Xenon Solubility in Plastics **DRAFT** D. Shuman, 6/17/2011

From this reference: IUPAC-NIST Solubility Data Series 70, Gas Solubility in Glassy Polymers, Patterson, volume editor

we find a collection of gas solubility data in glassy polymers. Only a few entries show Xenon solubility, and not in typical plastics but here is a chart with other noble gas data; one would guess that Xe solubility would be similar

Experimental Data

Henry's law solubility constants S for gases in PMMA

Gas	Pressure/atm	S/(cm^3(STP)/g atm)
He	3.8–7.2	0.066
Ne	2.7	0.126
Ar	3.2–7.4	0.105 ± 0.063
Kr	2.6–4.6	0.122
N_2	5.7–15.0	0.045 ± 0.028
CO_2	4.0–19.0	0.260 ± 0.024

using the value for Argon: 1 std cm^3 = $scc = 4.464 \times 10^{-5}\,mol$ $scc = 1\,\frac{atm \cdot cm^3}{R \cdot 273K}$

$S_{Ar\_PMMA} := 0.12\,\frac{scc}{gm \cdot atm}$ $S_{Ar\_PMMA} = 5.287 \times 10^{-8}\,\frac{m\,s^2\,mol}{kg^2}$ $\rho_{PMMA} := 1.2\,\frac{gm}{cm^3}$

Assume for this study we use a solid insulated field cage

$t_{ins} := 3cm$ $R_{ins} := 55.5cm$ $L_{ins} := 130cm$

Molar gas quantity

$N_{Xe\_ins} := 2\pi \cdot R_{ins} \cdot t_{ins} \cdot L_{ins} \cdot \rho_{PMMA} \cdot S_{Ar\_PMMA} \cdot 15bar$

$N_{Xe\_ins} = 12.943\,mol$

Mass of Xe inside insulator

$M_{Xe\_ins} := N_{Xe\_ins} \cdot M_{a\_Xe}$ $M_{Xe\_ins} = 1.76\,kg$

One has to ask, what happens when the vessel is depressurized. Would the absorbed gas craze or crack the plastic? Our electrrical technician, Gerry has anecdotal evidence that laminated polymers have been known to form interlayer bubbles from this sort of process.