Constant-Pressure Filtration Time (Ruth Equation)

Filtration time for a filtrate volume, and the volume after a time, at constant pressure from the Ruth constants found by a test (t/V against V).

Method: Ruth (1935) constant-pressure filtration t/V = (K_p/2)V + B (McCabe, Smith and Harriott)

Input parameters

Unit system: SI

Parameter	Value	Unit
Slope of t/V against V s/m⁶, from a filtration test plotted as t/V vs V.	2,000,000	
Intercept of t/V (s/m³)	20,000	
Filtrate volume	0.20000	m³
Filtration time	60.000	min

Calculated results

Parameter	Value	Unit
Time to collect V	733.33	min
Volume collected in t	0.050828	m³
Filtration rate at V	0.008571	m³/h

Notes for this case

- Constants hold for the same slurry, cake, area and pressure as the test.

Formula and method

$$t = \frac{K_p}{2} V^2 + BV, \quad V = \frac{-B + \sqrt{B^2 + 2K_p t}}{K_p}$$

Variables

K_p	Slope of t/V against V	-
B	Intercept of t/V (s/m³)	-
V	Filtrate volume	m³
t	Filtration time	s
$t(V)$	Time to collect V	s
$V(t)$	Volume collected in t	m³
dV/dt	Filtration rate at V	m³/s

Method and standards

Ruth equation.

Assumptions and limits

- Constant pressure, incompressible cake.
- With V = 0 and B = 0 the rate is unbounded and is not shown.

References

- Ruth (1935) constant-pressure filtration t/V = (K_p/2)V + B (McCabe, Smith and Harriott)

Report details

Report reference	FCC-3EZY-Q7P4 (the same inputs always give the same reference)
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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/separation/ruth-filtration-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.