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Unsteady Flow Formulas

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List of 37 Unsteady Flow Formulas

Unsteady Flow

Discharge in Well

1) Discharge given Drawdown

Open Calculator

fx $$Q = \frac{4 \cdot \pi \cdot F_c \cdot s_t}{W_u}$$

ex $$0.99929\text{m}^3/\text{s} = \frac{4 \cdot \pi \cdot 0.80\text{m}^2/\text{s} \cdot 0.83\text{m}}{8.35}$$

2) Discharge given Formation Constant T

Open Calculator

fx $$Q = \frac{F_c}{\frac{2.303}{4 \cdot \pi \cdot \Delta d}}$$

ex $$1.004\text{m}^3/\text{s} = \frac{0.80\text{m}^2/\text{s}}{\frac{2.303}{4 \cdot \pi \cdot 0.23\text{m}}}$$

3) Discharge given Time at 1st and 2nd Instance

Open Calculator

fx $$Q = \frac{\Delta d}{\frac{2.303 \cdot \log\left(\left(\frac{t_{2sec}}{t1}\right),10\right)}{4 \cdot \pi \cdot t_{hr}}}$$

ex $$1.073187 m^3/s = \frac{0.23 m}{\frac{2.303 \cdot \log\left(\left(\frac{62 s}{58.7 s}\right),10\right)}{4 \cdot \pi \cdot 0.01 h}}$$

Formation Constant

4) Constant dependent on Well Function given Formation Constant S

Open Calculator

fx $$u = \frac{F_c}{\frac{4 \cdot T \cdot t_{days}}{(d_{radial})^2}}$$

ex $$0.0567 = \frac{0.80 m^2/s}{\frac{4 \cdot 0.0009 m^2/s \cdot 0.500 d}{(3.32 m)^2}}$$

5) Formation Constant given Drawdown

Open Calculator

fx $$F_c = \frac{Q \cdot W_u}{4 \cdot \pi \cdot s_t}$$

ex $$0.808574 m^2/s = \frac{1.01 m^3/s \cdot 8.35}{4 \cdot \pi \cdot 0.83 m}$$

6) Formation Constant S

Open Calculator

$$F_c = \frac{4 \cdot u \cdot T \cdot t_{days}}{(d_{radial})^2}$$

$$0.804239 m^2/s = \frac{4 \cdot 0.057 \cdot 0.0009 m^2/s \cdot 0.500 d}{(3.32 m)^2}$$

7) Formation Constant S given Radial Distance

Open Calculator

$$F_{cr} = \frac{2.25 \cdot T \cdot t_{days}}{(d_{radial})^2}$$

$$7.936566 m^2/s = \frac{2.25 \cdot 0.0009 m^2/s \cdot 0.500 d}{(3.32 m)^2}$$

8) Formation Constant T given Change in Drawdown

Open Calculator

$$F_T = \frac{2.303 \cdot Q}{4 \cdot \pi \cdot \Delta d}$$

$$0.804781 m^2/s = \frac{2.303 \cdot 1.01 m^3/s}{4 \cdot \pi \cdot 0.23 m}$$

9) Formation Constant T given Formation Constant S

Open Calculator

fx $$T = \frac{F_c}{\frac{4 \cdot u \cdot t_{days}}{(d_{radial})^2}}$$

ex $$0.000895 m^2/s = \frac{0.80 m^2/s}{\frac{4 \cdot 0.057 \cdot 0.500 d}{(3.32 m)^2}}$$

10) Formation Constant T given Radial Distance

Open Calculator

fx $$T = \frac{F_c}{\frac{2.25 \cdot t_{days}}{(d_{radial})^2}}$$

ex $$9.1E\hat{}\text{-}5 m^2/s = \frac{0.80 m^2/s}{\frac{2.25 \cdot 0.500 d}{(3.32 m)^2}}$$

