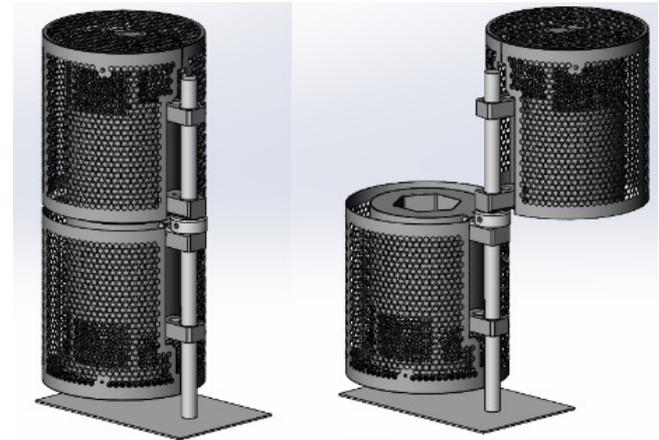


Introduction to the Pyrolyser Mini / DUO combustion furnaces



The Mini / DUO family

- 2-zone furnace systems



The Pyrolyser Mini concept

- Compact design.
- 2 worktubes
- Can be installed in fumecupboard or mobile lab.
- Low power consumption – can operate on 13A.
- Controllers located outside of enclosure.
- Air only – no O₂



Pyrolyser Mini test system



Pyrolyser Mini trials

I – Insulation
SZ – Sample Zone
CZ – Catalyst zone

End cap

Gas inlet

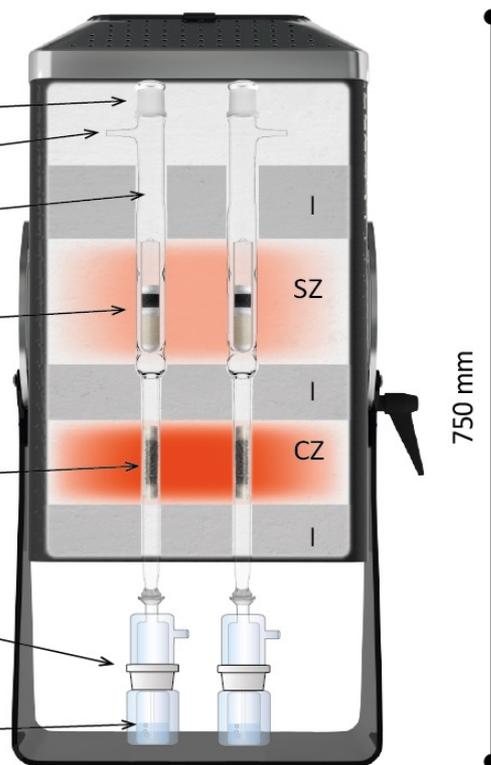
Work-tube

Sample tube with layers of silica wool, sample and CuO oxidant

0.3% Pt-Al₂O₃ catalyst

Anti-suckback bubbler

Trapping solution in scintillation vial



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

Catalyst zone held at 800°C

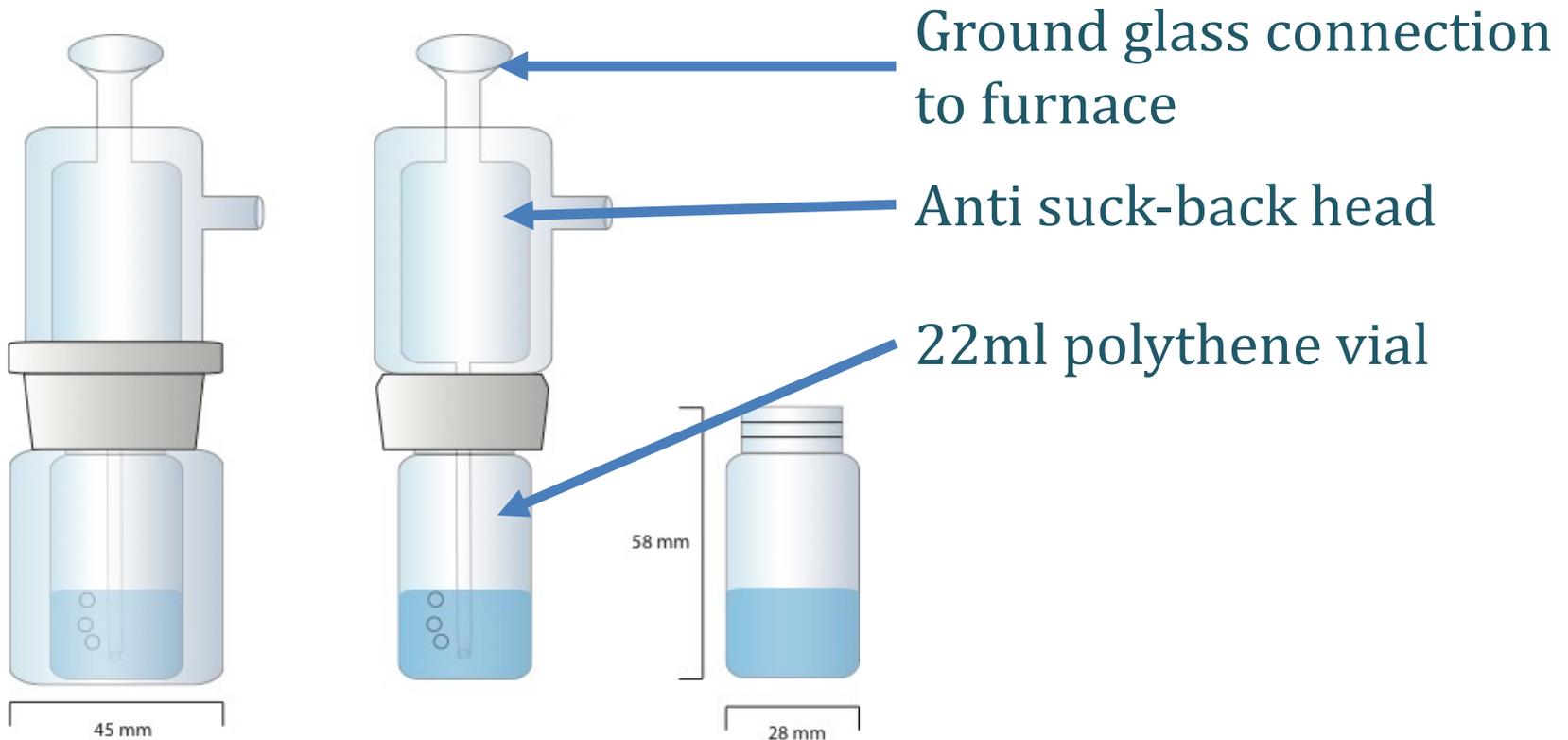
Warwick P.E., Croudace I.W. & Burrell F.M. A compact, dual-zone vertical tube furnace for the determination of tritium and carbon-14 in decommissioning wastes. (2021) *Appl. Radiat. Isot.* **179**, 109995.

