Darcy-Weisbach Application

This application includes several programs for utilization in the Darcy-Weisbach Equation. Be sure to read this for assumptions and how to use. The programs included will be tested with a sample homework example illustrating various aspects of the Darcy-Weisbach equation.

Dwff() is a program that calculates the Darcy-Weisbach friction factor used in calculating headloss used in the Darcy-Weisbach equation. For laminar flow the equation used is: $f = \frac{64}{Re}$. For critical/transitional flow this regime is not well understood and in reality would be some kind of interpolation between laminar and turbulent flow. However, for this program the same formula will be used for critical and turbulent flow. The Serghide's solution is employed to get an explicit approximation with very high accuracy. This formula is provided below:

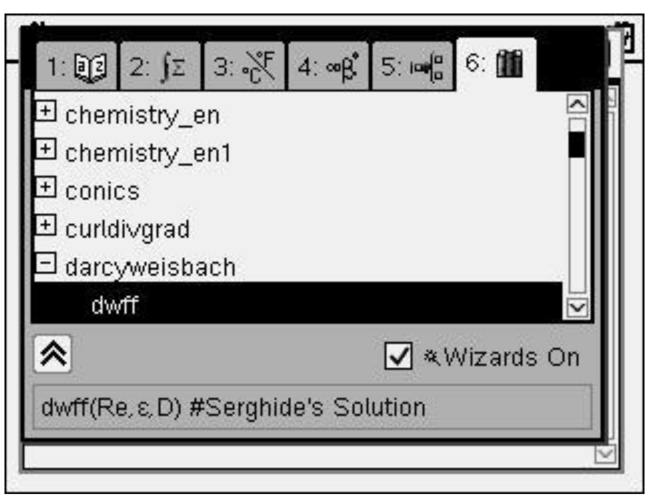
$$A = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{12}{\mathrm{Re}}\right)$$

$$B = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51A}{\mathrm{Re}}\right)$$

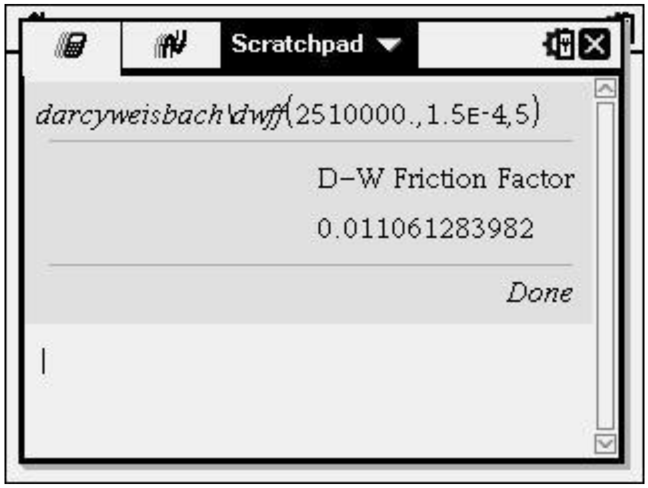
$$C = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51B}{\mathrm{Re}}\right)$$

$$\frac{1}{\sqrt{f}} = A - \frac{(B-A)^2}{C - 2B + A}$$

To use this program, access it from the public library. The wizard will show how to input into the program. This program will require the reynold's number, roughness, and pipe diameter and should be input as the wizard indicates:



So as the example problem indicates, Re=2.51x10^6 E=1.5x10^{-4} D=5. It would be input into the program as such:



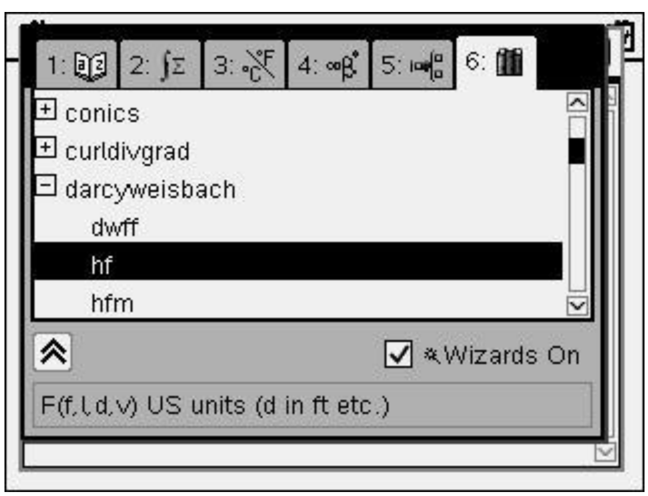
The friction factor for this example is 0.011.