Radial Distance

11) Radial Distance given Formation Constant S

Open Calculator

fx $$d_{radial} = \sqrt{\frac{4 \cdot u \cdot T \cdot t_{days}}{F_c}}$$

ex $$3.328784 m = \sqrt{\frac{4 \cdot 0.057 \cdot 0.0009 m^2/s \cdot 0.500 d}{0.80 m^2/s}}$$

12) Radial Distance given Formation Constant T

Open Calculator

fx $$d_{radial} = \sqrt{\frac{2.25 \cdot T \cdot t_{days}}{F_{cr}}}$$

ex $$3.321374\text{m} = \sqrt{\frac{2.25 \cdot 0.0009\text{m}^2/\text{s} \cdot 0.500\text{d}}{7.93\text{m}^2/\text{s}}}$$

Rate of Change of Height

13) Rate of Change of Height given Radius of Elementary Cylinder

Open Calculator

fx $$\delta h \delta t = \frac{\delta V \delta t}{2 \cdot \pi \cdot r \cdot dr \cdot S}$$

ex $$0.052346\text{m/s} = \frac{0.92\text{cm}^3/\text{s}}{2 \cdot \pi \cdot 3.33\text{m} \cdot 0.7\text{m} \cdot 1.2}$$

14) Rate of Change of Height given Rate of Change of Volume

Open Calculator

fx $$\delta h \delta t = \frac{\delta V \delta t}{(A_q) \cdot S}$$

ex $$0.015333\text{m/s} = \frac{0.92\text{cm}^3/\text{s}}{(50\text{m}^2) \cdot 1.2}$$

Rate of Change of Volume

15) Area of Aquifer given Rate of Change of Volume

Open Calculator

fx $$A_{aq} = \frac{\delta V \delta t}{(\delta h \delta t) \cdot S}$$

ex $$15.33333\text{m}^2 = \frac{0.92\text{cm}^3/\text{s}}{(0.05\text{m/s}) \cdot 1.2}$$

16) Change in Radius of Elementary Cylinder given Rate of change of Volume

Open Calculator

fx $$dr = \frac{\delta V \delta t}{2 \cdot \pi \cdot r \cdot S \cdot \delta h \delta t}$$

ex $$0.732846\text{m} = \frac{0.92\text{cm}^3/\text{s}}{2 \cdot \pi \cdot 3.33\text{m} \cdot 1.2 \cdot 0.05\text{m/s}}$$

17) Radius of Elementary Cylinder given Rate of change of Volume

Open Calculator

fx $$r = \frac{\delta V \delta t}{2 \cdot \pi \cdot dr \cdot S \cdot \delta h \delta t}$$

ex $$3.486251\text{m} = \frac{0.92\text{cm}^3/\text{s}}{2 \cdot \pi \cdot 0.7\text{m} \cdot 1.2 \cdot 0.05\text{m/s}}$$

18) Rate of Change of Volume given Radius of Elementary Cylinder

Open Calculator

fx $\delta V \delta t = (2 \cdot \pi \cdot r \cdot dr \cdot S \cdot \delta h \delta t)$

ex $0.878766 cm^3/s = (2 \cdot \pi \cdot 3.33 m \cdot 0.7 m \cdot 1.2 \cdot 0.05 m/s)$

19) Rate of Change of Volume given Storage Coefficient

Open Calculator

fx $\delta V \delta t = (\delta h \delta t) \cdot S \cdot A_{aq}$

ex $0.9198 cm^3/s = (0.05 m/s) \cdot 1.2 \cdot 15.33 m^2$

Storage Coefficient

20) Storage Coefficient given Radius of Elementary Cylinder

Open Calculator

fx $$S = \frac{\delta V \delta t}{-(-2 \cdot \pi \cdot r \cdot dr \cdot \delta h \delta t)}$$

ex $$1.256307 = \frac{0.92 cm^3/s}{-(-2 \cdot \pi \cdot 3.33 m \cdot 0.7 m \cdot 0.05 m/s)}$$

