

In this experiment you will examine the flow of water through a packed bed of sand. The pressure for the fluid flow will be by gravity only. Using these low pressures we will not risk the breakage of the glass tubes. For this experiment you will use all of the data collected from the 8 teams in the class. At the end of the laboratory period you will turn in this sheet to the Laboratory TA Bolaji Adigun. You need to first examine your column to determine if there are any air bubbles in the sand. If air bubbles are present, then you will not be able to use the void fraction of liquid from standard charts. To remove the bubbles you will need to make the sand flow back up the column by carefully moving the column. (e.g. tilt the top of the column downward and the sand will flow allowing the bubbles to coalesce into a large bubble. Which when you tilt the column upward this bubble will rise out to the tubing and you must remove this bubble for the siphon to work.) You must also make sure that you have no air bubbles below the bed otherwise the Bernoulli equation will not apply.

Record the following:

Sand Bed Height _____

Inside Diameter of Column _____

Determine an approximate average diameter of the sand particles _____

Data Table

Experiment	Liquid Height	Volume Liquid Collected	Graduated Cylinder Type	Time

Deliverables:

1. Draw a Sketch of your experimental Setup
2. Summarize the data in a table showing liquid height, flowrate, Sand Bed Height&ID and modified Reynolds number for all of the experiments (Make sure you give hand calculations showing units. In this table also show the error in calculating the flowrate from your measurements - propagation of error)
3. Make a plot showing the Flowrate as a function of liquid height for each team. You will use a new data set (e.g. new curve) for each team.
4. Make a second plot showing the Flowrate as a function of Bed Height using the liquid height as a parameter. To do this you will need to form groups and plot average values of the bed height. You will use a new data set (e.g. new curve) for each average bed height. (e.g. 15 cm, 29 cm, etc.)
5. Using your approximate value for the diameter of sand, determine a best fit value for the constant in equation 11.14 if the flow is laminar or 11.16 if the flow is turbulent. (Look at the equation to see what you should plot. Then you should compare your constant from your regression to the constant in the equation. use the graphs from Perry's that I have given you to determine a void fraction)
6. Compare your best fit values of the constant in the above step to the $f_{P,M}$ equation 11.17. To make this comparison you should make a plot of your $f_{P,M}$ value vs the modified Reynolds number. On the same plot show equation 11.17.
7. Using equation 11.17 and your experimental data back calculate the average value of the sand diameter.