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

Sample loading

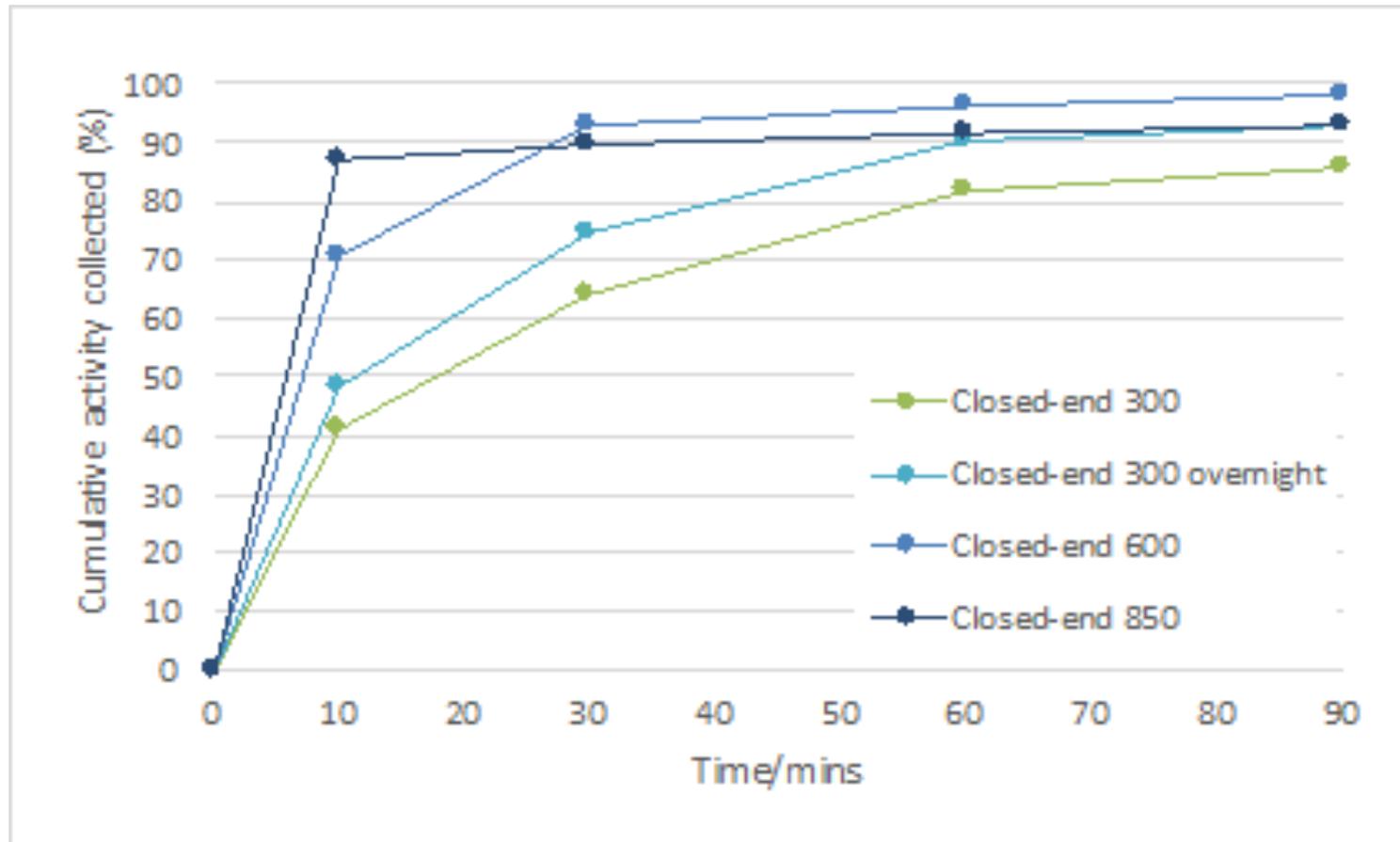


Trapping

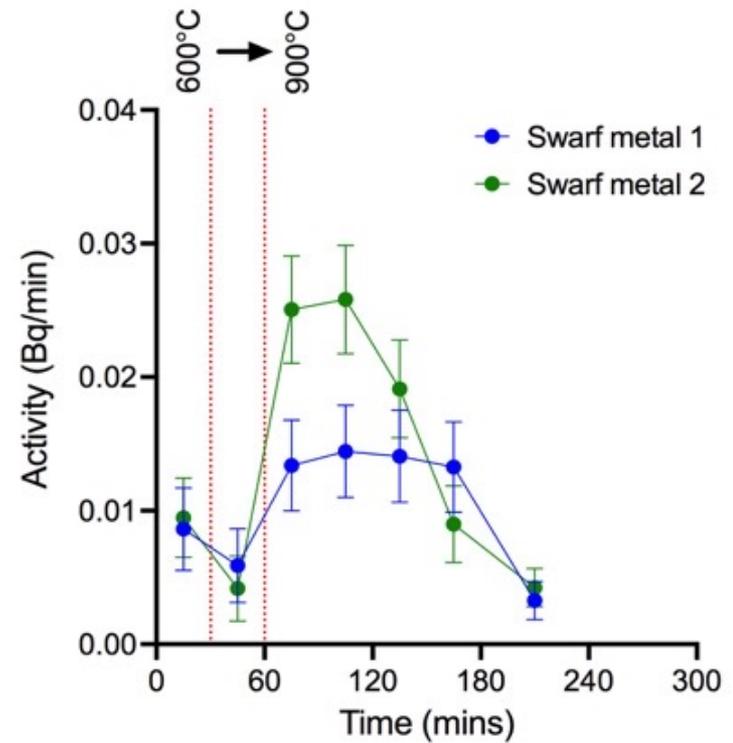
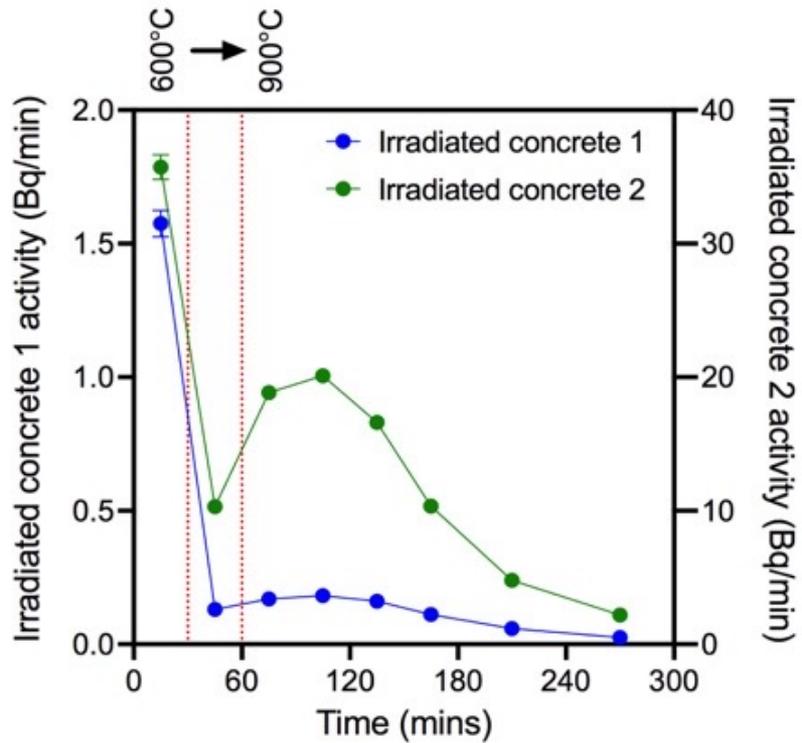


