The column pressure under any conditions can be predicted using the following equation:

$P = (150\ \eta\ L\ F) / (d_{particle}^2\ d_{column}^2)$

where P is the pressure, η is the solvent viscosity, L is the column length, F is the flow rate, $d_{particle}$ is the particle diameter, and d_{column} is the column inner diameter. If only the particle size is varied *(same method, same column dimensions)*, then the factor $(150\ \eta\ L\ F) / d_{column}^2$ becomes a constant *k:*

$P_{2µm} = k / d_{2µm}^2$

$P_{4µm} = k / d_{4µm}^2$

The constant will be the same for 4µm and 2µm columns so we can solve each equation for *k*…

$P_{2µm}\ d_{2µm}^2 = k$

$P_{4µm}\ d_{4µm}^2 = k$

…and then set the two expressions equal to each other:

$P_{2µm}\ d_{2µm}^2 = P_{4µm}\ d_{4µm}^2 = k$

Note that we don't need to know the actual numerical value of *k*. Now we want to know how the pressures compare, so we will rearrange the equation to show the pressure ratio of 2µm vs. 4µm columns as a function of particle size:

$(P_{2µm} / P_{4µm}) = d_{4µm}^2 / d_{2µm}^2$

$(P_{2µm} / P_{4µm}) = 4^2 / 2^2 = 16 / 4 = 4$

The equation shows the pressure will be theoretically **4 times higher** on the 2µm column than the 4µm column using equivalent conditions. In practice you may not use the exact same method conditions when transferring a 4µm method to a 2µm column. A lower flow rate or shorter column may be warranted, for example. You can still predict the pressure difference using different conditions but the comparison becomes more complicated if more than one variable is changed because *k* is no longer the same between the two methods.

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