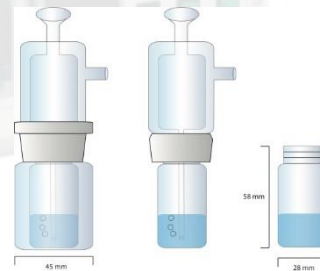
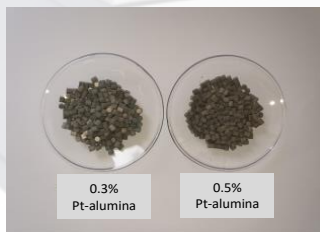
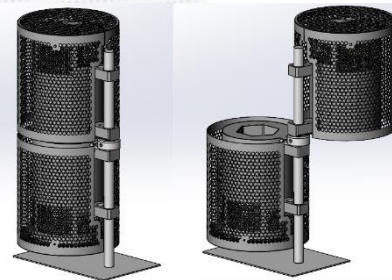


# Raddec - New innovations

Phil Warwick



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# Pyrolyser Gen III



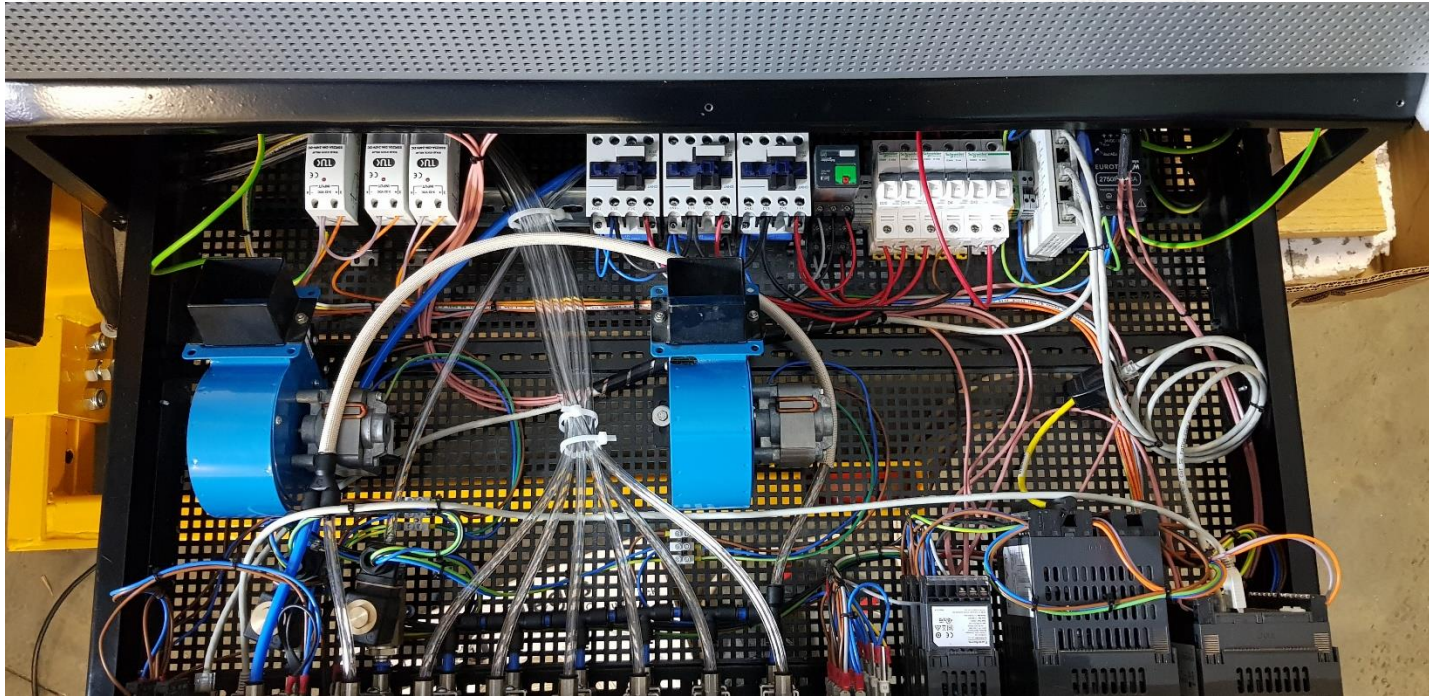
New front panel layout

All controls are now at the front

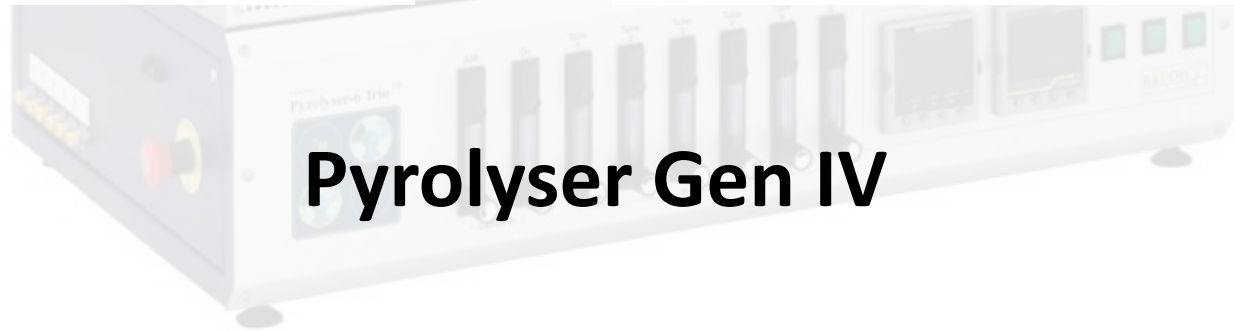