Integrated vial bubbler

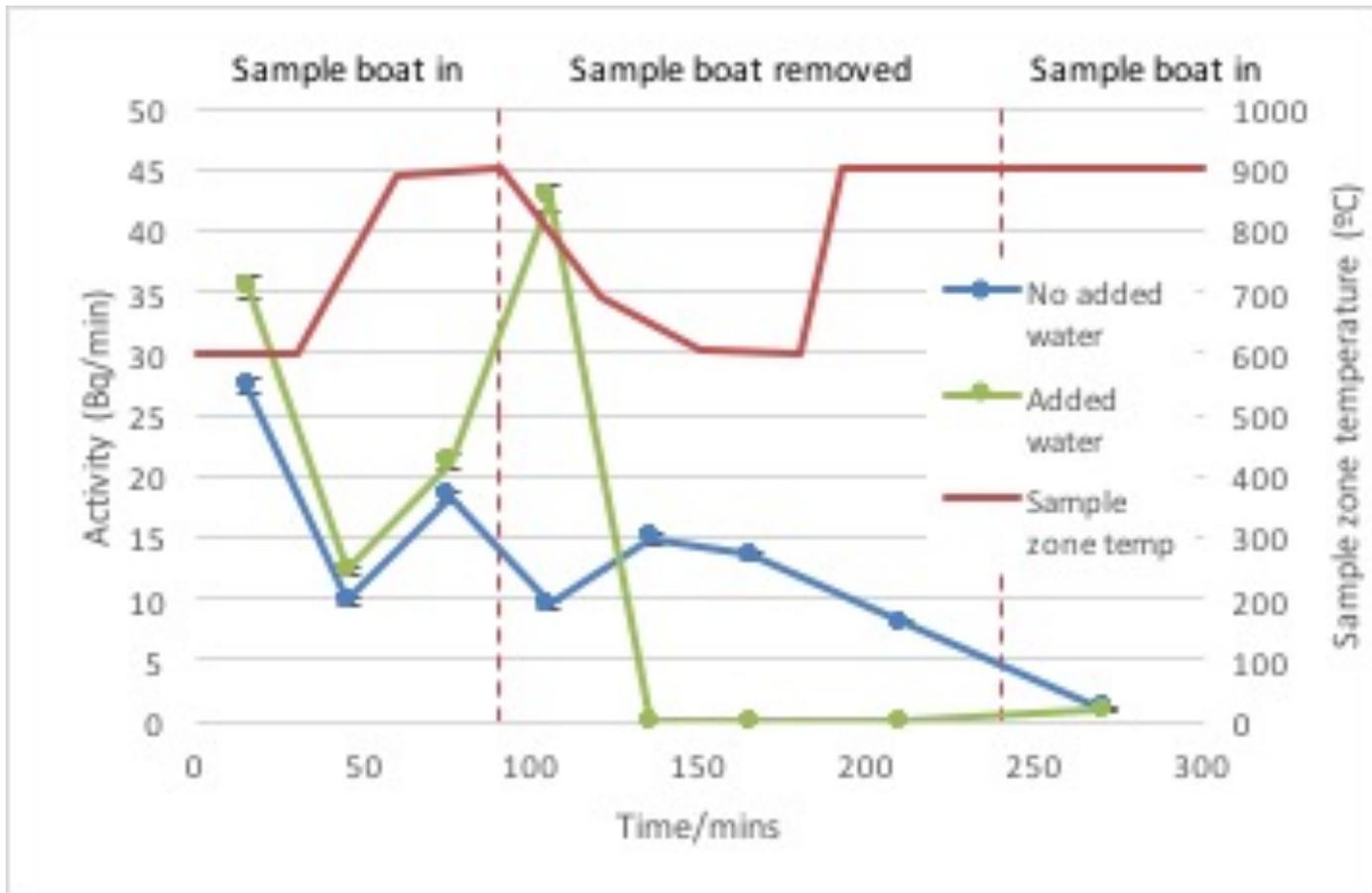
Release of HTO



^3H evolution profiles



Modified method



Modified method = replace sample boat with boat containing additional water to flush deposited activity through work tube

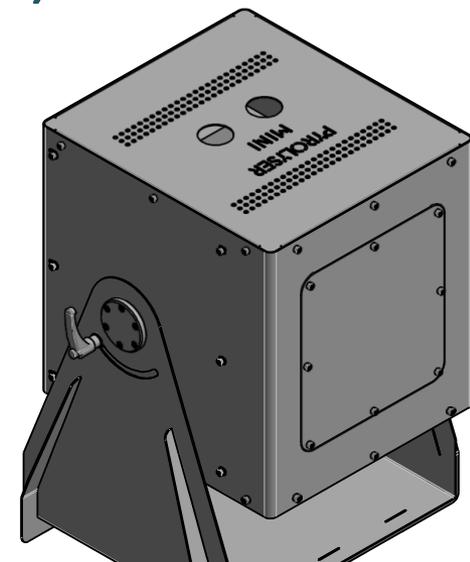
Extraction of ^3H and ^{14}C using a Pyrolyser Mini

Sample	H-3 activity (Bq/g)			C-14 activity (Bq/g)	
	Working value	Measured in 0.1M HNO_3	Measured in Carbontrap	Working value	Measured
Structural concrete (1.5 g)	4.8 ± 0.5	6.5 ± 0.8	6.9 ± 0.8	0.55 ± 0.07	0.59 ± 0.08
Irradiated concrete 1 (1.5 g)	37 ± 8	38 ± 4	46 ± 5	2.5 ± 0.3	2.8 ± 0.3
Irradiated concrete 2 (1.5 g)	1700 ± 200	1900 ± 200	2200 ± 300	7.7 ± 0.9	8 ± 1
Swarf metal 1 (1.5 g)	0.9 ± 0.6	7.6 ± 0.9	2.2 ± 0.3	7.0 ± 0.3	8 ± 1
Swarf metal 2 (1.5 g)	4 ± 7	3.4 ± 0.4	19 ± 2	7.9 ± 0.1	8 ± 1
OBT sediment sample (0.5 g)	11 ± 3	10 ± 1	10 ± 1	0.44 ± 0.04	0.6 ± 0.1

Note that the swarf metal contamination is highly heterogeneous

Pyrolyser Mini v2

- The Pyrolyser Mini has now been redesigned
- 2 work tubes
- Stainless steel case
- Separate control box (based on DUO)



Pyrolyser Duo system

- Rapid screening of concretes and metals for ^3H and ^{14}C to free release limits.
- Combination of radionuclide extraction and measurement functionality
- Operable by non-specialists outside of the laboratory environment.
- Deployable on-site in decommissioning environments.



Set-up

- Services required
 - 240 VAC, Single phase, 13 Amp supply
 - Compressed air supply **~1-5 Bar**
(compressor, cylinder, house-supply)
 - Optional Oxygen supply **~1-3 Bar**
(NB – it is important that a regulator of < 6 Bar is used)
 - Bubbler exhaust extract or charcoal vapour trap when using CarbonTrap



