Adsorber Breakthrough: Length of Unused Bed (LUB)

Breakthrough time of a fixed-bed adsorber of new length from a test bed's breakthrough and stoichiometric times, by the length-of-unused-bed method.

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Test bed length	0.50000	m
Test breakthrough time	3.0000	h
Test stoichiometric (mid-front) time	3.6000	h
Design bed length	2.0000	m

Calculated results

Parameter	Value	Unit
Length of unused bed	0.083333	m
Front velocity	3.8580e-05	m/s
Breakthrough time of the design bed	13.800	h
Bed used at breakthrough	95.833	%

Formula and method

$$LUB = L_t\left(1 - \frac{t_b}{t_s}\right), \quad v_f = \frac{L_t}{t_s}, \quad {t_b}' = \frac{L - LUB}{v_f}$$

Variables

L_t	Test bed length	m
t_b	Test breakthrough time	s
t_s	Test stoichiometric (mid-front) time	s
L	Design bed length	m
LUB	Length of unused bed	m
v_f	Front velocity	m/s
${t_b}'$	Breakthrough time of the design bed	s
$1 - LUB/L$	Bed used at breakthrough	-

Method and standards

Constant-pattern LUB method.

Assumptions and limits

- Constant-pattern front; same superficial velocity, particle size and temperature as the test. There is no input for a velocity change: scale the test to the design velocity before using it.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 16 (adsorption): length of unused bed (LUB) scale-up for a constant-pattern front

Report details

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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/unit-operations/lub-breakthrough-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.