



# FIXED & FLUIDIZED BED REACTORS



# Fixed Bed Reactor System

## SALIENT FEATURES

- Fixed, fluidized, trickle bed designs offered.
- Reactor volumes from 10mL to 100L.
- Designed up to 350 bar & 1000°C.
- SS316, Inconel, Hastelloy C etc.
- Explosion proof plants for hazardous area.
- Tabletop or skid mounted plants.
- Customisable systems for gas liquid feed combinations, series or parallel reactors, multi zone heating furnaces etc. with integrated controls, high level of safety, automation and SCADA software.

## APPLICATIONS

- Catalyst screening
- Hydrogenation
- Fischer-tropsch process
- Hydro-cracking
- Vapor phase reaction
- Coal to syngas production
- Pyrolysis reactions
- Biomass gasification



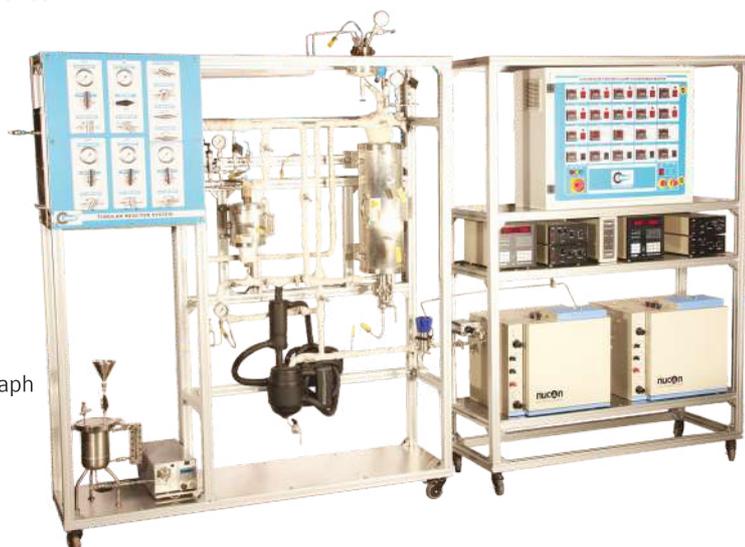
- Micro reactor assembly for Liposome formation
- Reactor volume: 100 mL
- Pressure: 100 bar
- Temperature: 500 °C
- Material: Hastelloy C



- 2 reactors with flexibility to connect in parallel & series
- Reactor volume: ~30mL
- Pressure: 5 bar.
- Temperature: 1000 °C.
- Materials: Inconel



Table Top Reactor System (TTRS)