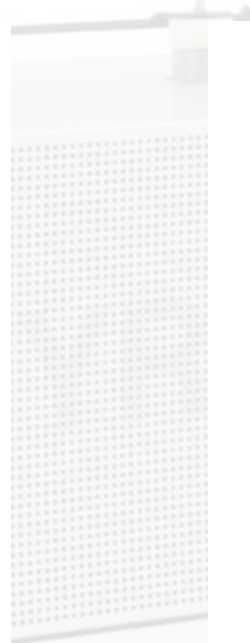
All electronics are housed within a sliding tray accessed at the front of the furnace



# Pyrolyser Gen III draw



Straightforward maintenance and repair from the front of the furnace



# Pyrolyser Gen IV



# Improved system building and servicing by using an instrument drawer system

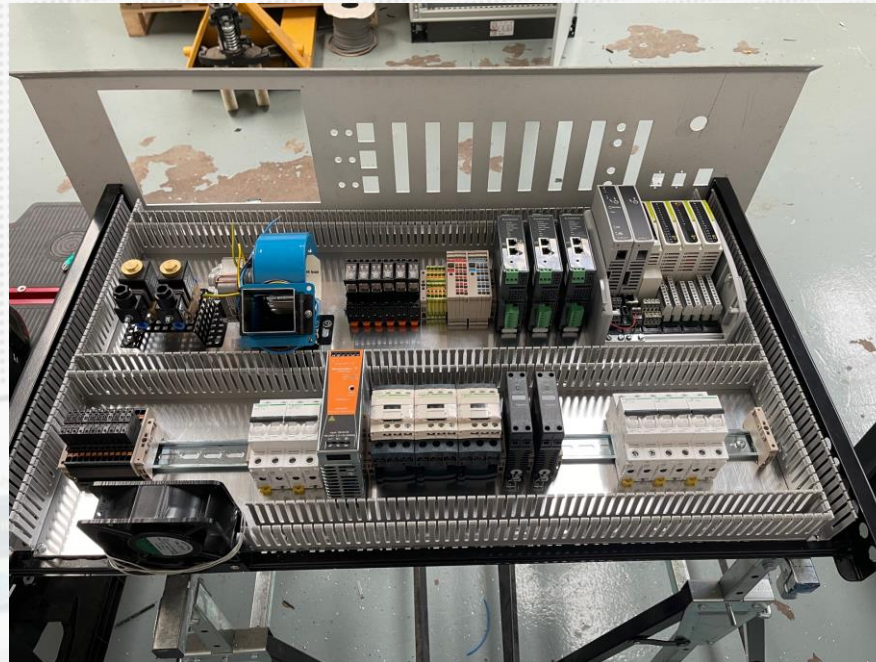
Enhanced electrical build to meet CSA standard

