Supplementary material to

Reciprocating plate column – fundamental research and application in Serbia from 1970 to 2020

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Table S-1. Types of RPCs [1]

Plate type	Reciprocating element	Characteristics	Country
Karr (KRPC)	Plates with large openings (open type)	Column diameter up to 1.7 m Large fractional free plate surface (50-60 %) Large plate opening diameter (10-16 mm) Plate modification – with a central opening (Baird type) Inserted buffers along the column of larger diameter reduce the radial flow non-uniformity. Operating mode: homogeneous	USA, Canada, Western Europe, India, Serbia
Prochazka (PRPC)	Plates with downcomers or segmental passages	Column diameter up to 1.2 m Small fractional free plate surface (4-30 %) Small plate opening diameter (2-5 mm) With a drain in the form of a pipe or a segmental passage in the form of a cut-off part of the plate (free surface fraction of 10-25 %) Movement of plats: all in the same phase or every other with a phase shift of 180° Operating mode: segregated and homogeneous	Czech Republic, Canada
Tojo and Miyanami (VDC)	Vibrating discs	Discs without perforations The fractional free plate surface depends on the disk diameter-to-column diameter ratio (4-0.78 %) Static buffers between every two disks	Japan
Karpačeva and Gorodetskiy (KRIMZ, GIAP)	Plates with rectangular openings	Column diameter up to 1.5 m, height up to 11 m Fractional-free plate surface about 45 % Rectangular openings with bent ends that divert fluid flow radially to reduce axial mixing Plates without (KRIMZ) or with a drain (GIAP)	Former USSR

[a]GIAP – the plate with rectangular openings with a drain, KRIMZ – the plate with rectangular openings without a drain, KRPC – the Karr type RPC, PRPC – the Prochazka type RPC, and VDC – the vibrating disc column.

Table S-2. Overview of previous research on RPCs in Serbia (adapted according to [1])

System	Phase flow	D_c / cm	l_c / m	n_p	h / cm	d_o / cm	ε	A / mm	f / Hz	u_g / cm s^{-1}	Subject[a]	Ref.
Water	-	2.54		18			0.51				Δp, P	[2]
Water-toluene, water-*n*-butanol	Batch	2.54	2.11	78	2.54	0.8	0.51	5-19.6	0.5-3.5	-	Δp, P	[3]
Water-toluene	-	2.54	2.71	18	2.54	ND	0.51	20.5	0.275-2	-	Δp	[4]
Water, air-sulfite solution	↑↓	2.54	2.14	65	2.6	0.8/0.6	0.51	0.65-2	0.483-6.18	0.8-3.2	D_l, ε_g, a	[5]
Air-water	↑↓	2.54	2.14	32 64	2.54 5.08	0.8/0.6	0.51	0.65-1.5	1.83-6	0.8; 2.9	D_l,	[6]
Water, air-sucrose solution	↑↓	2.54	2	33 65	2.54	0.7/0.5 0.8/0.6	0.41 0.51	<10 and <20	<10	< 5	Δp. P, ε_g, k_la, a	[7]

