

Tip# 110: HPLC PUMP SOLVENT COMPRESSIBILITY VALUES

- Have you ever noticed pump ripple (baseline noise) that is not caused by a defective check valve ? The ripple might be due to an incorrect solvent compressibility setting.

We normally think of liquids as not being compressible in general. Hydraulic systems take advantage of this physical fact and many innovations have been developed using this concept. However, in high pressure liquid chromatography (HPLC) we routinely subject different liquids to very high pressures which can result in measurable liquid compression. The degree of actual compression varies for each liquid (see Table 1). Though the amount of compression is very small, it is enough to change the flow rate of the system. When multiple solvents are mixed together at different proportions, such as is common when running a gradient, the measured flow rate can vary from the set flow rate during the entire run. This flow rate accuracy issue can be compensated for using the built-in solvent compressibility compensation software which is found in most modern HPLC systems. Many of these systems will allow you to manually enter the actual liquid compressibility values for each liquid (pump channel) used. This can result in better baseline stability and less pump noise. I would like to point out that the small improvement gained in performance is best implemented AFTER other major changes have been addressed first (i.e. such as fully degassing your solvents; filtering samples before injecting; selecting the best signal bandwidth and sampling rate values for your detector and insuring that your pumping system has received regular maintenance).

Note how Water has a compressibility value of ~ 46, but a very common solvent such as Methanol has a value of 120. These two are very different. *Most pumps are pre-set with a compressibility value of '100'. A 50/50 mixture of the two run isocratically might benefit from a manually edited compressibility value of 83 $[(46 + 120) = 166 / 2 = 83]$. This is a best guess value as the best compressibility value for a mixture of liquids must be determined through actual experiments. Choose the value which results in the lowest pump pressure ripple and/or noise.

> Bill Letter, 01/16/11.



Table 1: SOLVENT COMPRESSIBILITY VALUES TABLE

<u>Solvent</u>	<u>Compressibility (10⁻⁶ per bar)</u>
Water	46
Acetone	126
Acetonitrile	96
Benzene	95
Carbon Tetrachloride	106
Chloroform	100
Cyclohexane	113
Dichloromethane	99
Ethanol	112
Ethyl Acetate	113

Heptane	144
Hexane	158
Isopropanol	100
Methanol	120
Tetrahydrofuran	97
Toluene	90

- The values shown are approximate and recorded at a temperature of 20 C (Handbook of Chemistry and Physics #90). Various grades/purity and dryness of solvent may have different compressibility values so please verify the values of your own solvents before use.