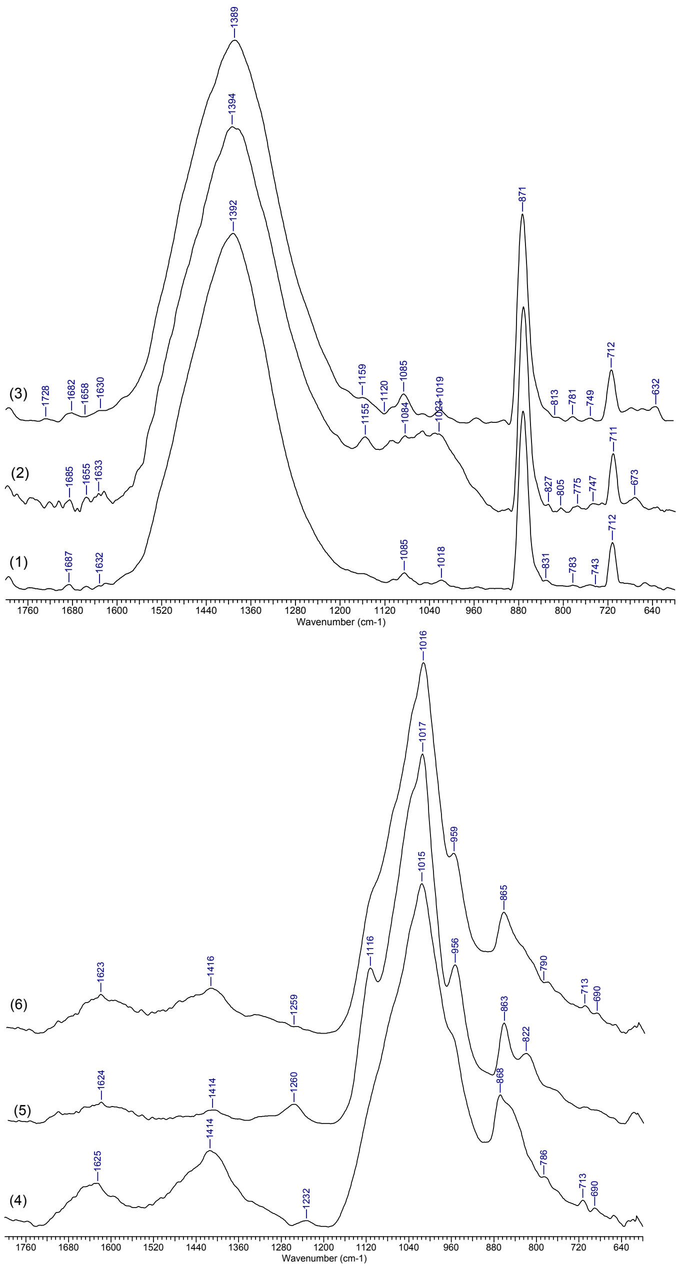


Figure 7S. FTIR spectra of KAN loaded sample: (1) $CaCO_3$/(PCT49/PAH=0.5), (2) $CaCO_3$/(PCT49/PAH=0.9), (3) $CaCO_3$/(PCT49/PAH=1.2) and after KAN release: (4) $CaCO_3$/(PCT49/PAH=0.5), (5) $CaCO_3$/(PCT49/PAH=0.9), (6) $CaCO_3$/(PCT49/PAH=1.2)

