TECHNICAL ARTICLE

CHOOSING THE RIGHT INLET LINER FOR YOUR APPLICATION

Part One

– Increasing sensitivity of high boiling point compounds.

There is a vast choice of inlet liners available today for the modern chromatographer ranging from straight through liners, to those with glass wool, baffles and laminar cups. Making the right choice can be a difficult task, but is important as it can affect the sensitivity of the analysis.

The liner's ability to transfer heat efficiently depends on its design. The first surface the liquid sample hits will have the largest influence on the amount of boiling point discrimination the sample suffers before it reaches the column. Another factor affecting discrimination is the loss of volatiles from the top of the liner, this affect is not as dramatic as the initial transfer of energy from the liner (or base seal) to the sample. Some liners do not transfer this energy as affectively as others and therefore slow the vaporization process.

When a liquid sample is first injected into a liner by an autosampler it exits the needle at a high speed. In most cases, some of the sample is sprayed slightly, but the majority of it stays together until it collides with a surface. An inlet liner has three surfaces that the liquid sample can hit before it begins to vaporize these are; quartz wool, glass (borosilicate or quartz) and metal (usually plated stainless steel). At the same temperature these materials contain different amounts of energy, therefore, act differently when the sample uses some of that energy to vaporize. Assuming that the affected surfaces of the glass and metal are the same mass, the temperature of the glass surface will not drop as much as the metal when the same amount of energy is used. This is due to the difference in heat capacities of the two materials. An example is shown in **Figure 1a and 1b**:

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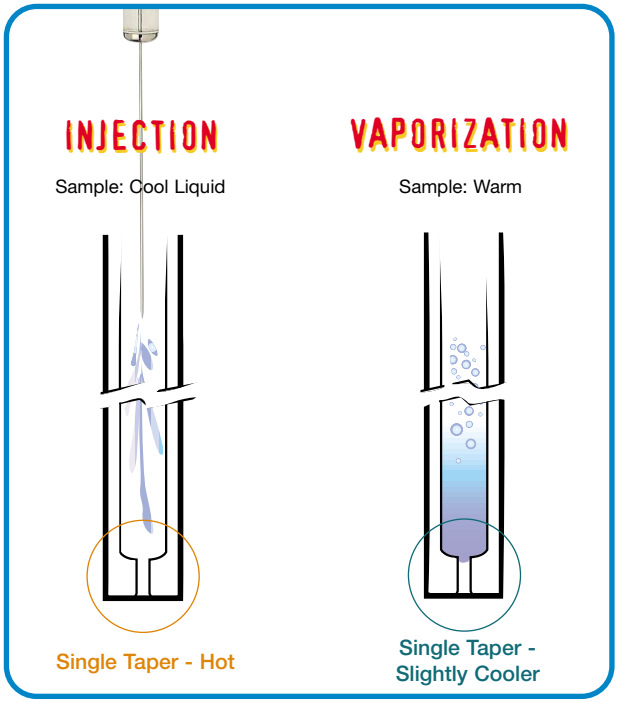

Figure 1a: Vaporization in a Single Tapered Liner.

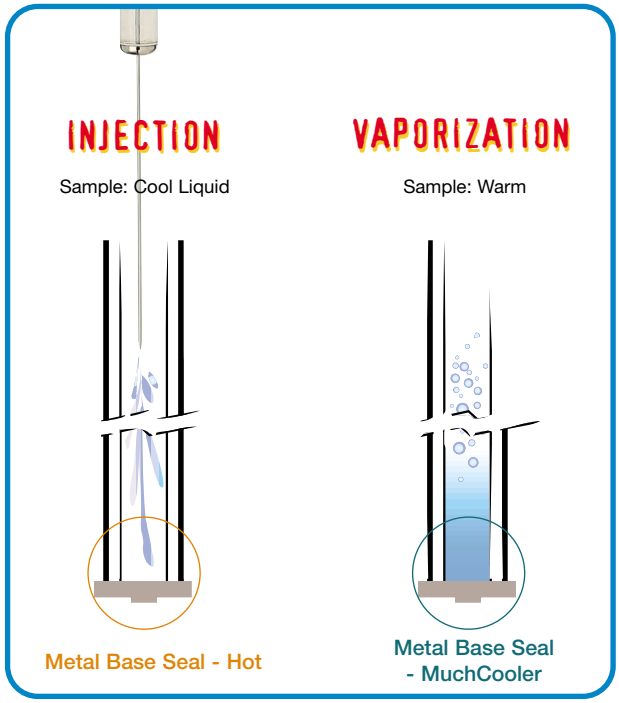

Figure 1b: Vaporization in a Straight-Through Liner.

