Advanced Gas Reactor Fuels Program Review

Preliminary Comparison of silver release predictions using PARFUME with results from the AGR-2 irradiation experiment.

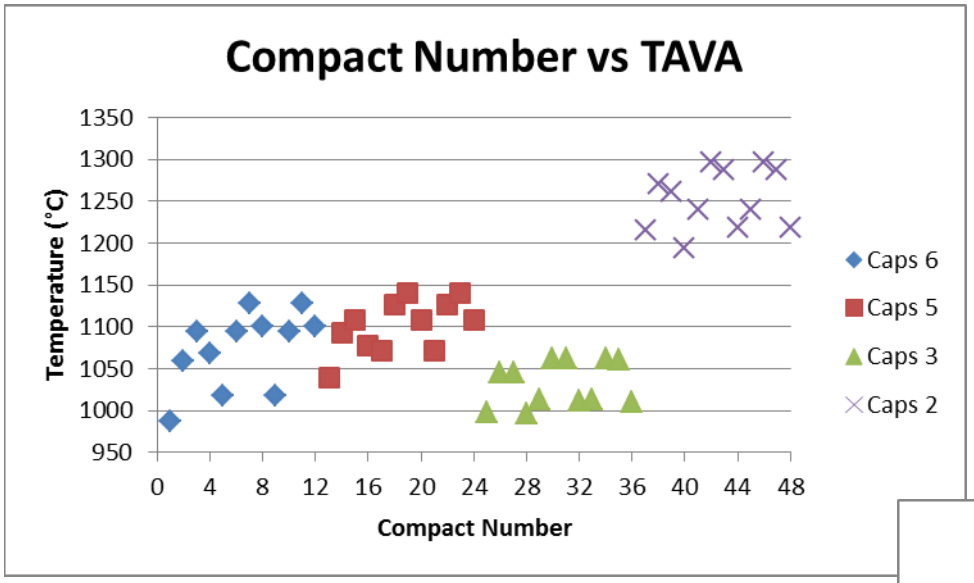
Blaise Collin
Irradiations & Fuel Performance Modeling