21) Storage Coefficient given Rate of Change of Volume

Open Calculator

fx $$S = \frac{\delta V \delta t}{-(-\delta h \delta t) \cdot A_{aq}}$$

ex $$1.200261 = \frac{0.92 cm^3/s}{-(-0.05 m/s) \cdot 15.33 m^2}$$

Chow's Function

22) Chow's Function given Constant dependent on Well Function

Open Calculator

fx $$F_u = \frac{W_u \cdot \exp(u)}{2.303}$$

ex $$3.838374 = \frac{8.35 \cdot \exp(0.057)}{2.303}$$

23) Chow's Function given Well Function

Open Calculator

fx $$F_u = \frac{W_u}{2.303}$$

ex $$3.625706 = \frac{8.35}{2.303}$$

Drawdown and Change in Drawdown

24) Change in Drawdown given Chow's Function

Open Calculator

fx $$\Delta d = \frac{s_t}{F_u}$$

ex $$0.21671\text{m} = \frac{0.83\text{m}}{3.83}$$

25) Change in Drawdown given Formation Constant T

Open Calculator

$$\Delta d = \frac{2.303 \cdot Q}{4 \cdot \pi \cdot F_c}$$

$$0.231374\text{m} = \frac{2.303 \cdot 1.01\text{m}^3/\text{s}}{4 \cdot \pi \cdot 0.80\text{m}^2/\text{s}}$$

26) Change in Drawdown given Time at 1st and 2nd Instance

Open Calculator

$$\Delta s = \frac{2.303 \cdot Q \cdot \log\left(\left(\frac{t2}{t_1}\right), 10\right)}{4 \cdot \pi \cdot t_{hr}}$$

$$0.01708\text{m} = \frac{2.303 \cdot 1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{240\text{s}}{120\text{s}}\right), 10\right)}{4 \cdot \pi \cdot 0.01\text{h}}$$

27) Chow's Function given Drawdown

Open Calculator

$$F_u = \frac{s_t}{\Delta d}$$

$$3.608696 = \frac{0.83\text{m}}{0.23\text{m}}$$

28) Drawdown given Chow's Function

Open Calculator

$$s_t = F_u \cdot \Delta d$$

$$0.8809\text{m} = 3.83 \cdot 0.23\text{m}$$

29) Drawdown given Well Function

Open Calculator

fx $$s_t = \frac{Q \cdot W_u}{4 \cdot \pi \cdot F_c}$$

ex $$0.838896\text{m} = \frac{1.01\text{m}^3/\text{s} \cdot 8.35}{4 \cdot \pi \cdot 0.80\text{m}^2/\text{s}}$$

Time of Flow

30) Time at 1st Instance since Pumping Started given Discharge

Open Calculator

fx $$t1 = \frac{t2}{10^{\frac{\Delta s}{\frac{2.303 \cdot Q}{4 \cdot \pi \cdot t_{seconds}}}}}$$

ex $$59.58426\text{s} = \frac{240\text{s}}{10^{\frac{0.014\text{m}}{\frac{2.303 \cdot 1.01\text{m}^3/\text{s}}{4 \cdot \pi \cdot 8\text{s}}}}}$$

31) Time at 2nd Instance since Pumping Started given Discharge

Open Calculator

fx $$t2 = t1 \cdot 10^{\frac{\Delta s}{\frac{2.303 \cdot Q}{4 \cdot \pi \cdot t_{seconds}}}}$$

ex $$236.4383\text{s} = 58.7\text{s} \cdot 10^{\frac{0.014\text{m}}{\frac{2.303 \cdot 1.01\text{m}^3/\text{s}}{4 \cdot \pi \cdot 8\text{s}}}}$$

