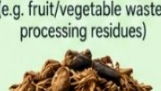
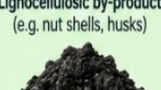


Specification: Supply and installation of a laboratory-scale, high-temperature, high-pressure batch reactor, including user training

Biomass feedstocks (to be converted)	Conversion pathway (Technology)	Typical operating conditions	Main expected products	Possible with the high-temperature reactor?
 Agricultural residues (e.g. crop residues)  Forestry residues (e.g. wood chips, sawdust)  Energy crops (e.g. grasses, dedicated crops)  Agro-industrial wastes (e.g. fruit/vegetable waste, processing residues)  Lignocellulosic by-products (e.g. nut shells, husks)  Wet biomass/sludge (e.g. agro-processing sludges)	Torrefaction 	200–350 °C, oxygen-deficient atmosphere	 Torrefied biomass (biochar), gases, condensates	✓
	Hydrothermal Carbonization (HTC) 	180–280 °C, 2–10 MPa	 Hydrochar, aqueous products, gases	✓
	Hydrothermal Liquefaction (HTL) 	250–400 °C, 2–25 MPa	 Biocrude oil, biochar, gases, aqueous products	✓
	Hydrothermal Gasification (HTG) 	>374 °C, >22.1 MPa	 H ₂ -rich syngas	✓
	Slow Pyrolysis 	300–500 °C, residence time: hours	 Biochar, gases, bio-oil	✓
	Fast Pyrolysis 	450–800 °C, residence time: 5–30 s	 Bio-oil, biochar, gases	✓
	Flash Pyrolysis 	450–1000 °C, residence time: 1–2 s	 Bio-oil, gases, biochar	✓
	Direct Combustion 	800–1400 °C, excess air	 Heat, electricity, flue gases	✗
	Conventional Gasification 	800–1600 °C	 Syngas, biochar, ash, tar	✗
	Plasma Gasification 	1500–5500 °C	 Syngas, vitrified slag	✗

Purpose: The ARC seeks to purchase a high-temperature, high-pressure laboratory reactor to investigate the thermochemical conversion of liquid or solid biomass at temperatures above 200 °C and pressures equal or above 250 bars.

- Hydrothermal Carbonisation (HTC)
- Hydrothermal Liquefaction (HTL)
- Hydrothermal Humification
- Renewable Hydrocarbon Production
- Catalytic Liquefaction
- Hydro pyrolysis
- Catalyst testing and optimisation

1. Reactor/Vessel Requirements

Parameter	Minimum requirement
Vessel type	Batch reactor
Vessel capacity	Nominal vessel capacity of 400- 600 mL
Installation	Bench-top
Material of Construction	Corrosion-resistant materials , such as stainless steel 316/316L or suitable alloys, capable of withstanding the required high temperature, high pressure, and chemical environment
Head/vessel configuration	Fixed-head or movable-head configuration acceptable
Catalyst and solids handling	Suitable for biomass, biomass/water slurries, particulate feedstocks, and heterogeneous catalysts.

2. Temperature capability

Parameter	Minimum requirement
Maximum operating temperature	$\geq 500^{\circ}\text{C}$
Temperature control	Programmable temperature controller
Cooling	Provision for safe cooling of the reactor from the operating temperature using an integrated or external cooling system.

3. Pressure capability

Parameter	Minimum requirement
Max working pressure at 500°C	≥ 250 bar
Pressure measurement & display	Digital or analogue pressure measurement with continuous measurement and display of reactor pressure
Pressure protection	Pressure relief/bursting-disc or equivalent certified over-pressure protection.
Gas service	Suitable for hydrogen and inert-gas pressurisation
Gas connections	High-pressure gas inlet and outlet connections suitable for the specified pressure rating

4. Gas handling and connections

The reactor shall support gas pressurisation, safe release and collection of reaction gases, and gas/liquid sampling for the proposed research.

Parameter	Minimum requirement
Gas inlet and pressurisation	Connections for introducing hydrogen and inert gases (e.g., nitrogen) for reactor pressurisation.
Gas outlet and collection	A gas outlet for safe release and collection of reaction gases for subsequent volume measurement and composition analysis.
Connections	Connections for gas inlet, gas outlet, pressure measurement, temperature measurement, and gas/liquid sampling
Sampling	The reactor shall allow safe withdrawal of gas and/or liquid samples for analysis without gas leakage or loss of safe pressure containment.

5. Control and data acquisition

Parameter	Minimum requirement
Temp control	Programmable PID or equivalent closed-loop temperature control.
Temp display	Digital display of actual and set-point temperatures
Programmable heating maps	Ability to program heating rates and temperature profiles
Pressure Monitoring	Continuous measurement and display of reactor pressure
Data logging	Recording of reactor temperature and pressure against time (desirable)
Data export	Ability to download or export recorded data in a standard digital format (desirable)

6. Safety Requirements

Parameter	Minimum requirement
Pressure and temperature protection	Pressure-relief/burst-disc system, over-pressure and over-temperature protection, with appropriate alarms.
Gas handling and venting	Suitable for hydrogen service, with provision for safe venting of gases.
Safety interlocks	Appropriate safety interlocks to prevent or respond to unsafe operating conditions.
Emergency shutdown	Provision for emergency shutdown of the reactor system.

7. Compulsory Technical Compliance Checklist – This checklist must be completed and returned upon submission. Failure to comply with any of the requirements will result in automatic disqualification.

Requirement	Minimum specification	Tenderer's offered specification	Comply (Y/N)
Reactor type	HP/HT batch reactor		
Vessel capacity	≥ 400 mL		
Maximum operating temperature	≥ 500°C		
Maximum allowable working pressure (MAWP)	≥ 250 bar		
Pressure rating at 500°C	To be specified by tenderer		
Hydrogen compatibility	Suitable for hydrogen service		
Temperature control and measurement	Programmable PID or equivalent, with temperature measurement		
Pressure measurement	Required		
Safety and cooling	Pressure-relief device and cooling system		
Gas inlet and connections	Gas inlet system, appropriate valves, and fittings		
Mandatory components	All components listed in Section B included in the applicable base quotation		
Documentation and commissioning	Manuals, calibration certificates, pressure test/certification documentation, installation, and commissioning		

8. Compulsory Documents to Submit -This checklist must be completed and returned upon submission. Failure to comply with any of the requirements will result in automatic disqualification. If Indicated “Yes” in last column, the supporting documents must be attached.

Requirement	Supporting documentation	Comply (Y/N)
Product documentation to be submitted with quote	Manuals including data sheets, installation, and commissioning	
Datasheets	The datasheets shall clearly demonstrate compliance with all the minimum technical specifications contained in this document.	
Product documents after commissioning	Operation and maintenance manual Calibration certificates, pressure test/certification documentation	
Original equipment manufacturer letter	Letter from OEM that specifies that the tenderer is an authorized agent/distributor of the quoted equipment	
Reference letters	3 reference letters that testify that the bidder has supplied, installed, and provided training of the same or similar high-pressure and high-temperature reactors	
Warranty	A minimum warranty period of 12 months – the warranty must be indicated on your quotation.	
Technically qualified personnel to install, train, and provide after-sales service	Submit proof of suitably qualified personnel to install, train, and provide after-sales service	