We have the following two expressions for the rate q,

$$q = \frac{k}{\mu} A \frac{\rho g(h(t) - h_b)}{\Delta l 1.01325 \cdot 10^6},$$

for the rate through the core with water level difference $(h(t) - h_b)$ between inlet and outlet end, and

$$q = -\frac{\mathrm{d}h}{\mathrm{d}t} A_r,$$

for the discharge of the water in the cylinder. These two expressions for q are set equal. The result is a first order differential equation for h as a function of t. One has to use that $\int dh/h = \ln h$. Applying the initial condition that $h = h_0$ when $t = 0$, we find the expression given.

In SI-units ($\rho g h$) is in (kg/m^3· m/s^2· m) which is kg/(m s^2) which again is N/m^2 or Pa. If we use ($\rho g h$) in g/(cm s^2) we get a factor 10 in difference, i.e., ($\rho g h$) in the given units is equal to 1013250 atmospheres.

By plotting the left-hand-side of the equation against time t, the permeability may be calculated from the slope of the resulting straight line.