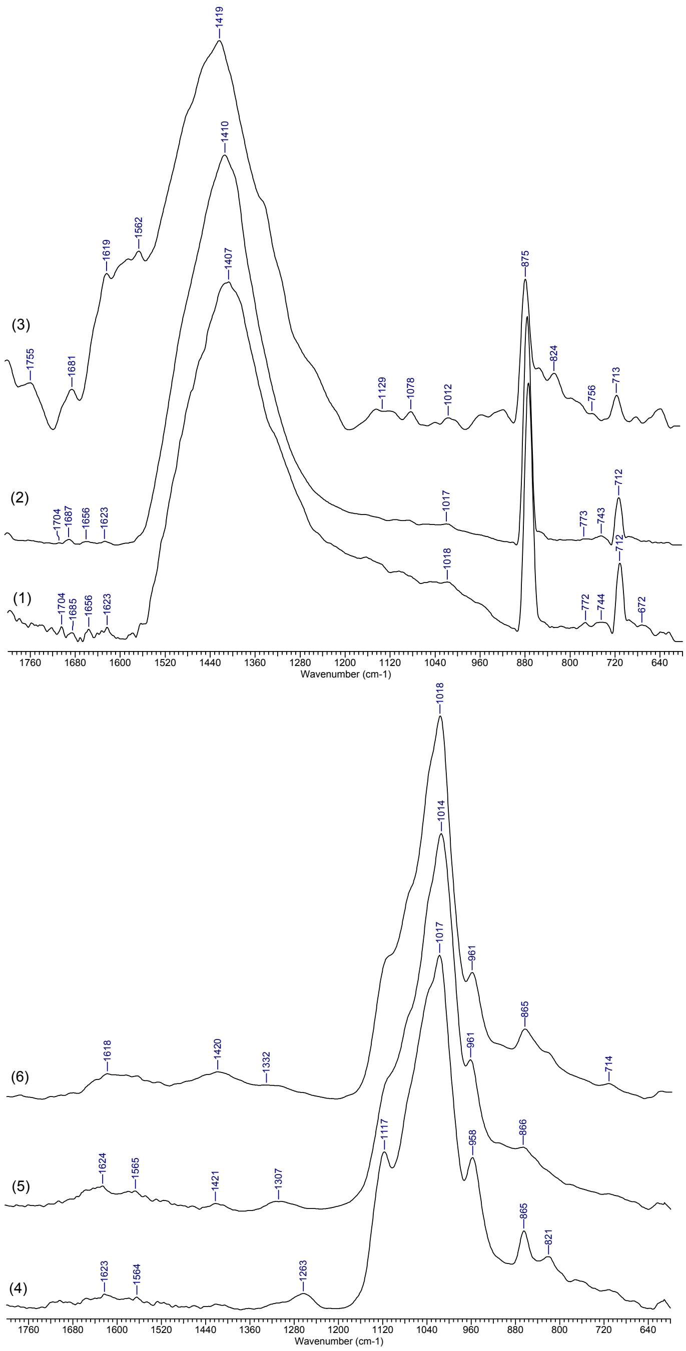


Figure 8S. FTIR spectra of STR loaded sample: (1) $CaCO_3$/(PCT53_A21/PAH=0.5), (2) $CaCO_3$/(PCT53_A21/PAH=0.9), (3) $CaCO_3$/(PCT53_A21/PAH=1.2) and after STR release: (4) $CaCO_3$/(PCT53_A21/PAH=0.5), (5) $CaCO_3$/(PCT53_A21/PAH=0.9), (6) $CaCO_3$/(PCT53_A21/PAH=1.2)