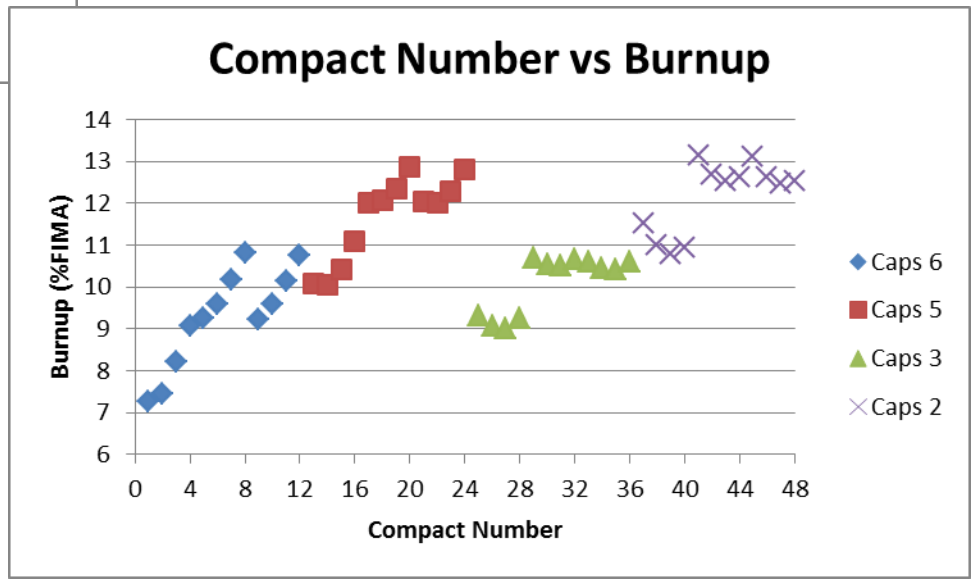
July 15-16, 2015

www.inl.gov

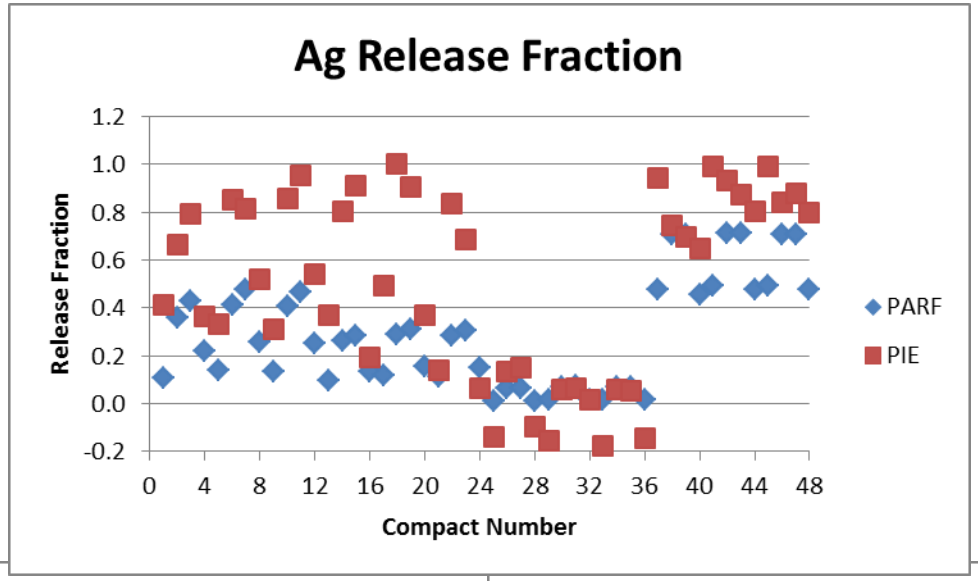
Idaho National Laboratory

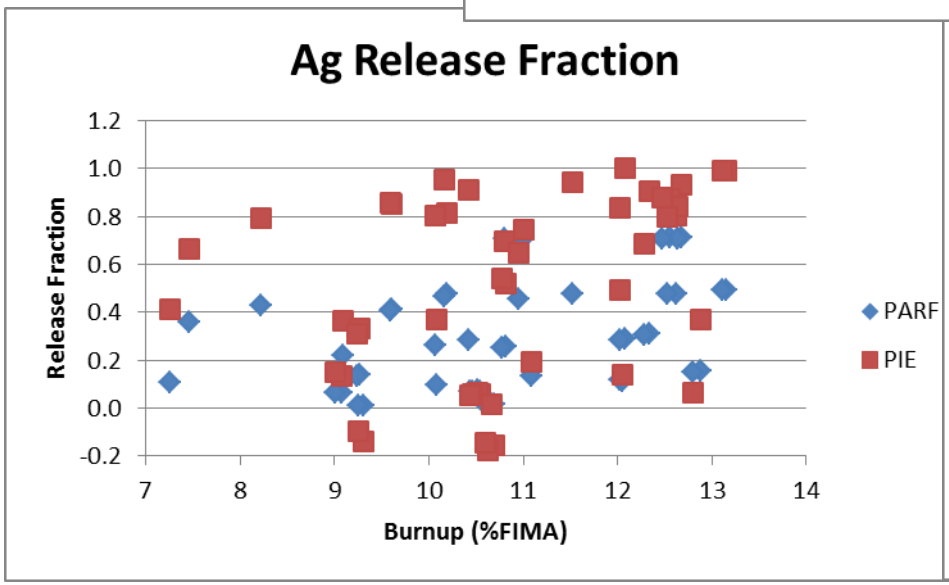
AGR-2 compacts

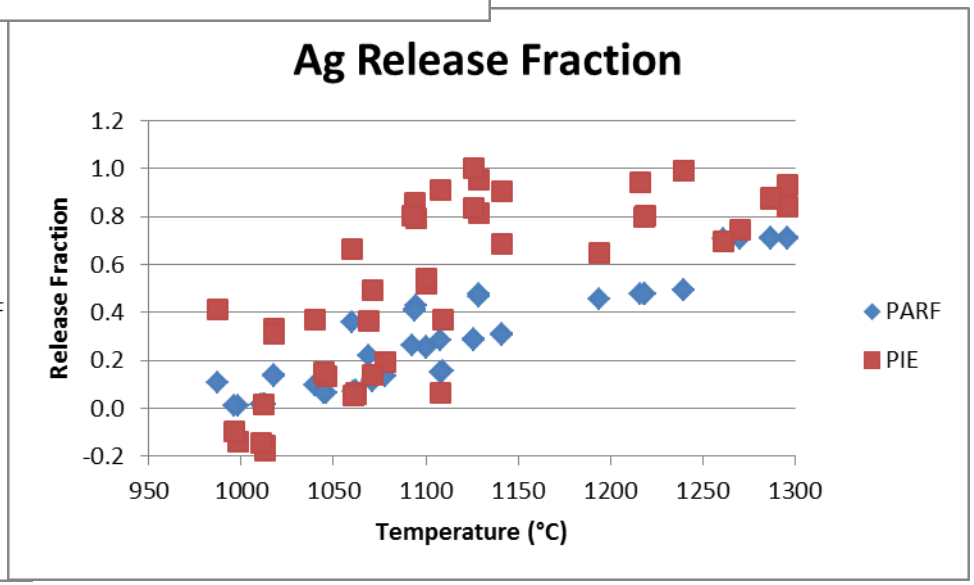




AGR-2 Ag fractional release – PARFUME vs. PIE







