



SOUTH WEST NUCLEAR HUB

Examining Radiocesium (Cs*) Release Potential From Chornobyl Red Forest Materials Under Wildfire Event Conditions: Implications for Atmospheric Availability & Dispersion Modelling

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James Bond star Sir Sean Connery dies aged 90

19:05



Wildfires 'edge closer to Chernobyl nuclear plant'

(13 April 2020)







Footage shows wildfires near the nuclear disaster site

Forest fires that have been burning for several days in northern Ukraine are now no more than a few kilometres from the abandoned Chernobyl nuclear





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Modified from Connor et al (2021)







"An important factor in our simulations was the emission factor of ¹³⁷Cs after a fire event, namely the fraction that will be emitted compared to what is present on the ground or in the biomass. Yoschenko et al. (2006) reported that this fraction is 4% conducting fire experiments in Chernobyl (small, controlled fires) and measuring budgets. Amiro et al. (1996) found that the emission factor ranges between 20% and 100%".





Aims & Objectives:

- Understanding of Cs* distribution and speciation.
- Derive gross alpha/beta/gamma activities.
- Determination of inventory of Cs* (and Sr*) within organics (pine, silver birch, acorns).
- Ascertain thermal emission behavior of Cs* under fire conditions.

Methodology:

- Gamma Spectrometry
- Gross Alpha/Beta Counting (in aq. solution)
- Micro-XRF
- Cerenkov Counting of Sr-90 (via Sr-85 spike)
- Thermal Decomposition in Pyrolyser-Trio
- Autoradiography (digital storage phosphor imaging plate)







Chornobyl Red Forest Samples:











ID	Sample Type
1246-A	Pine 1 – tree section (in resin)
1246-B	Pine 2 – tree section
246-B (A)	Pine 2 inner
246-B (B)	Pine 2 middle
246-B (C)	Pine 2 outer
1248	Silver Birch – tree section
1248 (A)	Silver Birch inner
1248 (B)	Silver Birch outer
1248-A	Silver Birch – tree section (in resin)
1249	Acorns - Acorn
1249-A	Acorns – Acorn half (in resin)





Gross Alpha/Beta:

ID	Measurement Date	Gross Alpha	+/-	Gross Beta	+/-
1246-B	27/07/2021	<2	-	1,000	100
1246-B (A)	09/09/2021	<2	-	1,200	100
1246-B (B)	09/09/2021	<1	-	1,100	100
1246-B (C)	09/09/2021	<1	-	750	70
1248	27/07/2021	<20	-	9,300	900
1248 (A)	09/09/2021	<10	-	10,000	1,000
1248 (B)	09/09/2021	<10	-	16,000	1,000
1249	19/07/2021	<10	-	2,600	200

Results are quoted in Bq/g (as received) Uncertainties are based on combined standard uncertainties, coverage factor k = 2





Sr-90:

ID	Sr-90	+/-
1246-B	430	50
1248	3,100	300
1249	580	70

Results are quoted in Bq/g (as received) Uncertainties are based on combined standard uncertainties, coverage factor k = 2





Gamma Spectrometry:

ID	Cs-137	+/-
1246-B	9.2	0.5
1246-B (A)	6.1	0.7
1246-B (B)	8.9	0.7
1246-B (C)	10.2	0.8
1248	370	20
1248 (A)	280	20
1248 (B)	470	30
1249	1280	70

Results are quoted in Bq/g (as received) Uncertainties are based on combined standard uncertainties, coverage factor k = 2





Autoradiography:





<< 1246-A (10-min exposure)



1248-A (1-min exposure) >>





Autoradiography:



1249-A (10-min exposure)



ВВС

GARDENERS OUESTION TIME







Thermal Decomposition:

	400°C		500°C		600°C		700°C		800°C	
	Cs-137	+/-								
1246-B (A)	1.1	0.2	1.1	0.2	1.1	0.2	1.0	0.1	1.0	0.1
1246-B (B)	0.9	0.1	1.0	0.1	1.0	0.1	1.01	0.09	1.03	0.09
1246-B (C)	1.1	0.2	1.1	0.3	0.9	0.2	1.20	0.2	1.1	0.1
1248 (A)	1.0	0.1	0.95	0.09	1.00	0.08	1.1	0.1	1.05	0.09
1248 (B)	1.02	0.08	1.01	0.08	1.01	0.09	1.01	0.08	1.05	0.09
1249	0.98	0.08	0.99	0.08	1.00	0.08	1.01	0.08	0.99	0.08

Results are quoted as a fraction of initial activity.

Cs-137 activity in the sample has been normalised to the initial activity present prior to combustion.





Conclusions, Future Work & Next Steps:

- Significant inventory of Cs* (and Sr*) within Chornobyl Red Forest derived organics.
- Strongly localised activity within pine, birch and acorn materials.
- Liberation of Cs* from charred materials limited under combustion within 'air' and OFN atmospheric conditions.
- Severe wildfire conditions unlikely to liberate significant inventories of Cs* from Red Forest environment.
- Applications within wider tree-science community with respect to material uptake and internal biological processes.
- Larger-scale combustion analysis with 'fuel consumption' conditions.
- Publication within Wildfire Research Journal, or Journal of Environmental Radioactivity.
- Evaluation of ground/biomass releases into mass-budget.
- NERC Discovery Science Grant submission following earlier rejection.
- Involvement in larger 'Chornobyl Consortia' NERC Programme Grant.