System Overview I

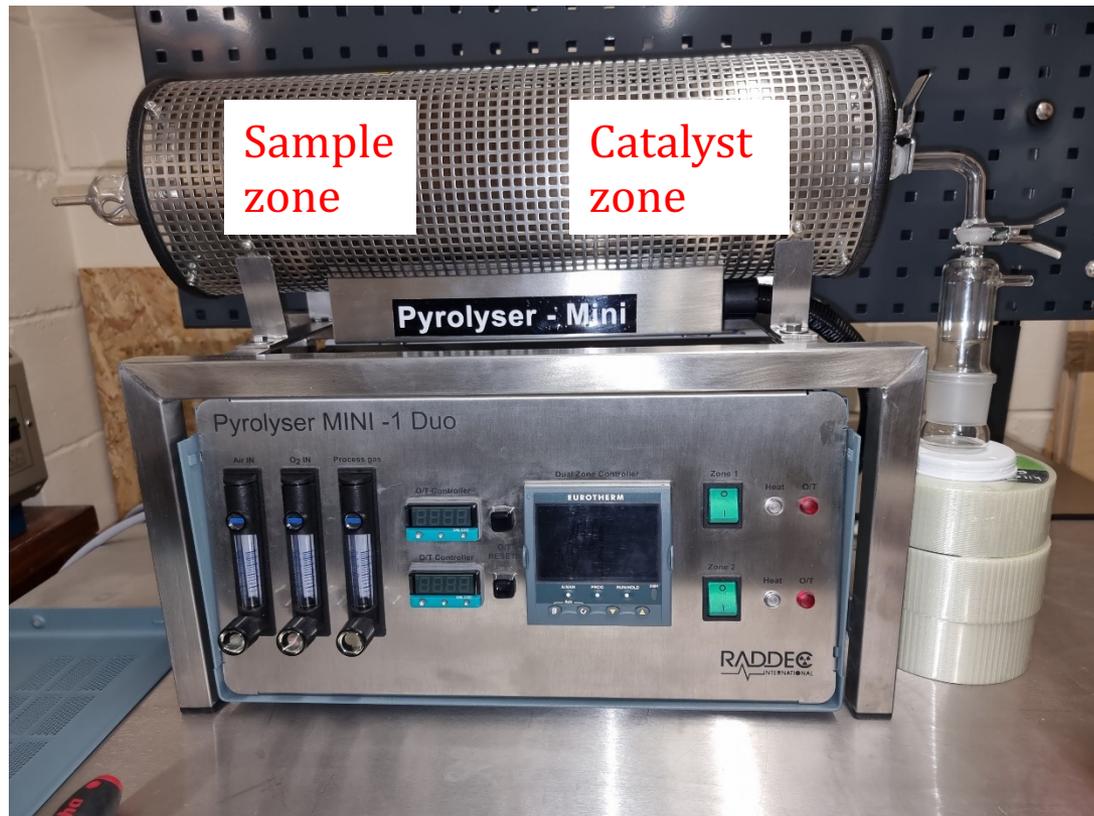
- 2 independent furnace zones
- Independent air/O₂ controls
- 1 quartz glass work-tube
- Glass connection to bubbler
- Eurotherm 3504 temperature controller
- CAL 3300 over-temperature controller