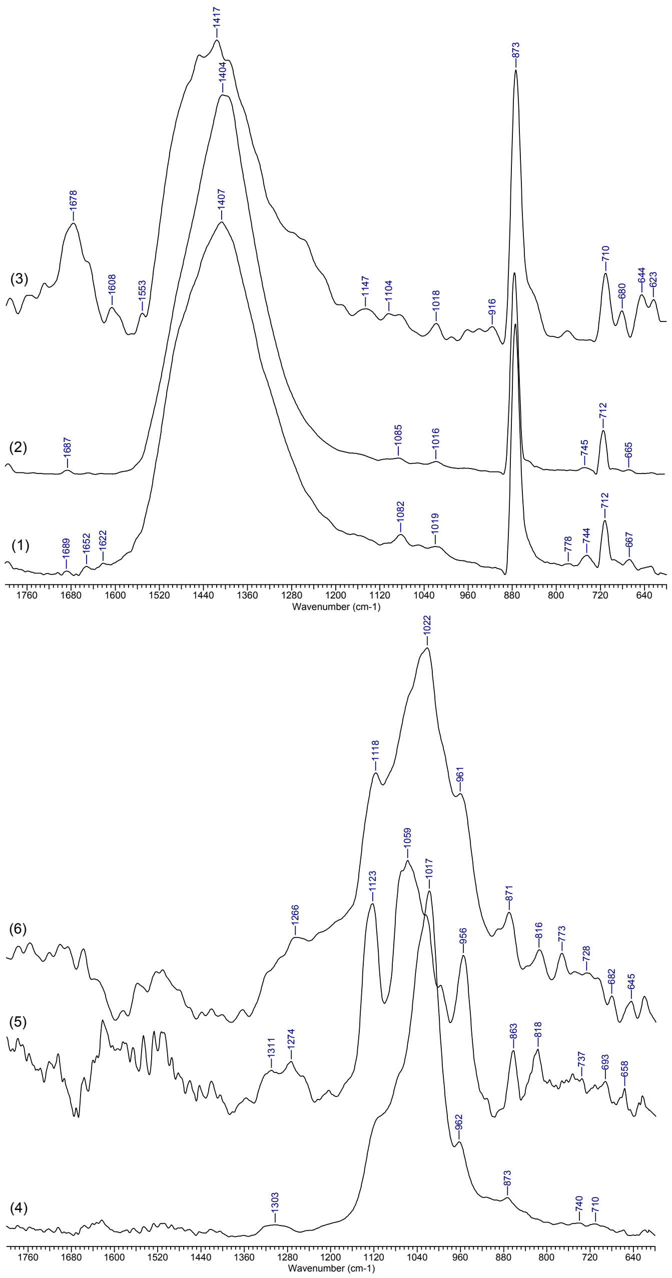


Figure 9S. FTIR spectra of KAN loaded sample: (1) $CaCO_3$/(PCT53_A21/PAH=0.5), (2) $CaCO_3$/(PCT53_A21/PAH=0.9), (3) $CaCO_3$/(PCT53_A21/PAH=1.2) and after KAN release: (4) $CaCO_3$/(PCT53_A21/PAH=0.5), (5) $CaCO_3$/(PCT53_A21/PAH=0.9), (6) $CaCO_3$/(PCT53_A21/PAH=1.2)