32) Time given Formation Constant S

Open Calculator

$$t_{days} = \frac{S_c}{\frac{4 \cdot u \cdot T}{(d_{radial})^2}}$$

$$0.932559\text{d} = \frac{1.50}{\frac{4 \cdot 0.057 \cdot 0.0009\text{m}^2/\text{s}}{(3.32\text{m})^2}}$$

33) Time in Days given Radial Distance

Open Calculator

$$t_{days} = \frac{S_c}{\frac{2.25 \cdot T}{(d_{radial})^2}}$$

$$0.094499\text{d} = \frac{1.50}{\frac{2.25 \cdot 0.0009\text{m}^2/\text{s}}{(3.32\text{m})^2}}$$

34) Time in Hours given Time at 1st and 2nd Instance since Pumping Started

Open Calculator

$$t_{hour} = \frac{2.303 \cdot Q \cdot \log\left(\left(\frac{t_{2sec}}{t1}\right), 10\right)}{4 \cdot \pi \cdot \Delta s}$$

$$0.154613\text{h} = \frac{2.303 \cdot 1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{62\text{s}}{58.7\text{s}}\right), 10\right)}{4 \cdot \pi \cdot 0.014\text{m}}$$

Well Function

35) Well Function given Chow's Function

Open Calculator

fx $W_u = F_u \cdot 2.303$

ex $8.82049 = 3.83 \cdot 2.303$

36) Well Function given Constant dependent on Well Function and Chow's Function

Open Calculator

fx $W_u = \frac{2.303 \cdot F_u}{\exp(u)}$

ex $8.331783 = \frac{2.303 \cdot 3.83}{\exp(0.057)}$

37) Well Function given Drawdown

Open Calculator

fx $W_u = \frac{4 \cdot \pi \cdot F_T \cdot s_t}{Q}$

ex $8.302763 = \frac{4 \cdot \pi \cdot 0.804\text{m}^2/\text{s} \cdot 0.83\text{m}}{1.01\text{m}^3/\text{s}}$

Variables Used

- A_{aq} Aquifer Area *(Square Meter)*
- A_q Area of Aquifer *(Square Meter)*
- d_{radial} Radial Distance *(Meter)*
- **dr** Change in Radius of Elementary Cylinder *(Meter)*
- F_c Formation Constant for Unsteady Flow *(Square Meter per Second)*
- F_{cr} Formation Constant S given Radial Distance *(Square Meter per Second)*
- F_T Formation Constant T given Change in Drawdown *(Square Meter per Second)*
- F_u Chow's Function
- **Q** Discharge *(Cubic Meter per Second)*
- **r** Radius of Elementary Cylinder *(Meter)*
- **S** Storage Coefficient
- S_c Formation Constant S
- s_t Total Drawdown in Well *(Meter)*
- **T** Formation Constant T *(Square Meter per Second)*
- t_1 Time of Drawdown (t1) *(Second)*
- t_{2sec} Time of Drawdown (t2) in Wells *(Second)*
- t_{days} Time in Days *(Day)*
- t_{hour} Time in Hours *(Hour)*
- t_{hr} Time in Hours for Well Discharge *(Hour)*
- $t_{seconds}$ Time in Seconds *(Second)*

- **t1** Time of Drawdown (t1) in Wells *(Second)*
- **t2** Time of Drawdown *(Second)*
- **u** Well Function Constant
- W_u Well Function of u
- **Δd** Change in Drawdown *(Meter)*
- **δhδt** Rate of Change of Height *(Meter per Second)*
- **Δs** Difference in Drawdowns *(Meter)*
- **δVδt** Rate of Change of Volume *(Cubic Centimeter per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: **log**, log(Base, Number)
  Logarithmic function is an inverse function to exponentiation.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s), Hour (h), Day (d)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s), Cubic Centimeter per Second (cm³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Kinematic Viscosity** in Square Meter per Second (m²/s)
  Kinematic Viscosity Unit Conversion

Check other formula lists

- **Unsteady Flow Formulas**

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