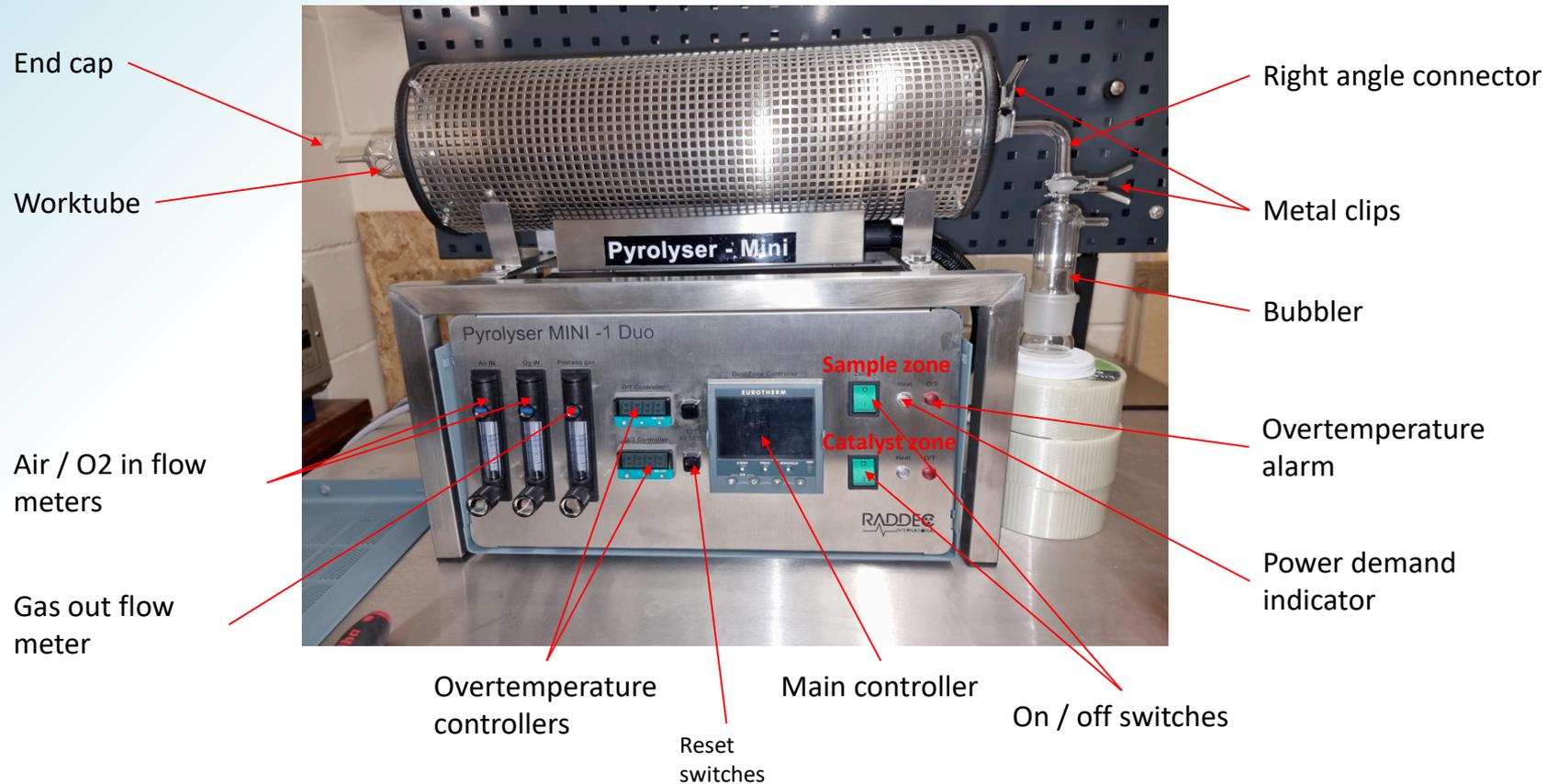
System Overview II

Main furnace
Single quartz
tube

Electronic
Control unit



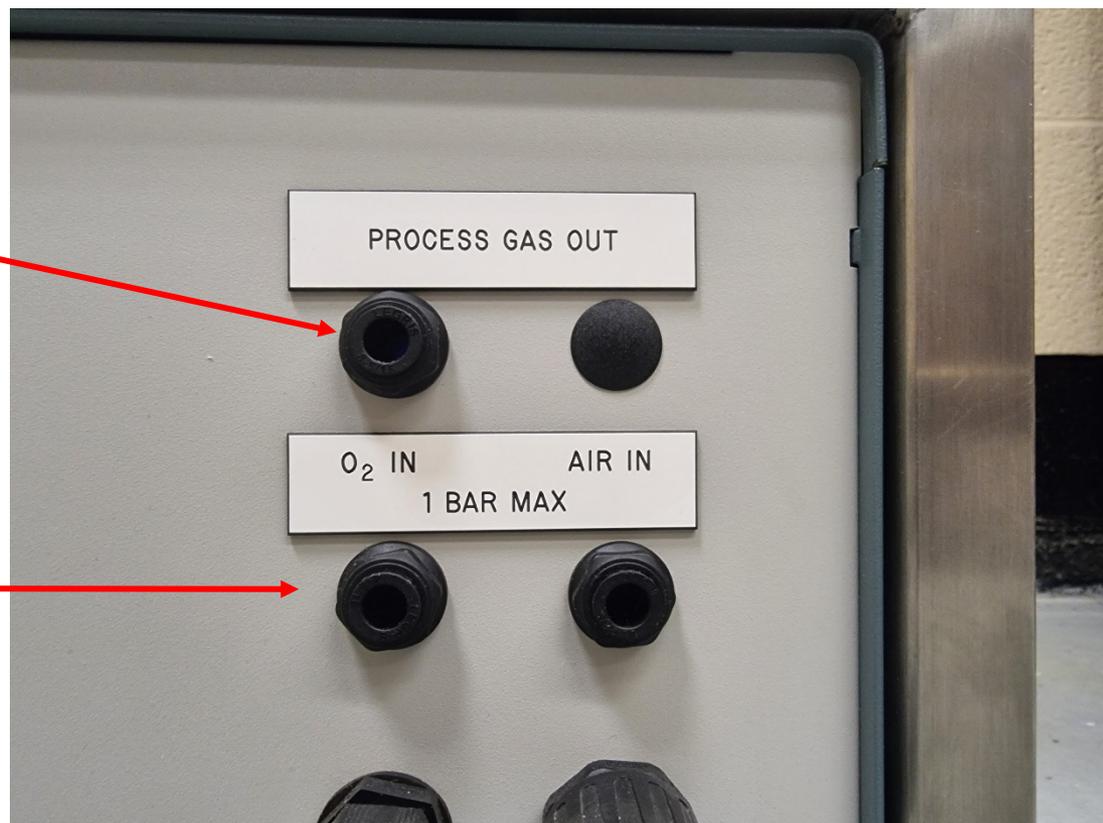
System Overview III



Gas connections

Gas outlet
- 1 bar

Air and O₂
(optional)
inlets
- 1 bar



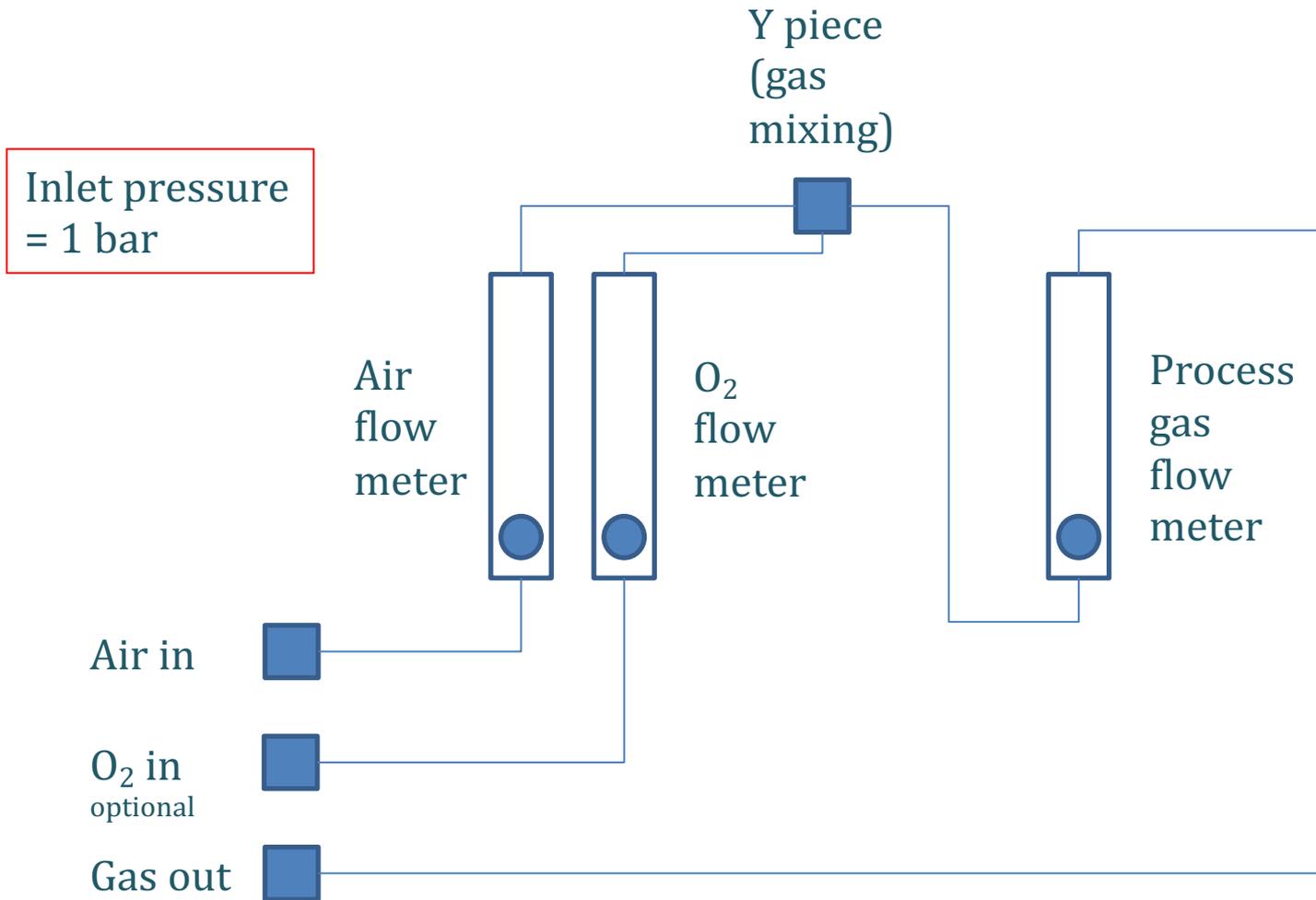
Gas control



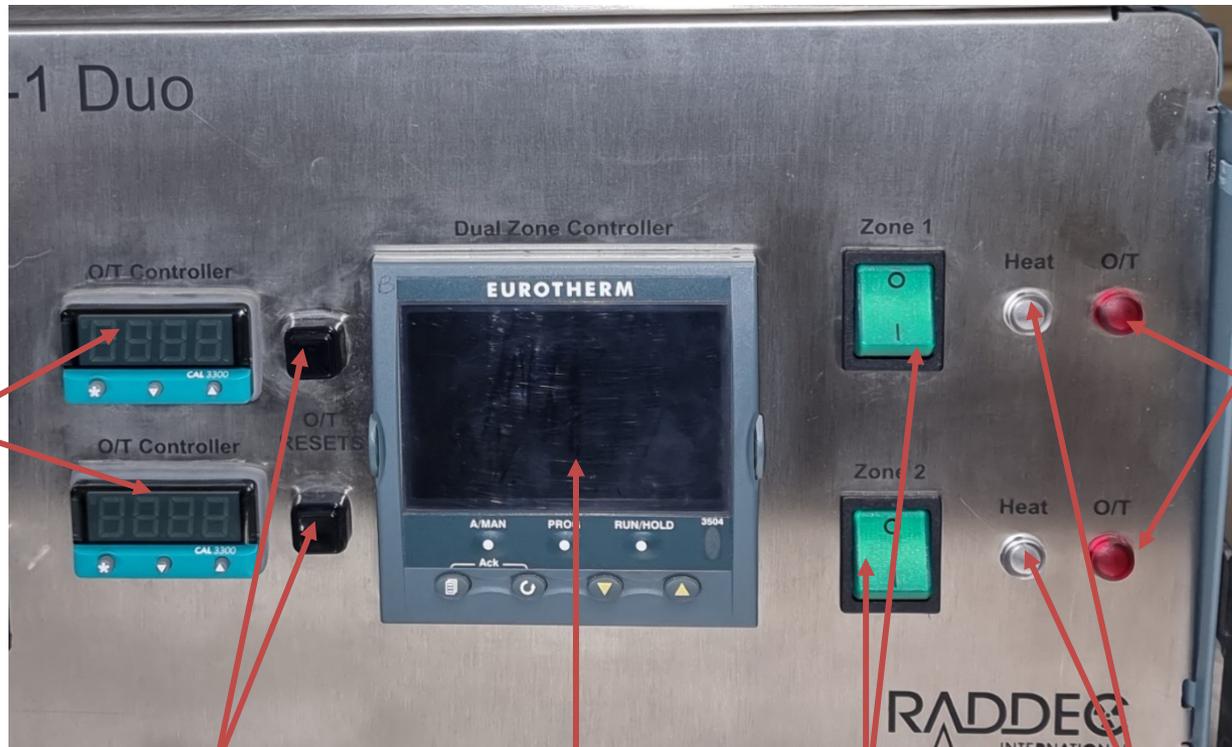