24 Volt DC components for enhanced safety

Single centrifugal fan with manifold to cool two zones

Single centrifugal fan with manifold to cool two zones

AIR, OXYGEN supplies - NITROGEN OPTION



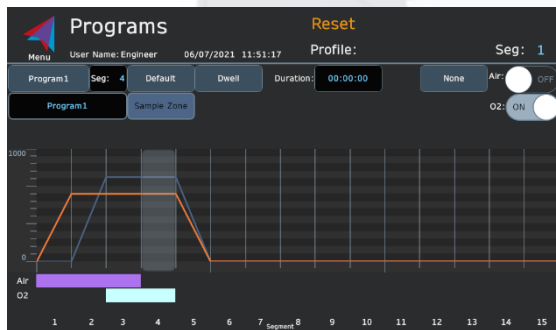
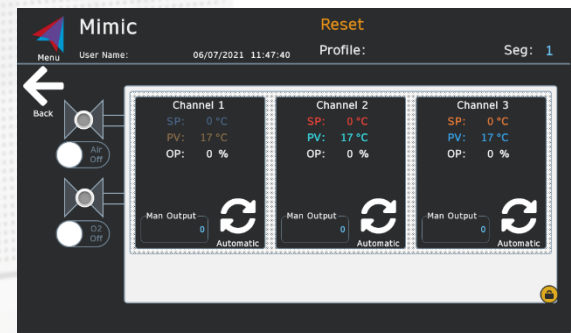
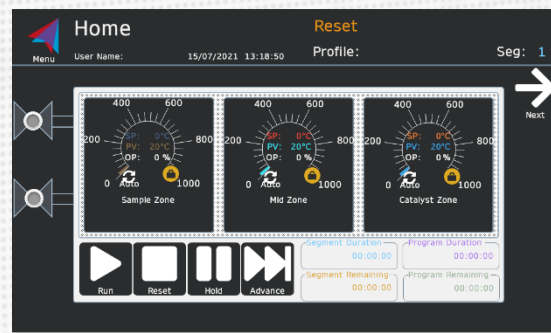
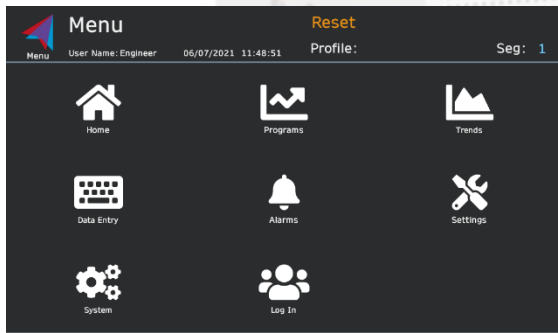
# Pyrolyser-6 Trio Generation<sup>IV</sup>

- Incorporates a EUROTHERM HMI-PLC system
- E+PLC400 racks with modules
- 7" HMI (touch sensitive programming)
- 3 x EPC2000 O/T controllers
- Sample and Mid-zone rapid cool down facility for rapid cycling (fan+chimney)

The **Pyrolyser- Trio GenIV HMI-PLC** system :-

- 3 completely independent furnace zones
- stores 20 editable heating programs;
- each program offers up to 15 segments.
- The user can modify existing programs whilst the Pyrolyser is running a current program.
- A multi-level LOGIN system is available to manage users at different levels (Operator, Supervisor, Engineer)

The **Pyrolyser- Trio GenIV HMI-PLC** system stores 20 editable programs; each program offers up to 15 segments. The user can modify existing programs whilst the Pyrolyser is running a current program. A multi-level LOGIN system is available to manage users at different levels (Operator, Supervisor, Engineer)



The 'Data Entry' screen displays a table for entering sample data across six workstubs. The table includes columns for Sample Name, Sample Type, Catalyst Type, Wet or Dry, and Sample Mass Grams.