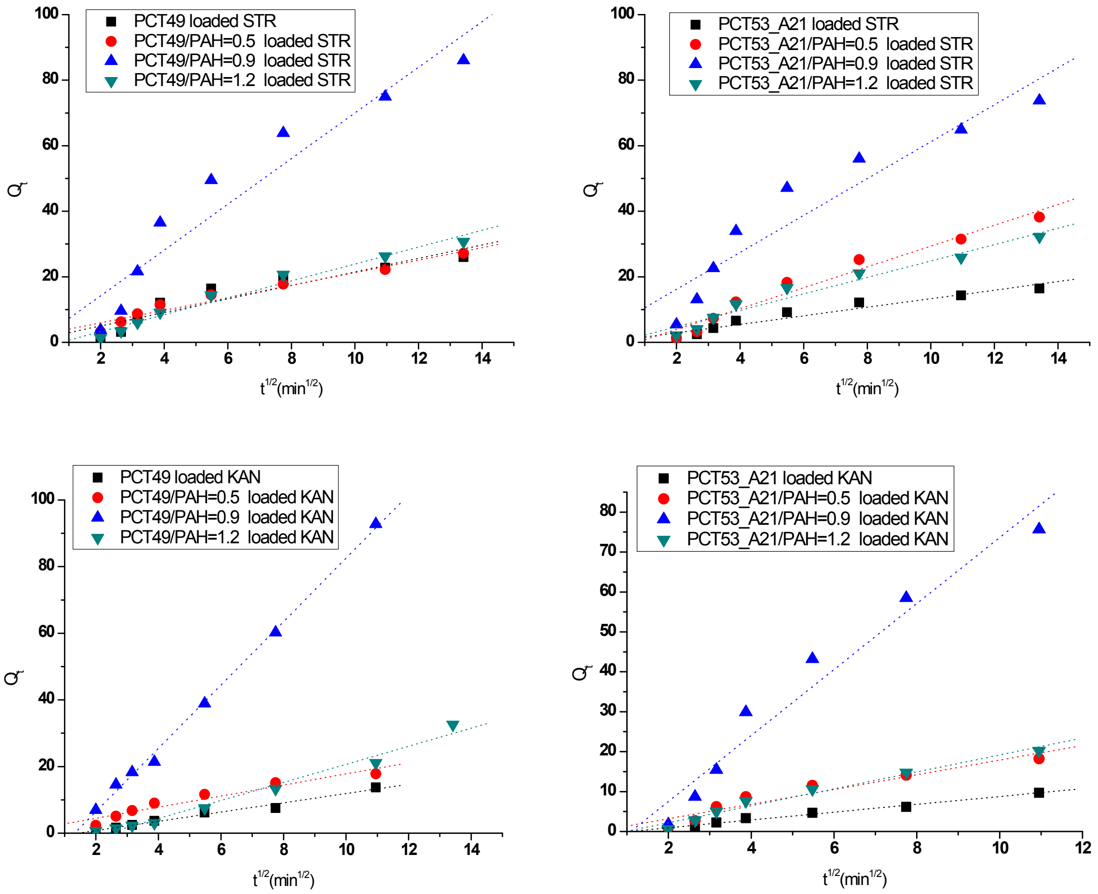


Figure 10S. Graphical representation of Higuchi equation

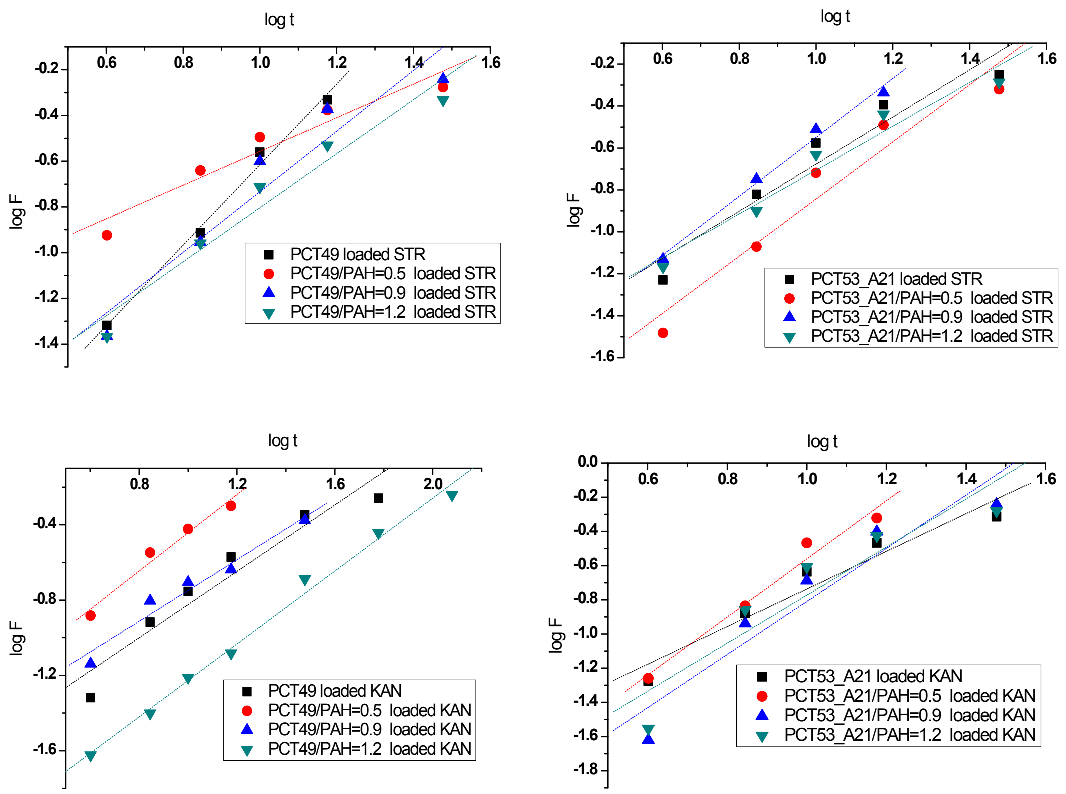


Figure 11S. Graphical representation of Korsmeyer-Peppas equation