Main air / oxygen
(optional)
flowmeters

Individual worktube
flowmeter

Gas distribution system



Controllers



CAL 3300
O/T
controllers

O/T alarm
indicators

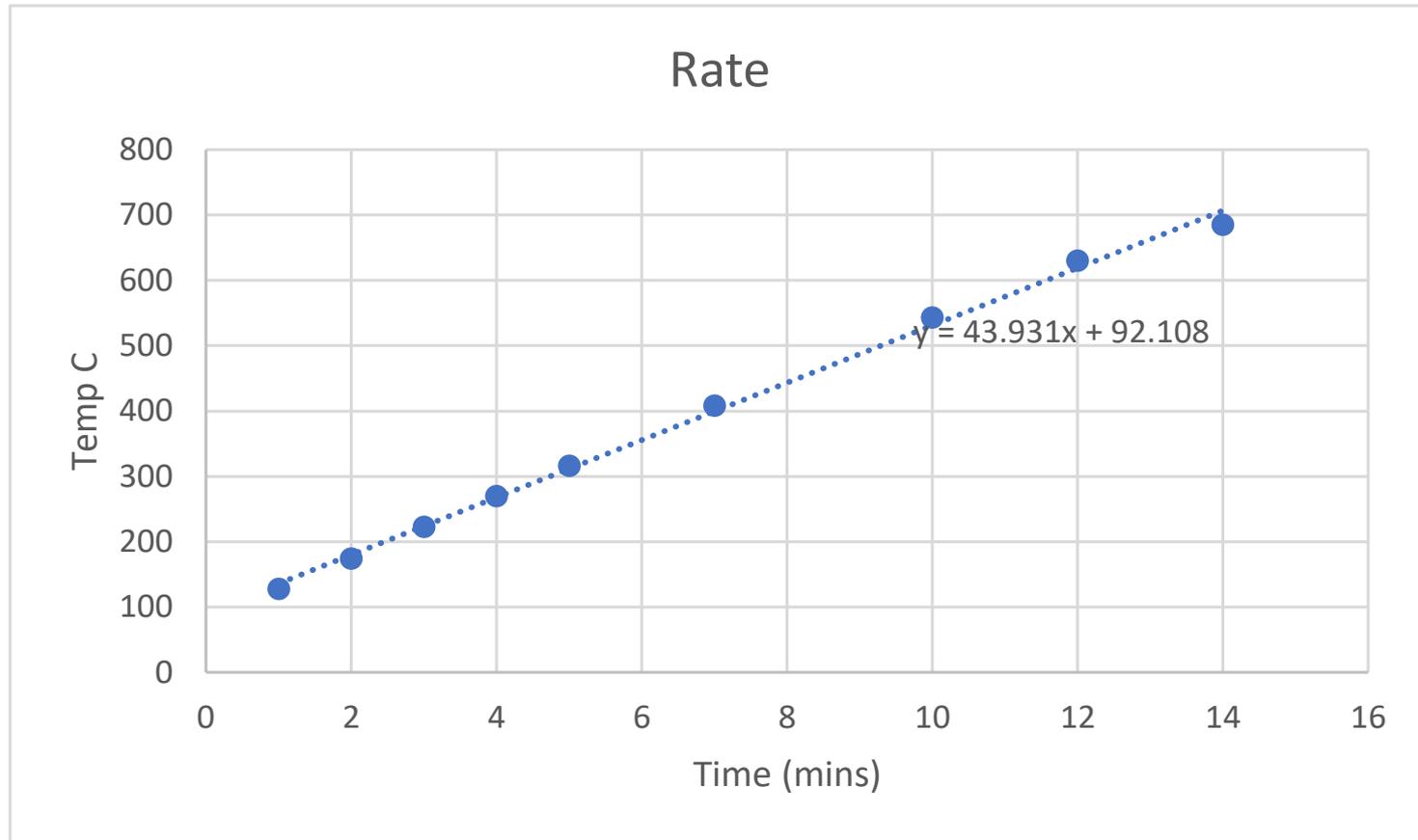
O/T reset

3504 main
furnace
controller

Isolator
switches

Power
indicators

Heating rate



Deployment of system