System	Phase flow	D_c / cm	l_c / m	n_p	h / cm	d_o / cm	ε	A / mm	f / Hz	u_g / cm s^{-1}	Subject[a]	Ref.
Water, air-sucrose, sulfate, mixtures of sucrose, fructose, and dextran	↑↓	2.54	2.14	32 64	2.54 5.08	0.8/0.6	0.51	0.65–1.5	1.83–6	0.275 to 1.1	k_la, dextran sucrase production	[8]
Water, air-sucrose, air-water	Batch	2.54	2	65 33	2.5 5.0	0.7/0.5	0.41	1–10	1–10	0.275 to 2.75	Δp, P, ε_g	[9]
Air-water	↑↓	2.54	2	33 65	5.0 2.5	0.7/0.5	0.41	1–10	1–10		ε_g	[10]
Water, air-solutions of sucrose, sulfate, and mixtures of sucrose, fructose, and dextran	↑↓	2.54	2	65 33	5.08 2.54	0.8/0.6 0.7/0.5	0.51 0.41	<20	<6.2	<5	k_la	[11]
Water, air, N_2, O_2-sucrose and sulfite solutions	Batch or ↑↓	2.54	2	65 33	5.08 2.54	0.8/0.6	0.51	<20	<6.2	<5	a	[12]
Air-water	↑↓	2.54	2	65 32	2.54 5.08	0.8/0.6	0.51	0–20	0–6.25	0.8–3.1	ε_g	[13]
Water, air-sucrose solution, fermentation medium	↑↓	2.54	2	65 33	2.54 5.08	0.8/0.6 0.7/0.5	0.51 0.41	-	-	-	k_la, dextran sucrase production	[14]
Air-water-solid	↑↓	2.54	2	65	2.54	0.8	0.51	17	0–6.4	0.5–12.8	ε_g, d_b	[15]
Air-water	Batch	2.54	2	65	2.54	0.8/0.6	0.51	13-23.5	1–7.2	0.4–7.5	Δp, P, ε_g	[16, 17]
Water, butanol (0.5 %), glycerol (69 %, 64 %), sulfite (0.8 mol dm^{-3}) and CMC (1 and 2 %) solutions; 2-phase (gas-liquid; liquid-solid) and 3-phase systems	Batch	2.54 9.2	1.836 1.05	65 15	2.54 5	0.8 0.8	0.51 0.454	2.35 2.35	2–6 2–6	0.5–1.5 0.5–1.5	Δp, P, ε_g, d_b, k_la, a	[18-20]
Water, air-water, air-water-solid, air-CMC, air-CMC solution (1 %)-solid solution (1 %)-solid	Batch	9.2	1.05	15	5	0.8	0.263 0.319 0.454	2.35	2–6	0.5–1.5	Δp, P, ε_g, k_la, a	[21-26]
CMC solution	Batch	9.2	1.05	15	5	0.8	0.454	2.35	2–5.5	0.5–1.5	ε_g	[27-30]
Air-water-solid	↑↓	2.54 9.2	1.836 0.856	65 15	2.54 5.0	0.8 0.8	0.51 0.454	2.35;1 2.35;1	2–4.5 2–4.5	0–1.48 0–1.88	D_l, ε_g, alcoholic fermentation	[31-37]
Air-water, air-water-solid	↑↓	16.6	0.97	15	5	0.78	0.466	2.35	2–6	0.5–1.5	Δp, P, ε_g, k_la	[31-37]
Air-CMC solution (0.5 - 1.5 %)-solid	Batch	9.2	1.05	15	5	0.8/0.6	0,454	2.35	2-5,5	0.5–1.5	ε_g	[38-43]
Methanol-oil, methanol-KOH-oil	↑↑	2.54	2.0	63	2.54	0.8/0.6	0.51	1.0 2.35	2-5	-	Δp, P, d_b, a, biodiesel production	[44]
Methanol-KOH-oil	↑↑	2.54	2.0	63	2.54	0.8/0.6	0.51	1.0	2-4	-		[45]
		16.6	1.53	15	5	0.8	0.466	2.35	2	-		
Methanol-oil, methanol-KOH-oil	↑↑	2.54	2.0	63	2.54	0.8/0.6	0.51	1.0	2.0	-	d_b, biodiesel production	[46]
Methanol-KOH-waste lard	↑↑	2.54	2.0	63	2.54	0.8/0.6	0.51	1.0	2.0	-	Kinetic modeling of biodiesel production	[47]

[a] a – specific interfacial area, d_b, – bubble/drop size, D_l, - axial dispersion coefficient, k_l – liquid mass transfer coefficient, k_la – volumetric mass transfer coefficient, Δp – pressure variation at the column bottom, P – power consumption, ε_d – dispersed phase (methanol) holdup, and ε_g – gas holdup.

Table S-3. Worldwide applications of RPCs (adapted according to [1])

Plate type[a]	Application	Reference
KRPC	Copper extraction	[47]
	Lysine biosynthesis	[48]
	Treatment of wastewater	[49]
	Extraction of the product from the fermentation liquid	[50]
	Penicillin extraction	[51]
	Biosynthesis of dextransucrase	[6,3]
	Production of antibiotics, ethanol, and citric acid	[52]
	Fermentation processes	[53]
	Fermentation of pullulan	[54]
	Ester saponification reaction	[55]
	Rare earth separation and recovery	[56]
	Extraction of phenol from water	[57-59]
	Caffeine extraction	[60]
	Alcoholic fermentation with immobilized yeast cells	[33]
	Biodiesel production	[43-46]
	Extraction of natural alkaloids	[61]
PRPC	Production of ephedrine and erythromycin Extraction of phenol and nitro-aromatic derivatives from wastewater	Cited according to [62]
KRIMZ, GIAP	Caprolactam extraction with organic solvents Extraction of cyclohexanone and cyclohexanol with benzene	Cited according to [62]

[a]GIAP – the plate with rectangular openings with a drain, KRIMZ – the plate with rectangular openings without a drain, KRPC – the Karr type plate, and PRPC – the Prochazka type plate.

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