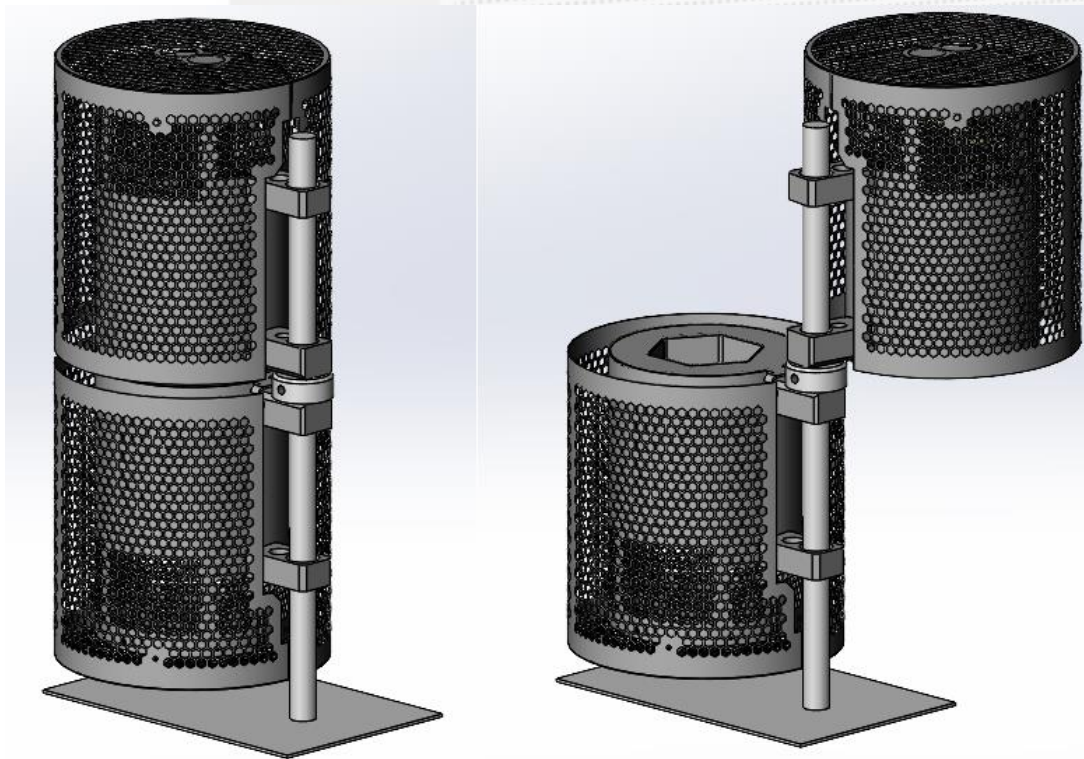
	Workstube 1	Workstube 2	Workstube 3	Workstube 4	Workstube 5	Workstube 6
Sample Name	Test3	Test3	Test3	Test3	Test3	Test3
Sample Type	New Samp	New Samp	New Samp	New Samp	New Samp	New Samp
Catalyst Type	0.3% Pt-Al	0.3% Pt-Al	0.3% Pt-Al	0.3% Pt-Al	0.3% Pt-Al	0.3% Pt-Al
Wet or Dry	Wet	Wet	Wet	Wet	Wet	Wet
Sample Mass Grams	1.00	1.00	1.00	1.00	1.00	1.00

The 'Alarms' screen displays a table of active alarms. The table includes columns for Active Date, Active Time, AlarmMessage, and AlarmStatus.

	Active Date	Active Time	AlarmMessage	AlarmStatus
Active	06/07/2021	11:47:11	Sample Zone Over Temp	Active
Historical	06/07/2021	11:47:11	Mid Zone Over Temp	Active
	06/07/2021	11:47:11	Catalyst Zone Over Temp	Active



# Pyrolyser mini



Modular construction for installation in glovebox environments.

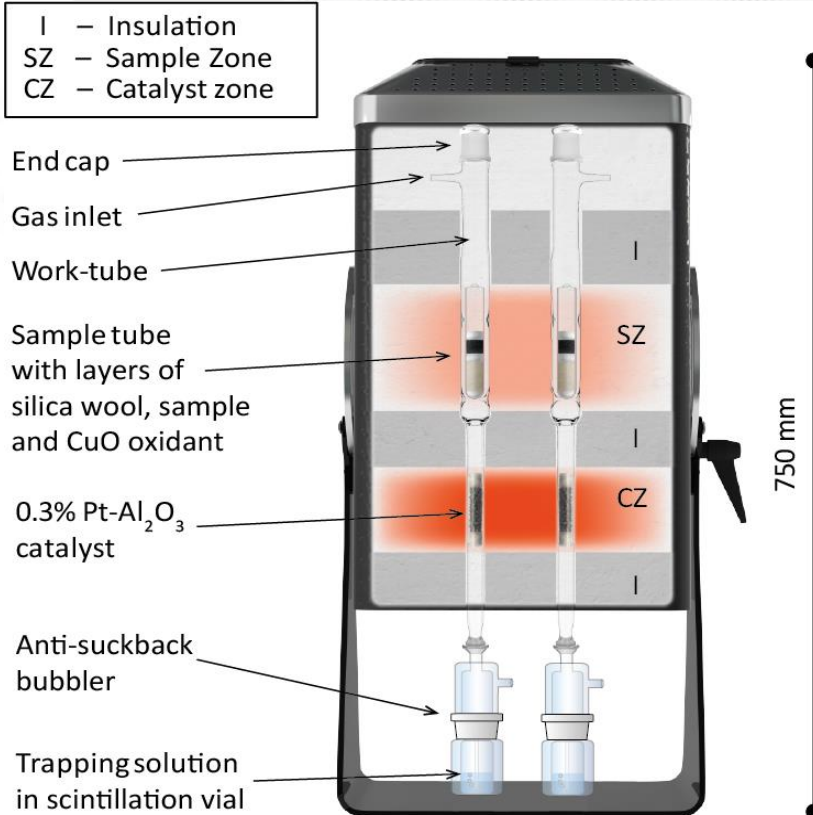
Readily accessible components for ease of maintenance.