10g concrete



Pyrolyser DUO workstation



Hidex Triathler LSC



2.5 hrs

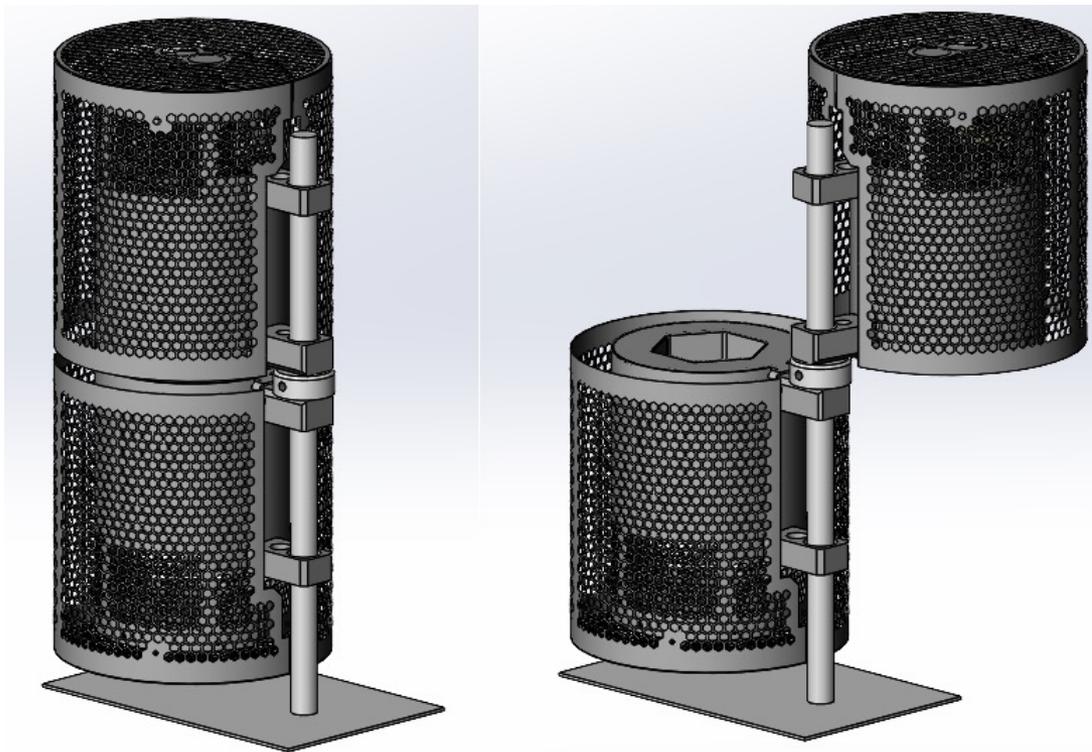


1 hr



LOD =
0.2 Bq/g

Pyrolyser mini – the next generation



Modular construction for installation in glovebox HA enclosure environments.

Readily accessible components for ease of maintenance.

Elements installed in a replaceable module.

Remotely located control unit

Multi-function capability.

Summary

- Pyrolyser Mini & DUO systems provide a compact furnace option ideal for deployment within containments or in on-site environments.
- Systems are designed to operate using standard power supplies.



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