Hf() is a program that calculates the headloss using the Darcy-Weisbach equation in US units. Additionally for metric units **Hfm()** is also provided. The formula used can be seen below:

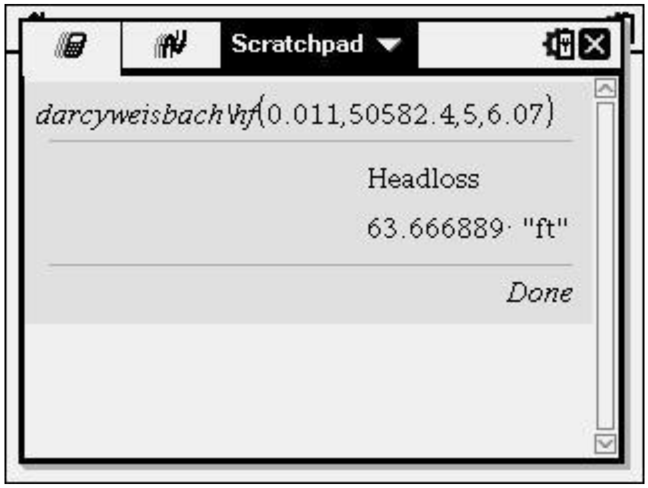
$h_f = f\,(L/D) \times (v^2/2g)$

h_f = head loss (ft)
f = friction factor
L = length of pipe work (ft)
d = inner diameter of pipe work (ft)
v = velocity of fluid (ft/s)
g = acceleration due to gravity (ft/s²)

Just like the friction factor program it is accessed in the public library and prompts the input:



Going back to the example problem, solving for the headloss would be input as such:



Reynolds() is the final program in this application. This program will calculate the Reynolds number and the viscosity of the water in question. ***It should be noted that this is ONLY VALID for water between 31.73° to 211.13° in temperature.*** Since water is typical fluid used with Darcy-Weisbach and generally its temperature is within that range this program has wide use. The viscosity of other fluids should be taken from a table and the Reynold's number is simple enough to calculate without this program as this is the equation:

$$Re = \frac{VL}{\upsilon}$$

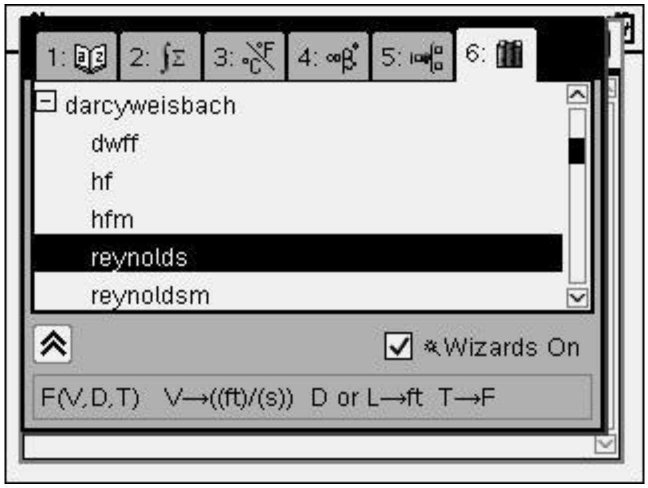
*L = D or diameter in a pipe conduit.

This program becomes valuable if you're working with water and don't want to look up the viscosity manually. This program estimates the viscosity using the Vogel equation. The Vogel equation uses different variable values for different fluids and these are not used in this program. For review here is the Vogel equation:

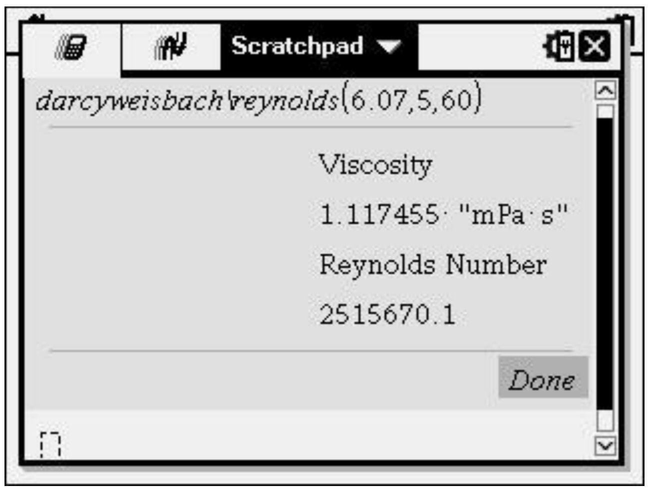
$$\eta = e^{A + \frac{B}{C+T}}$$

The Vogel equation calculates viscosity in metric units and so my Reynolds() program converts the result into US units. ***Please note in the US unit program although the viscosity from the Vogel equation is shown in metric the final Reynolds program output appropriately converts the remaining terms.*** Reynoldsm() is also provided for metric units. Lastly, this program can calculate just the viscosity as the only unknown is the temperature, so zeros can be placed for V & D if only looking for viscosity.

Using this program is just as the others, it is accessed in the public library and prompts the appropriate inputs:



And for the example problem it would be input as such:



And the result is the Reynold's number with the viscosity from the Vogel Equation for reviewal. That is the summation of all the programs given in the Darcy-Weisbach application.

In case you are unaware on how to add these to the public library:

Copy "DarcyWeisbach.tns" to the "MyLib" folder in your TI Nspire (Create the folder in the root if it does not exist already. After transferring to the calculator be sure to refresh libraries. (In calculator mode, click Doc-> 6:Refresh Libraries.) Let it update and then you should be able to access it in the library under the 6: tab.

If you notice any mistakes please let me know.

Thank You,
Brian