AGR-2 Ag fractional release – PARFUME vs. PIE

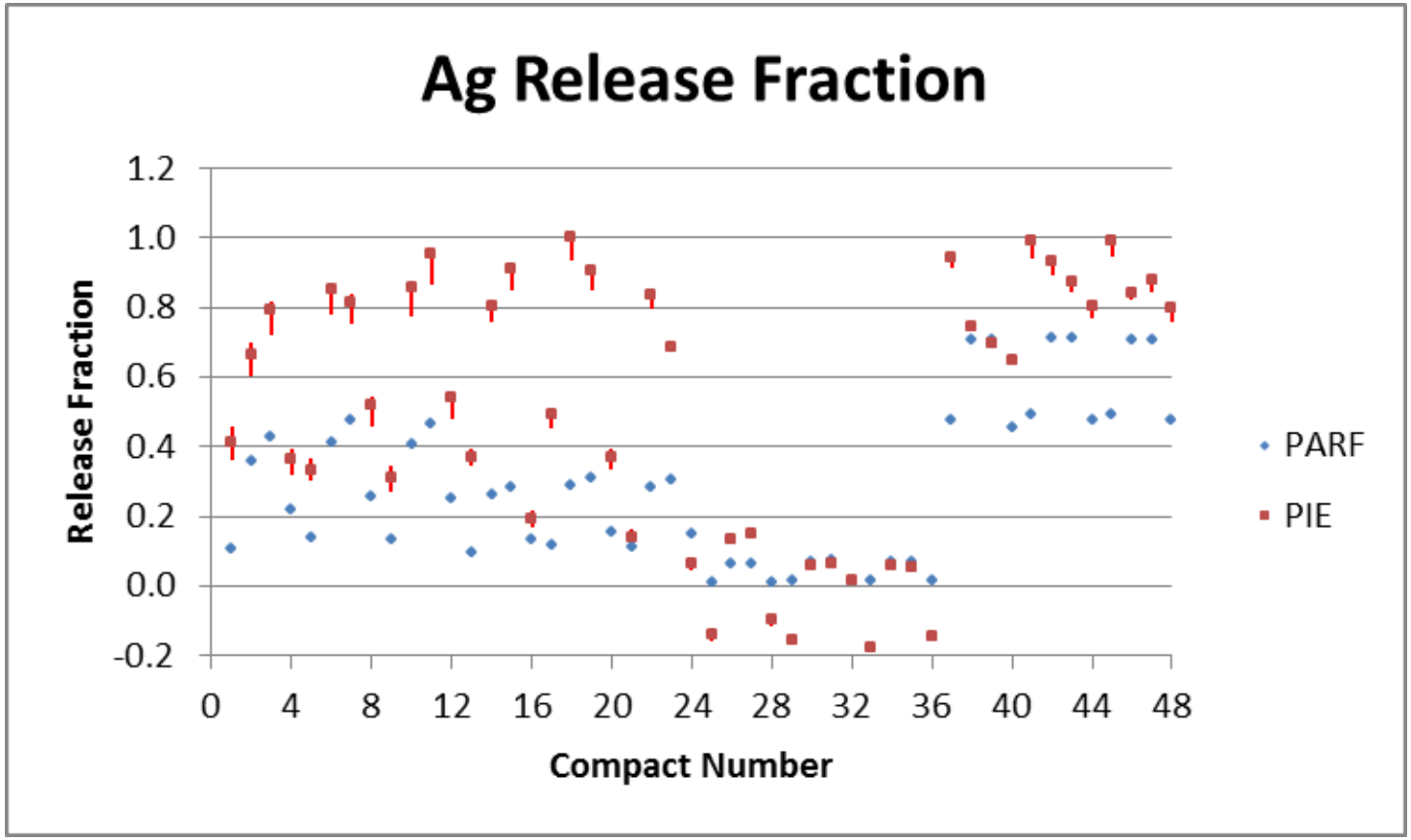
- Still preliminary results
- Need to check correlation between release and temperature
- Need to check potential temperature threshold effect
- Difference between UO_2 and UCO?