Elements installed in a replaceable module.

Remotely located control unit

Multi-function capability.

# Pyrolyser Mini trials

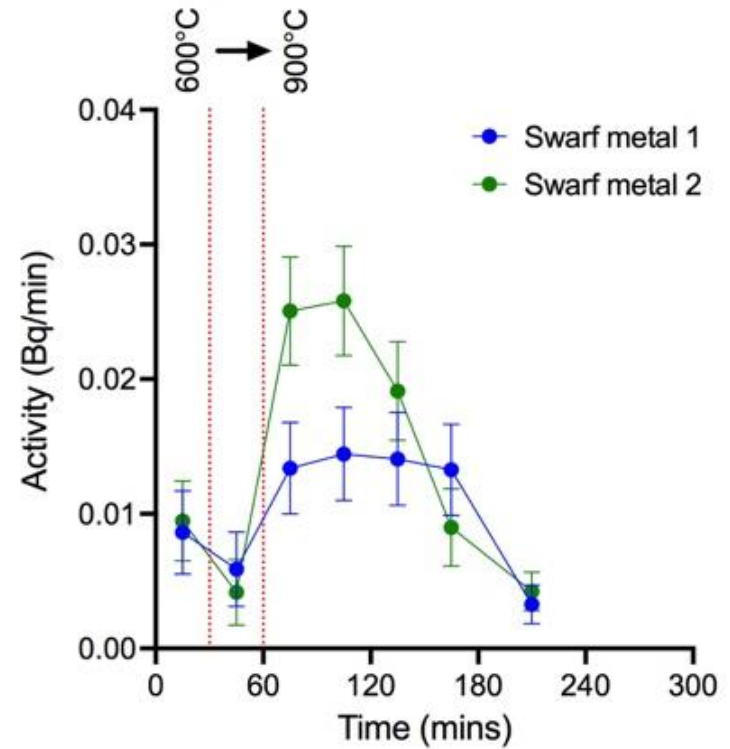
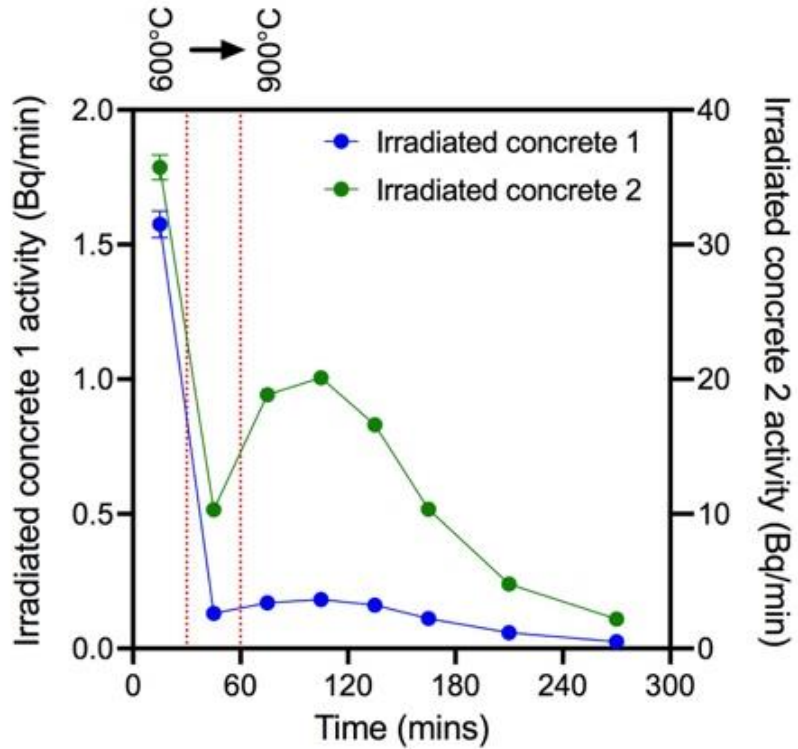