Let's consider the order of vaporization. If 1.0µL of 100ppm TRPH (Total Recoverable Petroleum Hydrocarbons, C8-C40) in dichloromethane is injected in splitless mode. The solvent and hydrocarbons will all absorb energy at approximately the same rate. However, it will take longer for the high boiling point compounds (>C18) to absorb the extra energy they need to vaporize, thus they will complete their vaporization much later than volatile compounds; i.e. C8 completes vaporization before C30 etc.

The problem is that in this example, 99.99% of the sample is solvent! The solvent will vaporize first, along with the volatile and some semi-volatile compounds. This will take a lot of energy from the liner or base seal (as shown in Figures 1a and 1b), but the high boiling point compounds have not finished vaporizing and the liner or base seal is now cooler than it was before. Depending on the sample size and the specific heat capacity of the solvent and injection port surface, this cooling can be significant enough to affect the rate of vaporization for high boiling point compounds. In other words, C18 and heavier hydrocarbons start to vaporize but the temperature drops quickly on the surface they are on, slowing their vaporization. It will not affect the low boiling point compounds because they have already finished vaporizing. The result is shown in **Figure 2**.

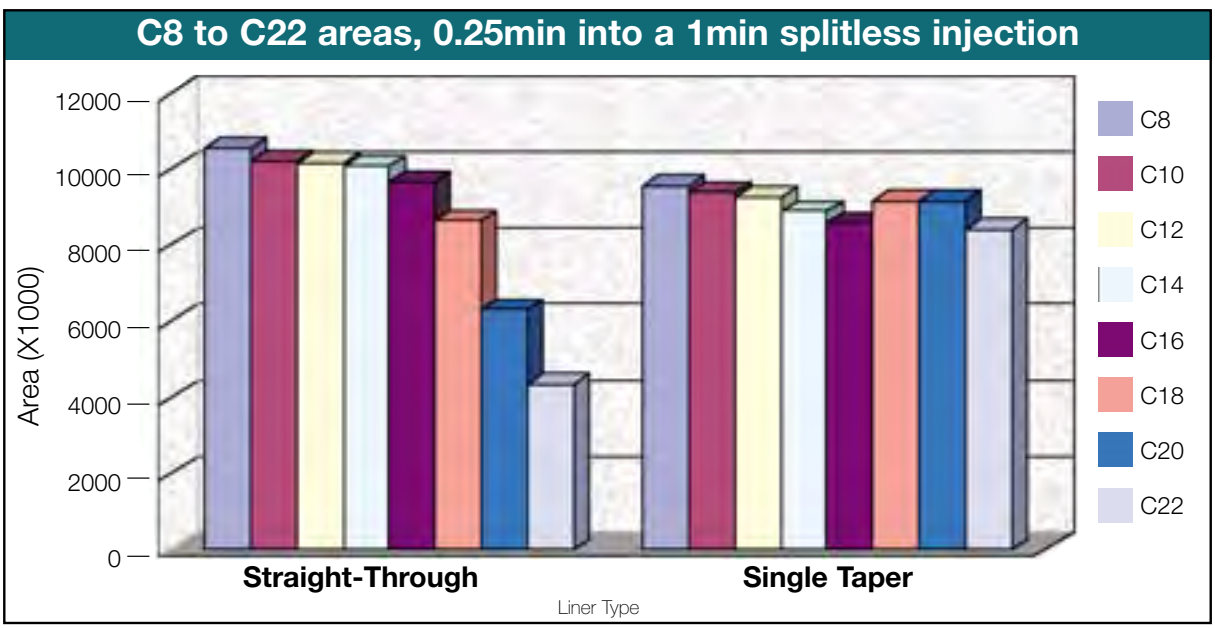

Figure 2: Discrimination caused by the delayed vaporization of heavy hydrocarbons in the straight-through liner.

The bar graphs in **Figure 2** show the area for C22 straight-through liner, is only half the height of the C22 single tapered liner. C22 is still vaporizing in both cases, but the parallel liner is less efficient at transferring energy to the sample because vaporization has cooled the metal base seal more than glass. This could also be attributed to the base seal being in a cooler area of the injection port and therefore it would start at a lower temperature. Eventually heat is transferred back into the base seal and liner but this occurs after the sample has vaporized.

This means that tapered glass liners or focus liners are preferable because they transfer high boiling point compounds more effectively to the column. This will give higher sensitivity for all analysis, not just hydrocarbons.

Next issue:

CHOOSING THE RIGHT INLET LINER FOR YOUR APPLICATION

Part Two – Increasing sensitivity of low boiling point compounds.