The Structure of Degassed Water-Enabled Oil-in-Water Microemulsions

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BACKGROUND

Anti-cancer drugs are hydrophobic, and they cannot be used on a patient without a surfactant to mediate the drug. These surfactants are often dangerous to a patient. Growing evidence suggests that it may be possible to mix oil in water at higher concentrations if dissolved gases are removed from water (Eastoe, 2007). This will allow anti-cancer drugs to have a surfactant that is not an added danger to the patient. The mechanisms of mixing are largely unknown and understanding the structure of oil-in-/water microemulsions could shed light on the mechanisms of mixing. This project will use turbidity/light scattering measurements to understand how hydrophobic molecules mix with degassed water.

METHODS

In this study we will be using the alkanes hexane, octane, decane, and dodecane. Every experiment has been carried out with 1% alkane and 99% by volume deionized water. For the un-degassed scans of light scattering, the alkane and water will be mixed before. The light scattering scans will span from 1 hour to 12 hours

Once the mixture is created, it is mixed by hand for 1 minute and sonicated for 2 minutes. Then it is directly taken to the light scattering set up.

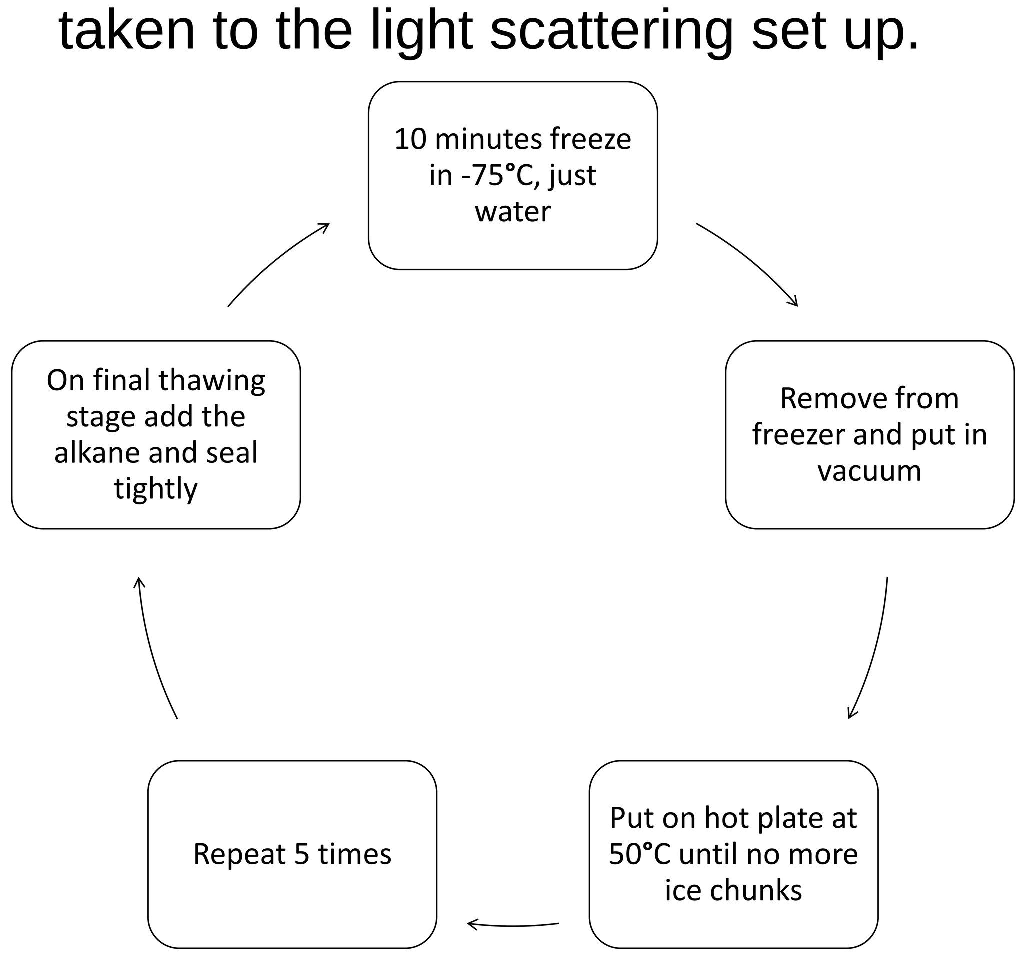

Figure 3 – Process for degassing

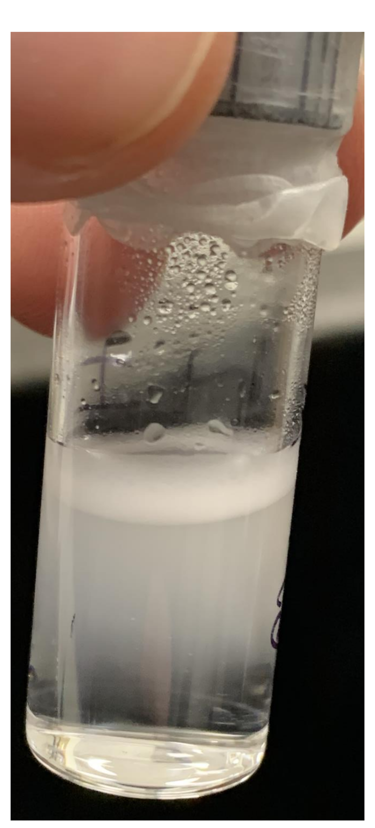

Figure 2 - Decane/water after a 12-hour scan

RESULTS

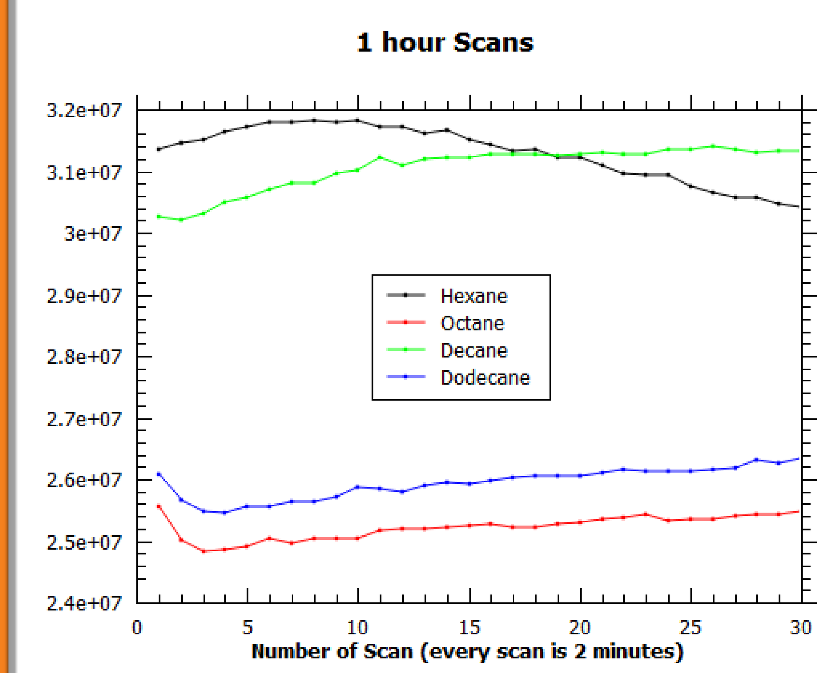

Figure 3 – All of the 1 hour scans without degassing

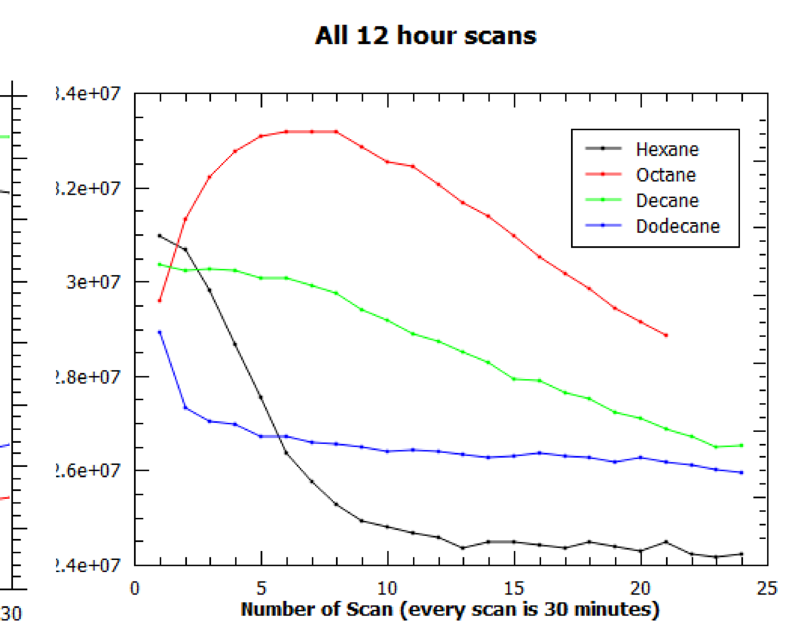

Figure 4 – All of the 12 hour scans without degassing

Figure 3 and 4 show the turbidity measurements for the samples that are not degassed. Hexane is shown to separate the fastest, in the 12-hour measurements it separates after approximately 12 hours. Another topic is the irregular "climbing" of the measurements. We believe this "climbing" happens directly after first mixing a sample of alkane and water. In the 12 hour scans the only measurement that did not have a 1 hour before it is the octane, which "climbs" while the other three do not.

