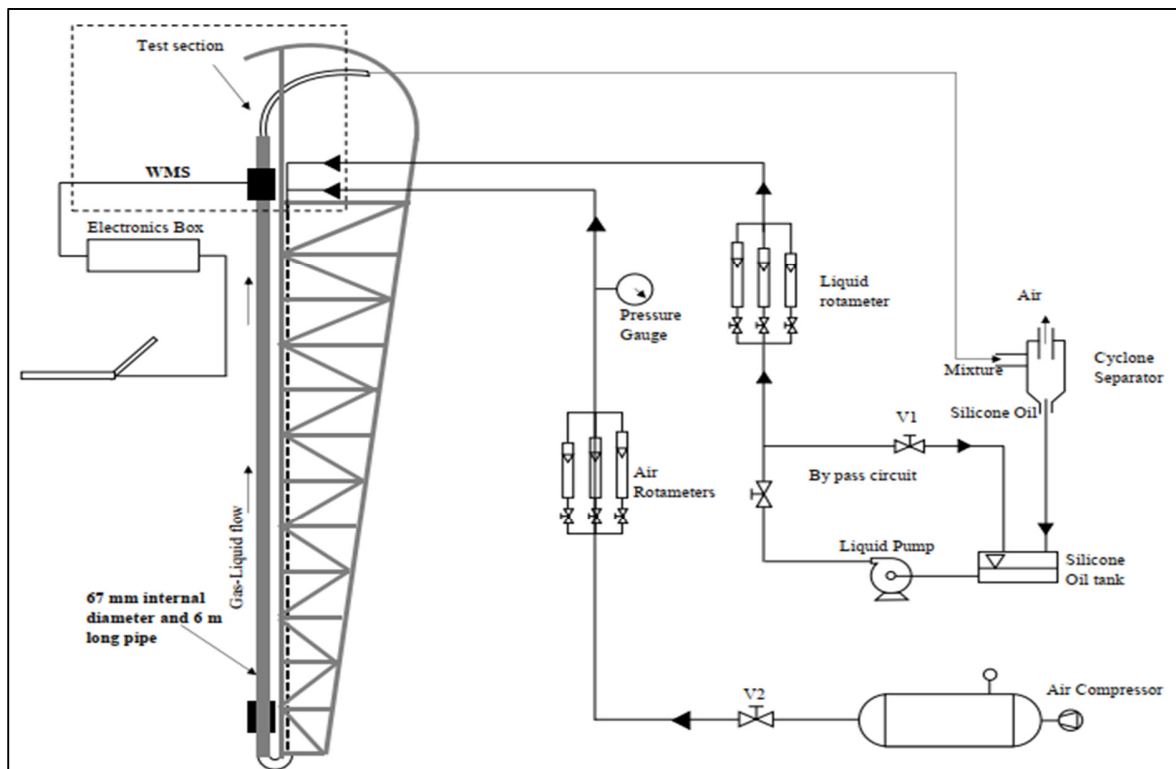
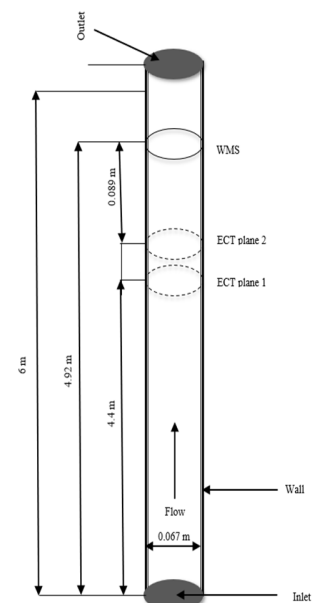


(a)



(b)