Questions?

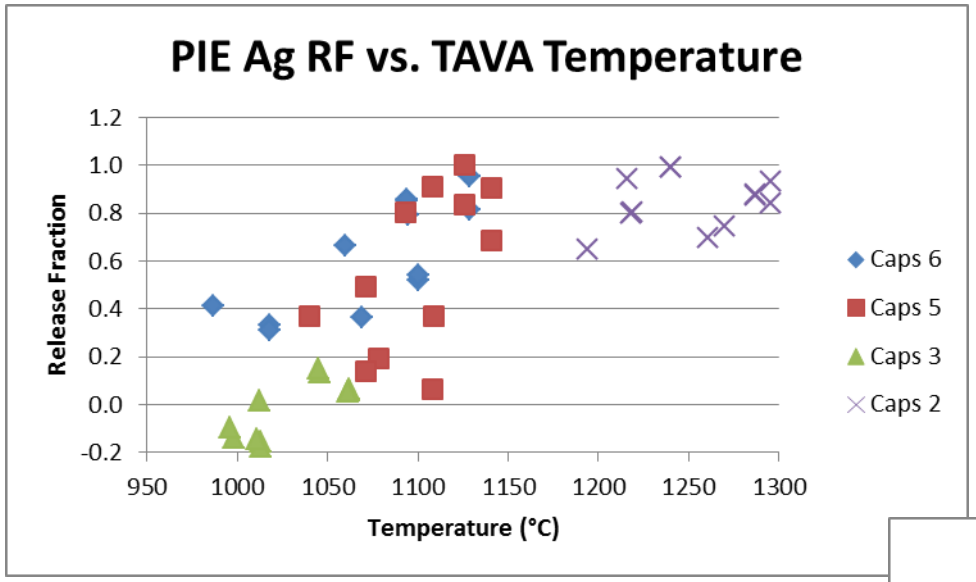
Blaise Collin
blaise.collin@inl.gov

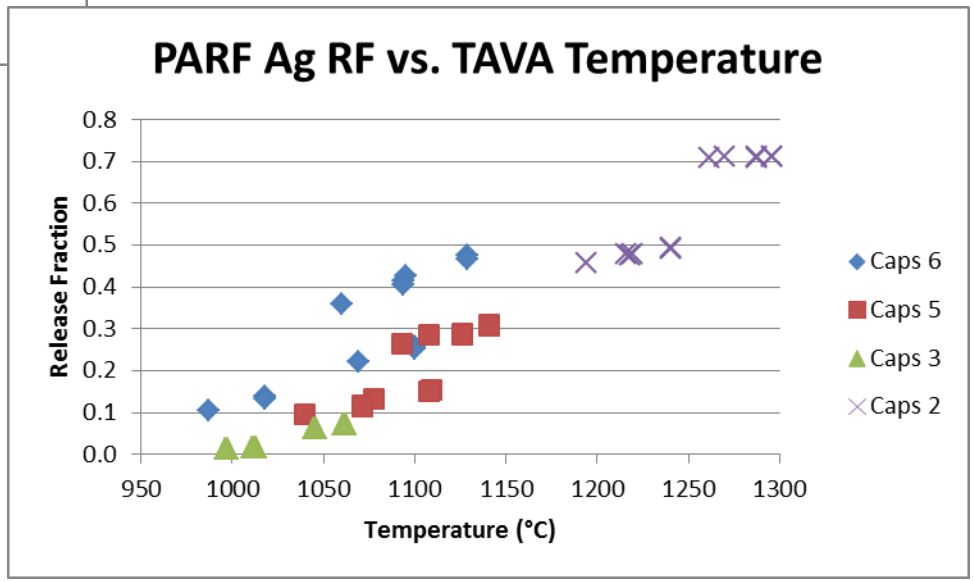
Idaho National Laboratory
(208) 526-2217