Samples loaded at 600°C then heated to 900°C.

Catalyst zone held at 800°C

This work was supported by the Nuclear Decommissioning Authority under their Direct Research Portfolio [NS4510-500-003].

# $^3\text{H}$ evolution profiles



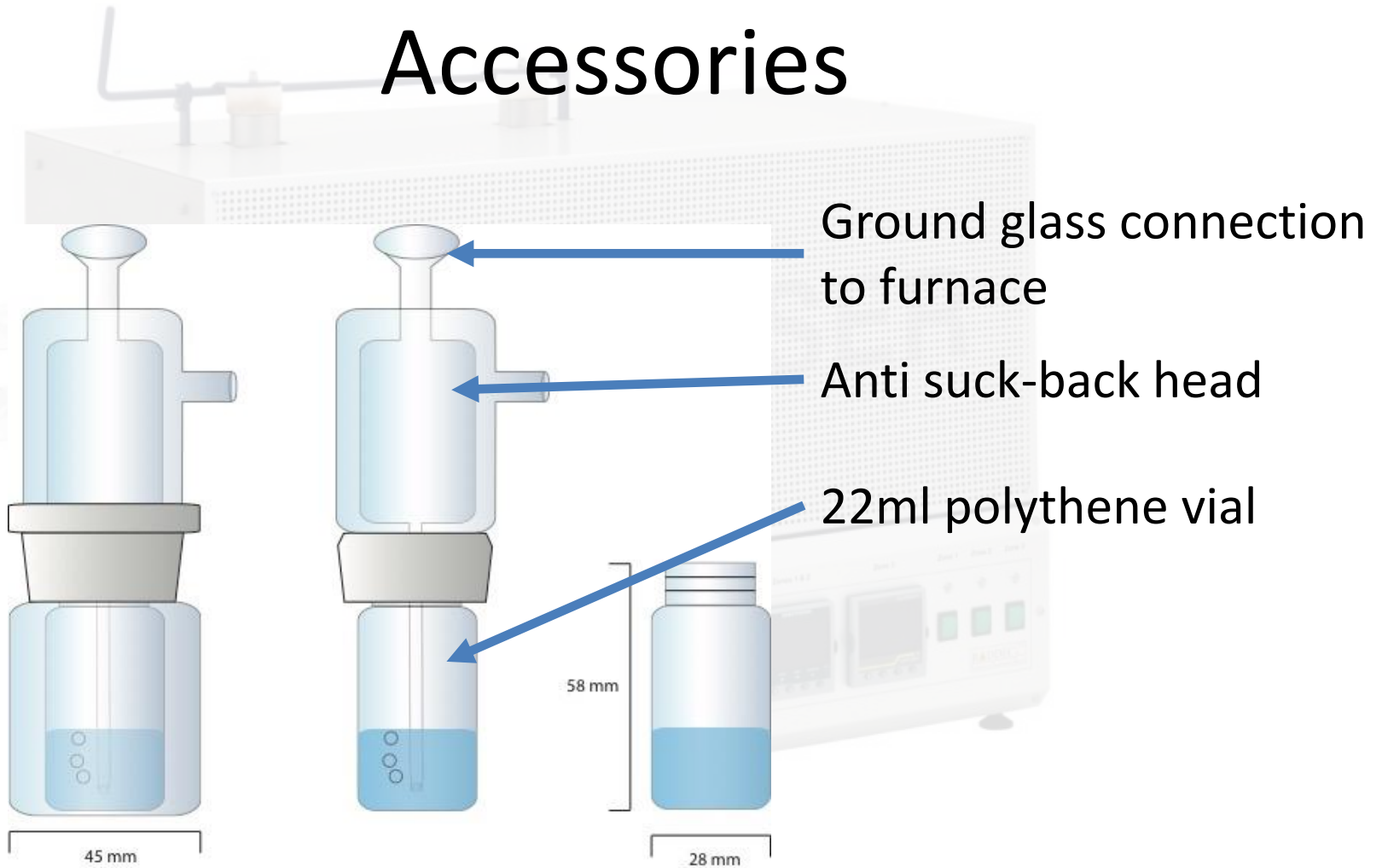


# Extraction of $^3\text{H}$ and $^{14}\text{C}$ using a Pyrolyser Mini

Sample	H-3 activity (Bq/g)			C-14 activity (Bq/g)	
	Working value	Measured in 0.1M $\text{HNO}_3$	Measured in Carbontrap	Working value	Measured
Structural concrete (1.5 g)	$4.8 \pm 0.5$	$6.5 \pm 0.8$	$6.9 \pm 0.8$	$0.55 \pm 0.07$	$0.59 \pm 0.08$
Irradiated concrete 1 (1.5 g)	$37 \pm 8$	$38 \pm 4$	$46 \pm 5$	$2.5 \pm 0.3$	$2.8 \pm 0.3$
Irradiated concrete 2 (1.5 g)	$1700 \pm 200$	$1900 \pm 200$	$2200 \pm 300$	$7.7 \pm 0.9$	$8 \pm 1$