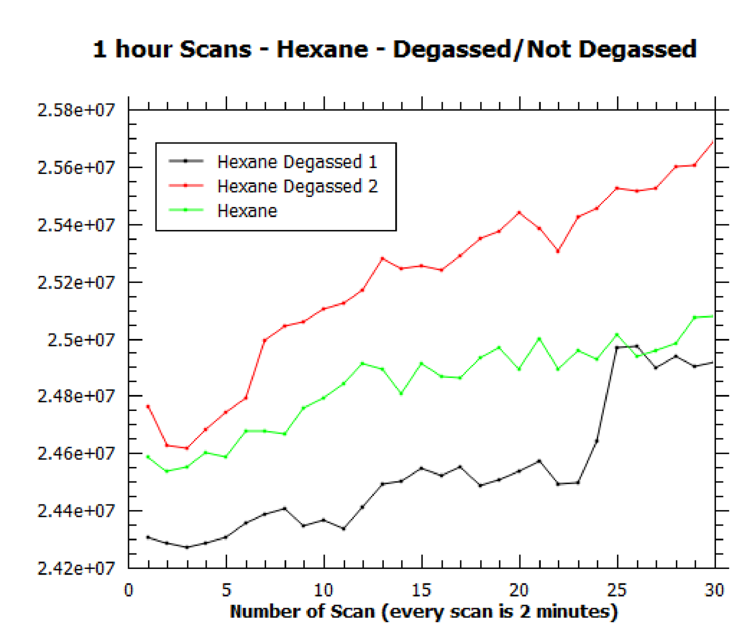

Figure 5 – Comparing the degassed 1 hour measurements with the normal 1 hour measurements, all of hexane

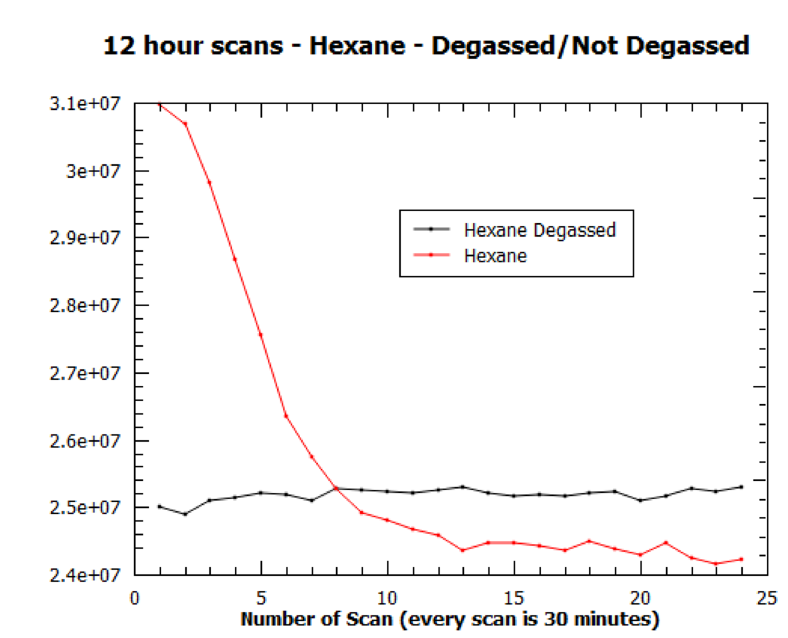

Figure 6 – Comparing the degassed and not degassed measurements for hexane

In figure 5 the degassed mixture closely resembles the first measurement of hexane, but more measurements are needed to confirm if there is a minimal difference. Figure 6 shows compares degassed to gassed and we can see that the degassed measurement is more turbid, but it is not separating.

DISCUSSION

All the alkanes separate from being mixed with water; hexane is the only one to separate within 12 hours while the other three need more testing to determine exactly when they separate. From degassing it is unclear if it makes a substantial difference yet. More testing is needed to determine if it will be useful in anti-cancer drugs delivery. The stable nature of the degassed measurement in figure 6 is a promising start, but many more experiments are needed to confirm its stability.

FUTURE PLANS

- Complete the degassing cycle with octane, decane, and dodecane
- Use SAXS and other structural measurements to help determine structure of microemulsions
- Perhaps repeat measurements with the parameter of weight instead of volume
- Repeat measurements to confirm exactly how long it takes to separate

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