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Letter to the Editor

Comment on "Pressure drop and flow regime in cocurrent gas–liquid upflow through packed beds" [Chem. Eng. J. 88 (2002) 233–243]

Sir,

Based on a dataset for frictional pressure drops in gas–liquid cocurrent upflow packed bubble column reactors, the authors [1] developed in their paper a set of three pressure drop correlations each being valid for a particular flow pattern that can be discriminated from a flow pattern diagram proposed therein. The claim quoted from their paper "*. . . This present correlations are more accurate than those previously reported*" [1] is perhaps enthusiastic and insufficiently backed up. We believe such an enthusiasm could be moderated considering the comments and results to follow.

1. The proposed set of correlation equations (9)–(11) [1] is not fully predictive because a priori knowledge of the bulk density, and likely also the liquid hold-up, is required for calculating the pressure drop. It is unclear however from the paper how the bulk density was computed. Without procurement of accurate liquid hold-up values, this set of correlations cannot be used if one's aim is an evaluation of pressure drop.
2. In our previous work [2] (cited as Ref. [20] in [1]), a more *general* correlation was set using an extensive database for frictional pressure drops for the same type of reactors. It would have been very instructive if the authors did test it on their own data (Fortran source + Excel worksheet of the correlation are downloadable from the net: http://www.gch.ulaval.ca/flarachi). For completeness, it would have been very beneficial to the Chem. Eng. J. readers that a discussion of their Table 4 would have included such a comparison.
3. Therefore, the generalisation capability of the set of pressure drop correlations presented in [1] is assessed on our own extended database. With the exception of the PERC and Ref. [1] pressure drop data, our database consists of the most exhaustive compilation of the literature on the subject traced back to the 1960s, i.e., 3689

Table 1
Summary of statistical tests of literature pressure drop correlations for upflow packed beds[a]

Correlations' sources	No. of data	BF	DBF	PF	All data
		1352	1168	1169	3689
Murugesan and Sivakumar [1]	AARD[b] (%)	170	92.7	91.8	120.7
	σ [c](%)	235	20.0	25.4	–
Larachi et al. [2]	AARD (%)	38.8	30.2	64.6	44.3
	σ (%)	41.3	57.6	127	83.6
Khan et al. [3]	AARD (%)	80.6	–	129	–
	σ (%)	21.3	–	232	–
Turpin and Huntington [4]	AARD (%)		–		78.4
	σ (%)				104.0
Yang et al. [5]	AARD (%)		–		62.0
	σ (%)				118.5
Larachi et al. [6]	AARD (%)		–		62.7
	σ (%)				284

[a] BF: bubble flow; DBF: dispersed bubble flow; PF: pulse flow. Frictional pressure drop database built using the literature data in Refs. [3–32].

[b] $\text{AARD} = (1/N)\sum_1^N |1 - ([\Delta P/Z]^{\text{calc}}_{\text{fric},i}/[\Delta P/Z]^{\text{meas}}_{\text{fric},i})|$, where N is the number of data points and $[\Delta P/Z]_{\text{fric}}$ the frictional pressure drop (Pa/m).

[c] $\sigma = \sqrt{(1/(N-1))\sum_1^N (|1 - ([\Delta P/Z]^{\text{calc}}_{\text{fric},i}/[\Delta P/Z]^{\text{meas}}_{\text{fric},i})| - \text{AARD})^2}$, where N is the number of data points and $[\Delta P/Z]_{\text{fric}}$ the frictional pressure drop (Pa/m).

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measurements from 30 sources [3–32]. Eqs. (9)–(11) have been implemented and tested along with other popular literature correlations after the flow pattern split has been operated by means of Eqs. (2)–(7). For the estimation of liquid hold-up, use was made of the general correlation of Bensetiti et al. [33] to yield the bulk density as defined for instance in [31]. Table 1 is a summary of the statistical figures of merit for six correlations, assessed in terms of an absolute average relative deviation (AARD) and the standard deviation σ around AARD. Though a much broader database is used here, testing the literature correlations [2–6] reveals levels of accuracy comparable to those quoted in the authors' own work, Table 4 [1]. However, if the accuracy of the authors' correlations [1] is good for the particular dataset based on which they were fitted (Table 4 [1]), the same cannot be said when these correlations are confronted to a broader set of experiments.

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