Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Table S2. Mathematical models of kinetic dissolution rate used to simulate $CoFe_2O_4$ nanoparticles dissolution.

Kinetic model and linear forms of kinetic equations	Linear plot to determine k	k unit	Observation	Reference
Zero-order kinetic $[M]_t = -kt + [M]_0$	$[M]_t$ vs time	$M\ h^{-1}$	The rate of reaction will be independent of the concentration of reactants	1,2
First-order $In[M]_t = -kt + In[M]_0$	$ln[M]_t$ vs time	h^{-1}	The rate of reaction depends on the concentration of at least one reactant. Thus, the rate of reaction is proportional to the concentration of the reactant	1,2
Second-order $1/[M]_t = kt + 1/[M]_0$	1/[M] vs time	$M^{-1}\ h^{-1}$	The rate is proportional to the square of the concentration of one reactant (2A➔products). Also, a second-order reaction has a reaction rate that is proportional to the product of the concentrations of two reactants (A+B➔products)	1,2
Pseudo-first order $In([M]_0-[M]_t) = In[M]_t - k't$	$In([M]_0-[M]_t)$ vs time	h^{-1}	This rate of reaction occurs when one reacting material is present in great excess or is maintained at a constant concentration compared with the other substance	3
Pseudo-second order $t/[M]_t = 1/k_2[M]_s^2 + t/[M]_s$	$t/[M]_t$ vs time	$L\ mol^{-1}\ h$		4
One-half- order $[M]_t^{1/2} = -1/2kt + [M]_0^{1/2}$	$[M]_t^{1/2}$ vs time	$M^{1/2}\ h$	Fractional order reactions often indicate a chemical chain reaction or other complex reaction mechanisms	5
Three-half-order $1/[M]_t^{1/2} = 1/2kt + 1/[M]_0^{1/2}$	$1/[M]_t^{1/2}$vs time	$M^{-1/2}\ h$		5
Elovich $[M]_t = (1/\beta)\ In\ (\alpha\beta) + (1/\beta)\ Int$	$[M]_t$ vs In(time)	$M\ h^{-1}$	This model was originally developed to describe the kinetics of heterogeneous chemisorption of gases on solid surfaces, but it seems to describe several reaction mechanisms, including bulk and surface diffusion, activation and deactivation of catalytic surfaces	2
Higuchi model $Mt = kt^{1/2}$	The cumulative amount of drug release vs $t^{1/2}$	$M\ h^{1/2}$	Describe the drug dissolution from the matrix system Assumptions: • The matrix contains an initial drug concentration much higher than the solubility of the drug • The diffusion is unidirectional • The thickness of the dosage form is much larger than the size of the drug molecules	6

			• The swelling or dissolution of the matrix is negligible • The diffusivity of the drug is constant • The perfect sink conditions are attained in the release environment	
Hixson-Crowell model $W_0^{1/3} - W_t^{1/3}=k\ t$	$[W0-Wt]^{1/3}$ vs time	$M^{1/3}\ h^{-1}$	It assumes that the drug release is limited by dissolution velocity and not by diffusion	6
Korsmeyer-Peppas $(Mt/M\infty)=kt^n$	$(Mt/M\infty)$ vs t^n	h^{-n}	Is a semi-empirical model, and it establish the exponential relationship between the release and the time. The power-law model is useful for the study of drug release from polymeric systems when the release mechanism is not known or when more than one type of phenomenon of drug release is involved. Depending on the value of n that better adjust to the release profile of an active agent in a matrix system, it is possible to establish a classification, according to the type of observed behavior: Fickian model or Non-Fickian model	6,7
Baker-Lonsdale $3/2[1-(1-Mt/M\infty)^{2/3}]-(Mt/M\infty)=kt$	$(Mt/M\infty)$ vs time		Describes the drug-controlled release from a spherical matrix	7
Weibull Model $Log[-ln\ (M\infty/(M\infty-Mt)]= b\ log\ (t-T_i)-log\ a$	Log [M]t vs Log time		This model is a distribution function with the property to describe the phenomena and processes associated with a finite time. Take into account that there is not any kinetic fundament and could only describe, but does not adequately characterize, the dissolution kinetic properties of the drug. And there is not any single parameter related to the intrinsic dissolution rate of the drug	7

Notes: $[M]_0$, Concentration of the reactant at the time 0; $[M]_t$, the cumulative concentration of the compound release at the time t; $[M]_s$, the concentration of the compound release at the saturation concentration for the solute in liquid, W_0, the initial amount of reactant; W_t, the remaining amount of reactant at the time t; $(Mt/M\infty)$, the fraction of drug released at time t; n, it is the release exponent; $M\infty$, amount of dissolved reactant as a function of time; Ti, lag time measured as a result of dissolution process parameters, a scale the parameter that describes the time dependence; b, the shape of dissolution curve (b=1 indicates exponential curve, b=2 indicates sigmoid curve, b=3 indicates parabolic curve).

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