NovaSheet
Technology: SF3-UV
Application: Perfluorocarbon Emulsions / Blood Substitutes

Analysis Conditions / System Set-up

Solvent	: 0.1% (v/v) NovaChem Surfactant 100	- Channel Thickness : 250 µm
Injection Volume	: 20 µL	- Channel Flow : 4.0 mL/min
Initial Field	: 1000 rpm	- Field Program: t_1 = 5 min.s, t_a = -40 min.s
FFF System	: postnova S101 Series	- Sedimentation Field-Flow Fractionation
UV Detector	: postnova PN3240 UV/Vis	- 4-Channel UV/Vis Detector (Wavelength: 254 nm)

Perfluorocarbon emulsions are one of the leading candidates for blood replacement.

World-wide research for blood substitutes is an ongoing task to overcome the limited resources of natural blood supplied by humans. The demand for blood is expanding as a direct result of the growing age of the human populations and the ever increasing level of medical services. Most of the complicated high tech surgeries (heart, cancer, etc.) require immense amounts of blood during the medical treatment.

For almost a hundred years saline has been used to replace lost blood volume. But it does not have the same electrolyte composition as human blood plasma and it is far less effective or safe when directly compared to blood plasma. Ringer's lactate solution is now the most common replacement, but this only provides electrolytes and glucose.

Perfluorocarbons
The perfluorocarbons under study have the advantage that they can be excreted through the kidneys and vaporized through the lungs. On the downside, they can alter the way the body fights infections, producing a flu-like syndrome. Perfluorochemicals are cheap and are completely free of biological materials so there is no risk of infectious agents contaminating them. In order to work, they must be combined with other materials that enable them to mix in with the bloodstream. These companion materials are fatty compounds known as lipids that take the form of an emulsion. They form a suspension of extremely small particles in a liquid that can be injected into a patient. The emulsion is relatively unstable and must be kept frozen until time of use.

Sedimentation FFF (postnova S101 Series), is ideally suited for separation and characterization of biological samples such as blood cells, emulsions, and drug delivery vehicles. It provides high resolution separation under gentle, low shear conditions. As an analytical-scale, elution-based technique, the size information is provided along with the separation. Thus the size distribution is a direct measurement, free from any assumptions.

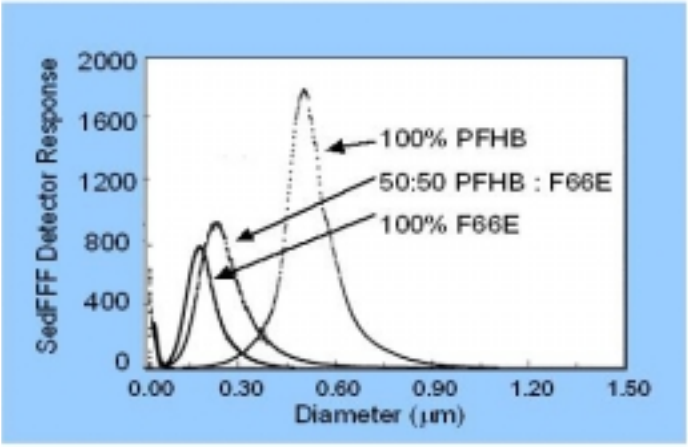

Figure 1: Characterization of 3 emulsions with varying composition using SdFFF - UV. Ref: D.H. Klein, D.B. Burtner, L.A. Trevino, R.A. Arlauskas. Biomat. *Art. Cells & Immob. Biotech.* **20**: 859-864 (1992).

In comparison with other particle sizing techniques and/or any chromatographic separation techniques, only SdFFF can separate sub-micron sized emulsion droplets of any density. Figure 1 shows that SdFFF can distinguish the small differences between emulsions – the emulsion composed of a 50:50 mix of PFHB and F66E is only slightly larger in size than the pure F66E emulsion.

Significance of the Size Distribution Measurement
A detailed examination of the size distribution is also key to understanding emulsion stability. Early determination of an instability can be forecast by examination of the size distribution. The high resolution capabilities of the SdFFF separation provide this information.

Figure 2 tracks the changes of a mixed perfluorocarbon emulsion. Since size classed fractions are provided with the separation, the composition of each size fraction could be determined to help one understand the emulsion stabilization process.

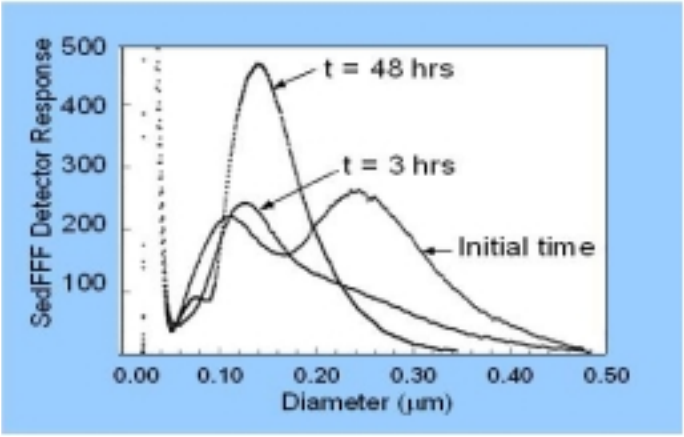

Figure 2. Size distributions determined by SdFFF – UV detection of an unstable emulsion. Over a 48 hr period, the size distribution changed from a bimodal to monomodal with an average droplet size of 0.14 µm. Ref: R.A. Arlauskas, G. Weers, *Langmuir*, **12**, 1923-1925 (1996)

Why use SdFFF for Emulsion Characterization?

- ► High resolution separation provides detailed size distribution information.
- ► Fast, gentle and nearly interaction free separation without stationary phase.
- ► Fraction collection for further analytical techniques for, e.g., compositional information.
- ► Easy and precise stability monitoring of emulsions.

For further information about the SFFF characterization of perfluorocarbon or other emulsions, contact us at info@postnova.com.