AGR-2 Ag fractional release – PARFUME vs. PIE

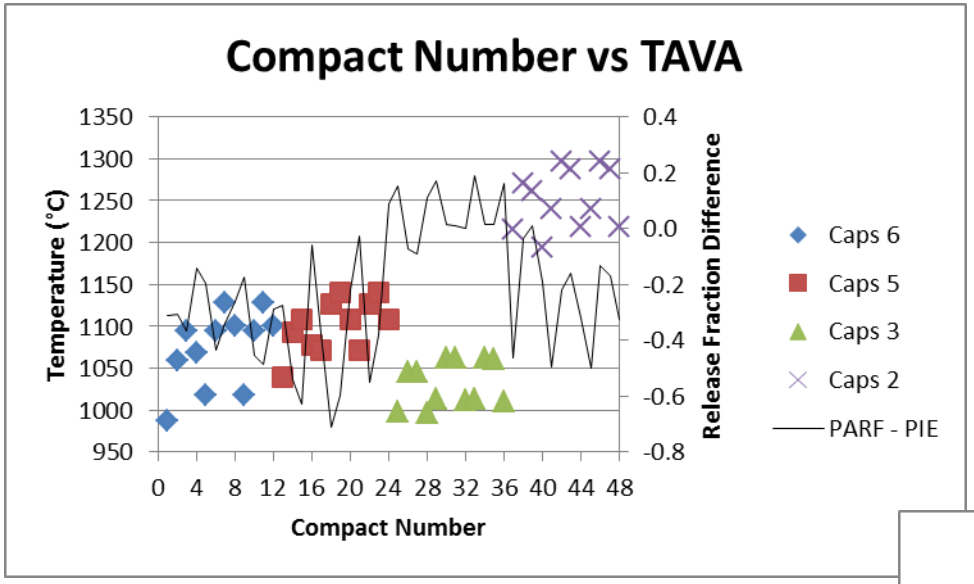


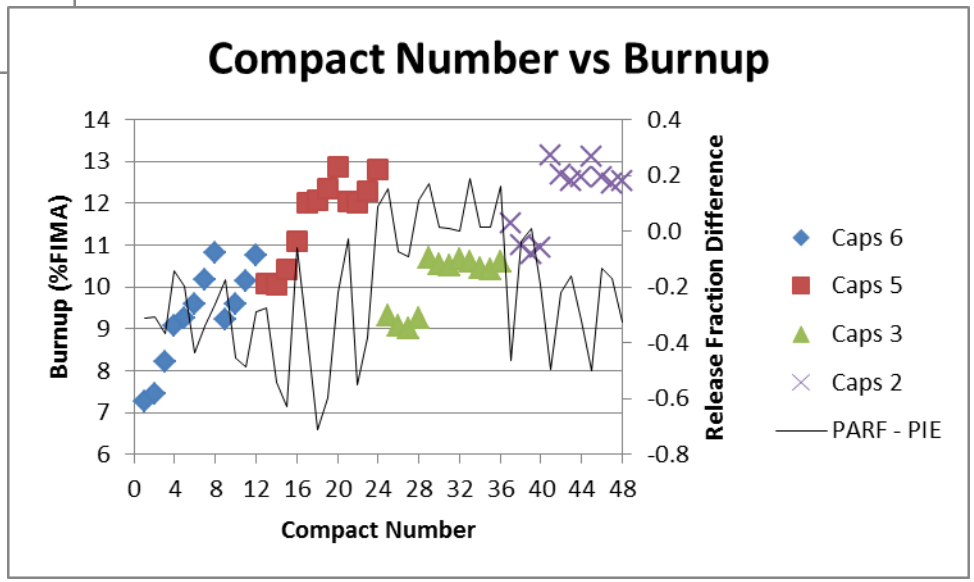
AGR-2 Ag fractional release – PARFUME vs. PIE