Swarf metal 1 (1.5 g)	$0.9 \pm 0.6$	$7.6 \pm 0.9$	$2.2 \pm 0.3$	$7.0 \pm 0.3$	$8 \pm 1$
Swarf metal 2 (1.5 g)	$4 \pm 7$	$3.4 \pm 0.4$	$19 \pm 2$	$7.9 \pm 0.1$	$8 \pm 1$
OBT sediment sample (0.5 g)	$11 \pm 3$	$10 \pm 1$	$10 \pm 1$	$0.44 \pm 0.04$	$0.6 \pm 0.1$

Note that the swarf metal contamination is highly heterogeneous

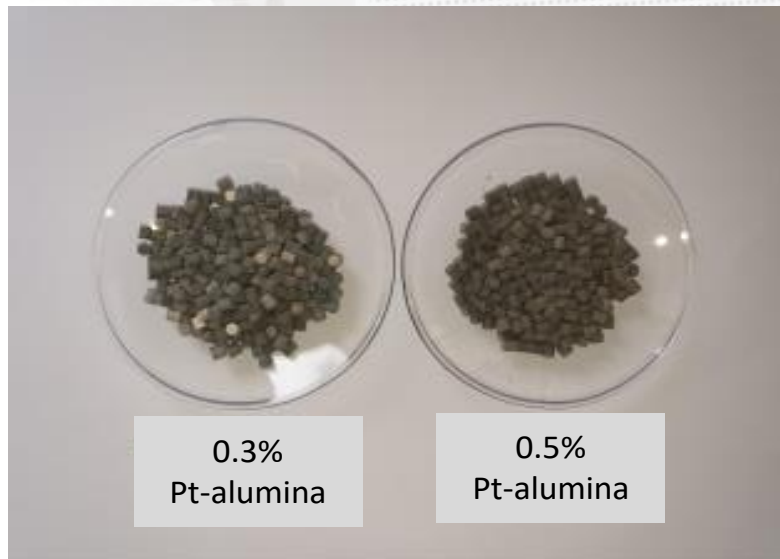
# Accessories



## Integrated vial bubbler

# Pt-alumina catalyst

## Introduction of 0.3% Pt-alumina catalyst



More robust supply of material.  
0.5% Pt-alumina is being phased out.

Tested with  $^3\text{H}$ -thymidine spiked milk.

Catalyst operating at 400°C.

Quantitative recovery of  $^3\text{H}$

No colouration in the bubbler.