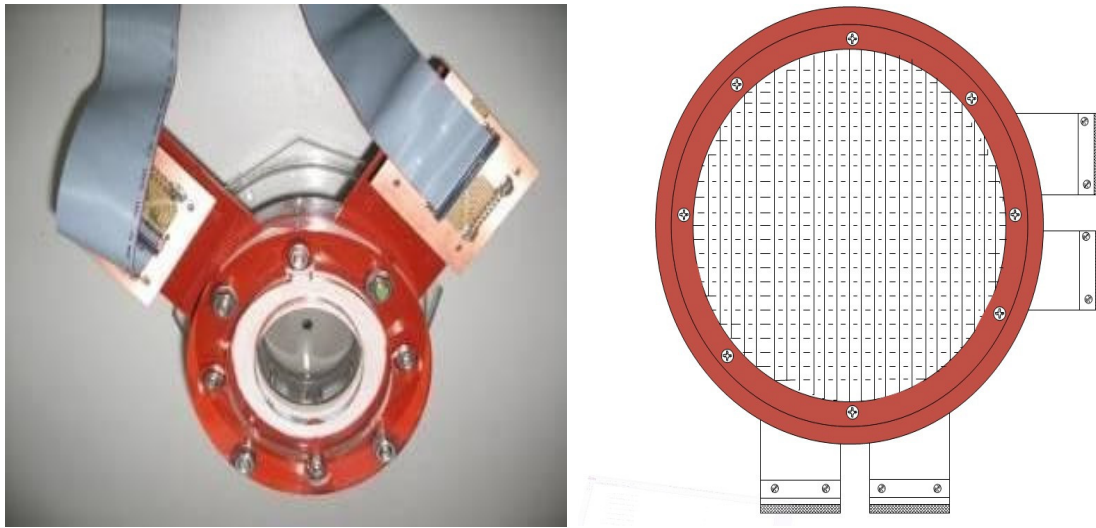


Figure S1 Experimental flow loop facility (a) Schematic Flow Process (b) Laboratory Experimental Inclined Rig (c) Wire Mesh Sensor

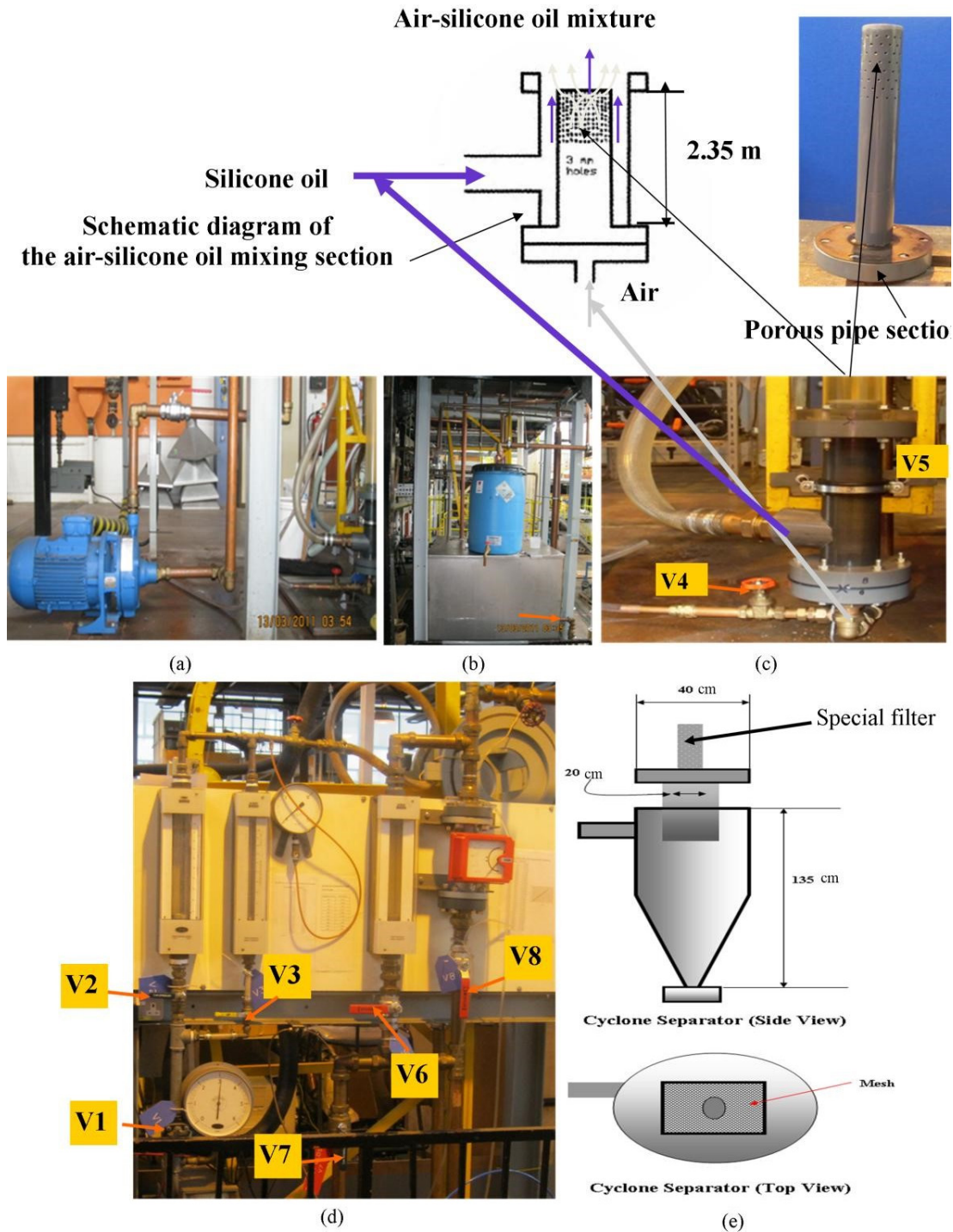


Figure S2 Major components of the rig (a) Liquid pump (b) Liquid tank (c) Air-silicone oil mixing section (d) Rotameters and (e) Cyclone separator

