Supplemental file

Table S1 is provided for comparison between experimental data of overall mass transfer coefficient based on continuous phase and predicted values by the previous correlations for several mechanical extraction columns, i.e., pulse sieve plate column (PSC), pulse packed column (PPC), rotating disc contactor (RDC), Kühni and spray column. Average absolute relative deviation (AARD) is used to compare the results. As can be seen from Table S1, none of previous correlations are suitable to accurately determine the overall mass transfer coefficient in the horizontal-vertical pulsed packed column. However, deviation values represents the experimental data for overall mass transfer coefficient obtained in the horizontal-vertical pulse packed extraction column are roughly similar to those obtained in the other extraction columns (the last six equations).

Table S1- The AARE between the K_{oc} obtained by the previous correlation and experimental data

Researcher	Equation		AARD (%)	
			H	V
Lochiel and Calderbank [35]	$Sh_c = 0.7Re^{0.5}Sc_c^{1/3}$	High Reynolds number	420	513
Clift et al. [33]	$Sh_c = \frac{2}{\sqrt{\pi}}(Pe_c)^{1/2}$	High Reynolds number	732	802
Brauer et al. [29]	$Sh_c = 2 + \left[\frac{0.66}{1+Sc_c} + \frac{Sc_c}{2.4+Sc_c}\left(\frac{0.79}{Sc_c^{1/6}}\right)\right]\left(\frac{Pe_c^{1.7}}{1+Pe_c^{1.2}}\right)$	1<Re<1000	330	373
Clift et al. [33]	$Sh_c = 1 + 0.724Re^{0.48}Sc_c^{1/3}$	$100 < Re < 2000\,,\ Sc > 200$	410	493
Weber et al. [34]	$Sh_c = 2\left(\frac{Pe_c}{\pi}\right)^{1/2}\left[1 - \frac{1}{Re^{1/2}}\left(2.89 + 2.15\left(\frac{\mu_d}{\mu_c}\right)^{0.64}\right)\right]^{1/2}$	$\frac{\rho_d}{\rho_c} < 4;\ \frac{\mu_d}{\mu_c} < 4$	273	300
Seibert and Fair[32]	$Sh_c = 0.698\ Re^{0.5}Sc_c^{0.4}(1-\varphi)$		295	316
He et al. [30]	$K_{oc}a = 1.4296u_c^{0.6685}u_d^{0.2404}Af^{0.5536}$	$D_c = 0.05\ m$	98	113
Torab-mostaedi and safdari [9]	$Sh_{Oc} = -49.76 + 14.8\,\mathrm{Re}^{0.64}$	C to d direction, $10 < Re < 150$	54	71

Safari et al. [12]	$\frac{K_{oc} a d_{32}}{\rho_c u_{slip}} = 1.9 \times 10^{-8} \frac{Re^{1.78}}{(1-\varphi)^2} \left(\frac{Af}{u_{slip}}\right)^{0.09} \left(\frac{u_d}{u_c}\right)^{1.62}$		91	103
Asadollahzadeh et al.[16]	$Sh_{oc} = -12.2 + 8.56 Re^{0.514} (1-\varphi)$	C to d direction, $4.99 < Re < 23.96$	65	83
Torab-mostaedi et al. [19]	$Sh_{oc} = 12.34 + 0.116 Re^{1.389}$ $Sh_{oc} = 2.586 + 0.000217 Re^{4.86}$	$Re > 10$ $Re < 10$	89	105
Kumar and Hartland [31]	$\frac{Sh_c/(1-\varphi) - Sh_{c,rigid}}{Sh_{c,\infty} - Sh_c/(1-\varphi)} = 5.26 \times 10^{-2} Re^{\frac{1}{3} + 6.59 \times 10^{-2} Re^{\frac{1}{4}}} Sc_c^{1/3} \left(\frac{V_s \mu_c}{\sigma}\right)^{1/3} \frac{1}{1 + \big(\mu_{d/}}$ $Sh_d = 17.7 + \frac{3.19 \times 10^{-3} \left(Re Sc_d^{1/3}\right)^{1.7}}{1 + 1.43 \times 10^{-2} \left(Re Sc_d^{1/3}\right)^{0.7}} \left(\frac{\rho_d}{\rho_c}\right)^{2/3} \frac{1}{1 + (\mu_d/\mu_c)^{2/3}} \Big[1 + 4.33 \Big\{\frac{\varepsilon_D}{g} \Big($ $\varepsilon_D = \frac{2\pi^2 (1-\alpha^2)}{3 h C_D^2 \alpha^2} A f^3 \quad C_D = 0.6$ $Sh_{c,rigid} = 2.43 + 0.775 Re^{1/2} Sc_c^{1/3} + 0.0103 Re Sc_c^{1/3}$ $Sh_{c,\infty} = 50 + \frac{2}{\sqrt{\pi}} (Pe_c)^{1/2}$		73	84