AGR-2 Ag fractional release – PARFUME vs. PIE





Fuel Characteristics (1/2)

Category	Parameter	Fuel type Mean Value ± Standard Deviation	
		UCO	UO_2
Fuel characteristics	U235 enrichment (wt%)	14.029 ± 0.026	9.600 ± 0.010
	Oxygen/uranium (atomic ratio)	1.428 ± 0.005	2.003 ± 0.005
	Carbon/uranium (atomic ratio)	0.392 ± 0.002	N/A
	Uranium contamination fraction	1.59×10^{-6}	1.57×10^{-6}
Particle geometry	Kernel diameter (μm)	426.7 ± 8.8	507.7 ± 11.9
	Buffer thickness (μm)	98.9 ± 8.4	97.7 ± 9.9
	IPyC thickness (μm)	40.4 ± 2.5	41.9 ± 3.2
	SiC thickness (μm)	35.2 ± 1.2	37.5 ± 1.2
	OPyC thickness (μm)	43.4 ± 2.9	45.6 ± 2.4
	Particle asphericity @ SiC (aspect ratio)	1.037 ± 0.011	1.034 ± 0.010

Fuel Characteristics (2/2)

Category	Parameter	Fuel type Mean Value ± Standard Deviation	
		UCO	UO_2
Compact characteristics	Diameter (mm)	12.286 ± 0.005	12.269 ± 0.007
	Number of particles per compact	3176	1543
	Compact matrix density (g/cm^3)	1.589 ± 0.005	1.680 ± 0.008
Material properties	Kernel density (g/cm^3)	10.966 ± 0.033	10.858 ± 0.082
	Buffer density (g/cm^3)	1.05	0.99
	IPyC density (g/cm^3)	1.890 ± 0.011	1.90 ± 0.05
	OPyC density (g/cm^3)	1.907 ± 0.007	1.884 ± 0.004
	IPyC (post compact anneal) BAF	1.0465 ± 0.0049	1.0471 ± 0.0036
	OPyC (post compact anneal) BAF	1.0429 ± 0.0019	1.0365 ± 0.0016

Diffusion Coefficients

Species	$D_{0,i}$ (m^2/s) $Q_{0,i}$ (kJ/mol)	Kernel	Buffer	IPyC / OPyC	SiC	Matrix graphite	Structural graphite
Ag	$D_{0,1}$	6.7×10^{-9}	10^{-8}	5.3×10^{-9}	3.6×10^{-9}	1.6	1.6
	$Q_{0,1}$	165	0	154	215	258	258
Cs	$D_{0,1}$	5.6×10^{-8}	10^{-8}	6.3×10^{-8}	$5.5\times10^{-14}\times e^{\Gamma/4.5}$	3.6×10^{-4}	1.7×10^{-6}
	$Q_{0,1}$	209	0	222	125	189	149
	$D_{0,2}$	5.2×10^{-4}	-	-	1.6×10^{-2}	-	-
	$Q_{0,2}$	362			514		
Kr	$D_{0,1}$	1.3×10^{-12} / 8.8×10^{-15}	10^{-8}	2.9×10^{-8}	37 / 8.6×10^{-10}	6.0×10^{-6}	6.0×10^{-6}
	$Q_{0,1}$	126 / 54	0	291	657 / 326	0	0
	$D_{0,2}$	0 / 6.0×10^{-1}	-	2.0×10^{5}	-	-	-
	$Q_{0,2}$	0 / 480		923			
Sr	$D_{0,1}$	2.2×10^{-3}	10^{-8}	2.3×10^{-6}	1.2×10^{-9}	10^{-2}	1.7×10^{-2}
	$Q_{0,1}$	488	0	197	205	303	268
	$D_{0,2}$	-	-	-	1.8×10^{-6}	-	-
	$Q_{0,2}$				791		