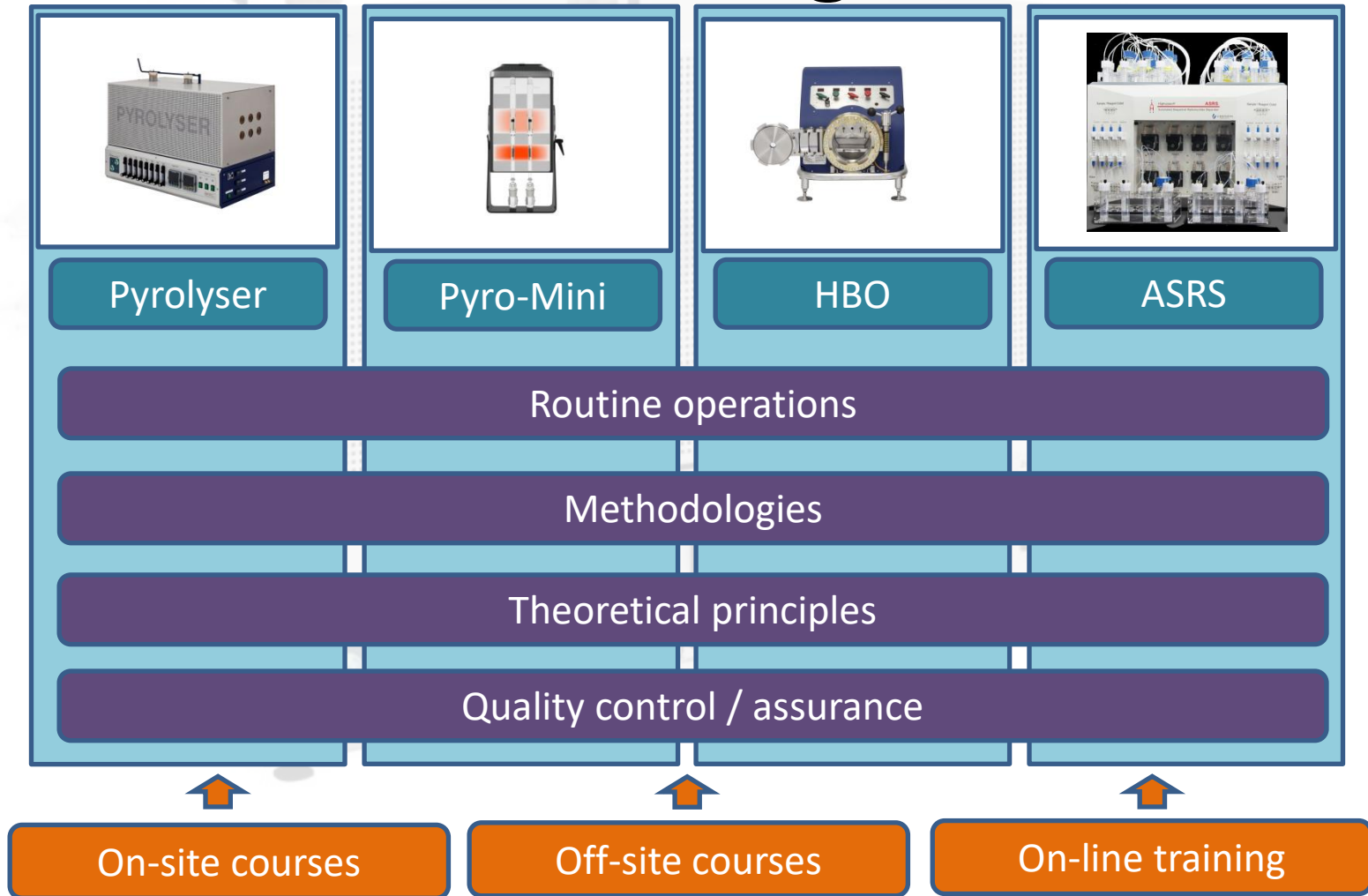
Quench values comparable to those obtained using 0.5% Pt-alumina



# Other improvements

- New standard worktube with a B34 entry cone to enable larger diameter boats to enter.
- Provision of larger diameter worktubes (up to 42 mm OD to enable even larger sample to be loaded (e.g. 10 grams Fish, biota, foodstuffs)
- Development of a method to cleanly oxidise 10 grams fish in 7.5 hours (so 60 grams of fish in 1 working day)

# Training



# Online

- Main web site at  
[www.raddec.com](http://www.raddec.com)
- Also, see technical videos on YouTube  
(follow link from our website)



# Acknowledgements

## Pyrolyser Mini $^3\text{H}$ & $^{14}\text{C}$ extraction studies

Jonathan Cox (formerly NSG Environmental) and David Wickenden (Magnarox Ltd), for their oversight of this research

Ben Russell (National Physical Laboratory) for a contribution relating to the mobile laboratory deployment and

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