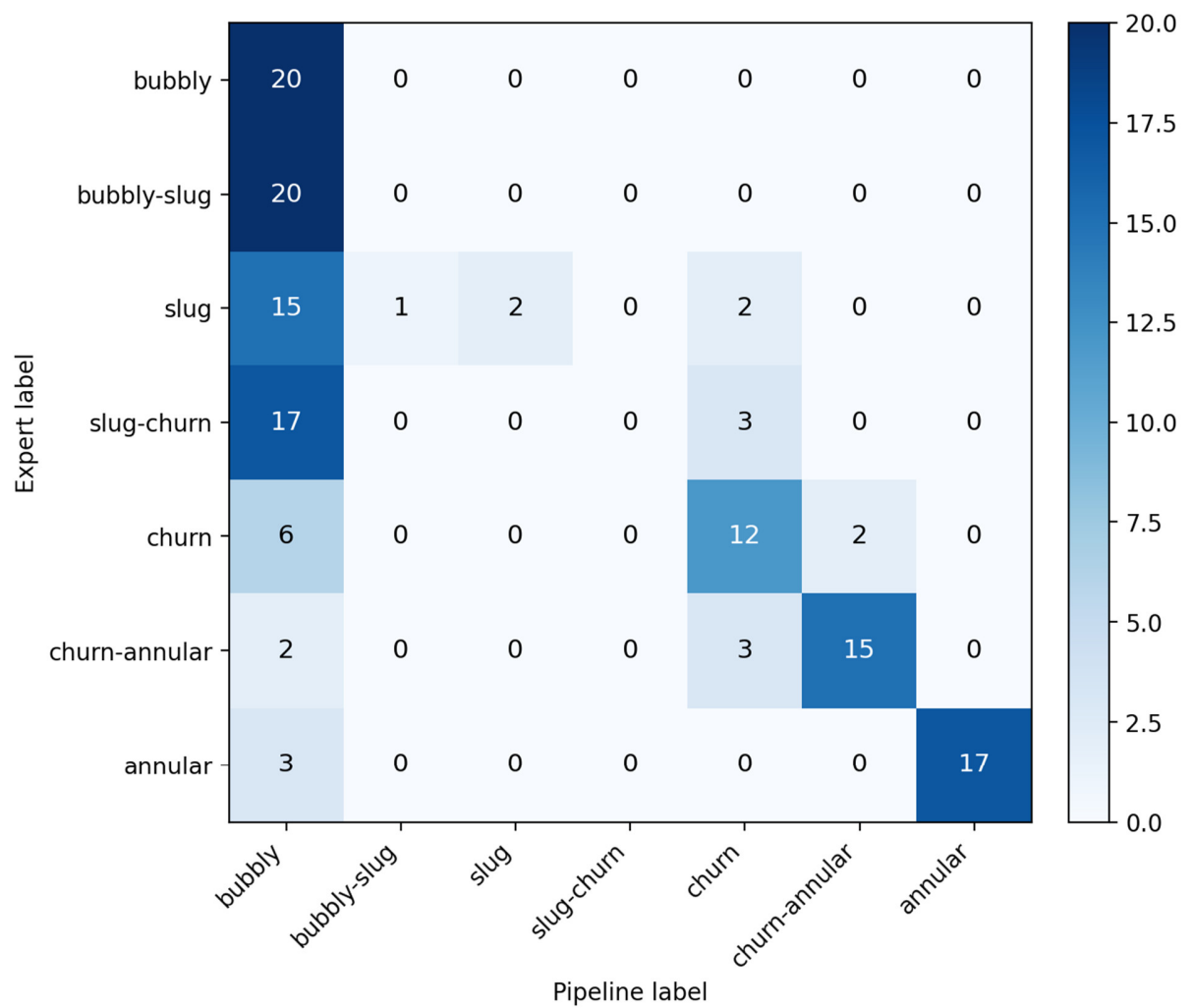


Figure S3 Confusion matrix of the automated labelling stage against independent expert labels on 140 images (20 per class). Rows are expert labels, columns are automated-stage labels.

Table S1. Per-class agreement of the automated labelling stage with independent expert labels on 140 images (20 per class). Precision, recall, and F1 are computed with the expert labels as ground truth.

Regime	Precision	Recall	F1
Bubbly	0.24	1.00	0.39
Bubbly-slug transition	0.00	0.00	0.00
Slug	1.00	0.10	0.18
Slug-churn transition	0.00	0.00	0.00
Churn	0.60	0.60	0.60
Churn-annular transition	0.88	0.75	0.81
Annular	1.00	0.85	0.92
			Accuracy 0.47; macro-F1 0.41; Cohen's kappa
Overall			0.38 (n = 140)