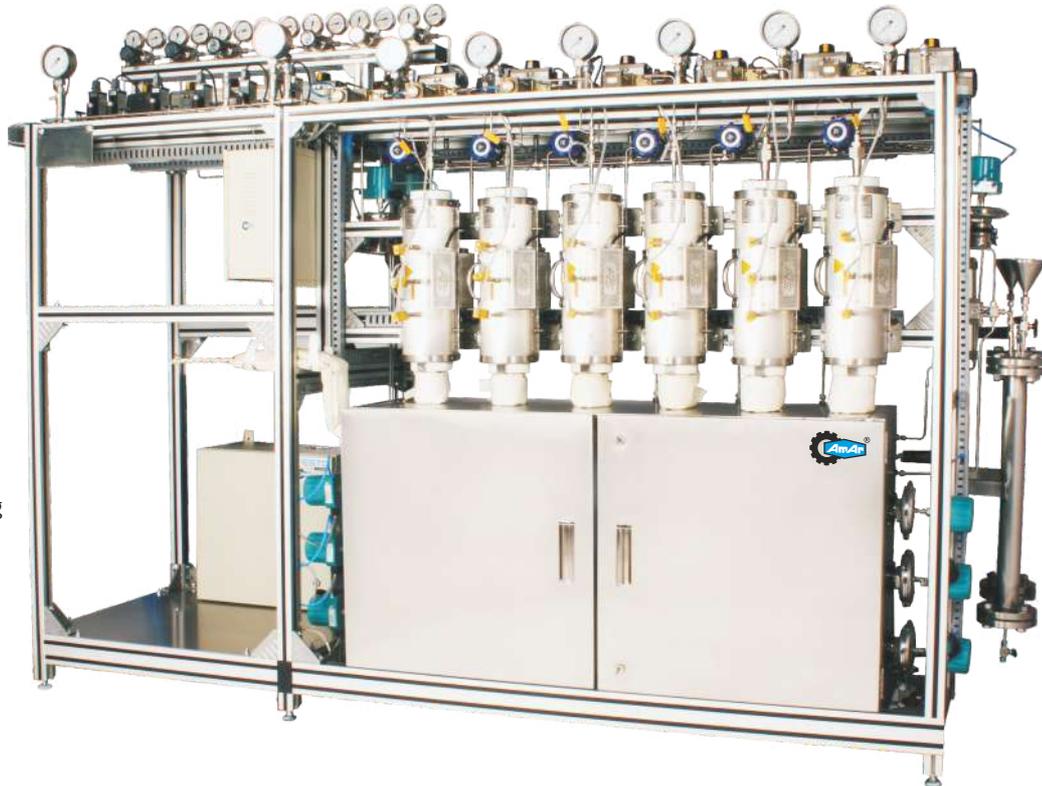


- Reactors: 2 nos.
- Pressure: 100 bar
- Temperature: 700 °C
- With gas chromatograph

# Fixed Bed Reactor System

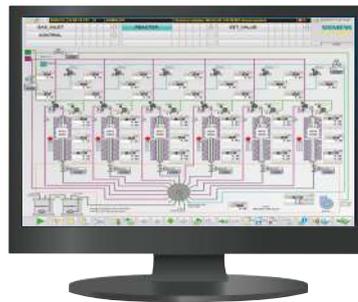


High throughput multi tube reactor system for catalyst screening



## SYSTEM SPECIFICATIONS

- Reactor volume: 6 Nos- parallel- 10 to 100mL same or of different volumes (optional: upto 16 nos in parallel).
- Design pressure: 100 bar
- Design temperature: 900 °C
- Material: SS 316, Inconel, Hastelloy C, etc.



Pilot scale tubular reactor with purge panels for continuous biojet fuel production



# Example of Fixed Bed Reactor System

## Gas Panel - MFC

- Thermal
- Coriolis

## Control Panel

- Manual – PID
- PID + HMI screen (touch panel)
- PLC + SCADA

## Structure Skid

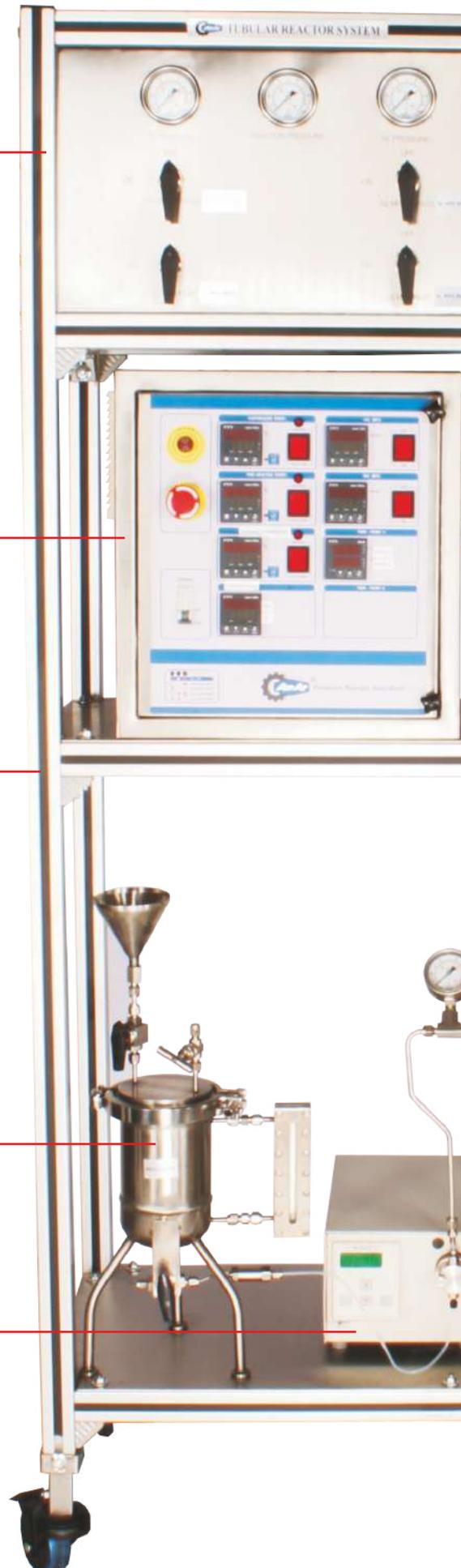
- Aluminium
- SS 304
- MS

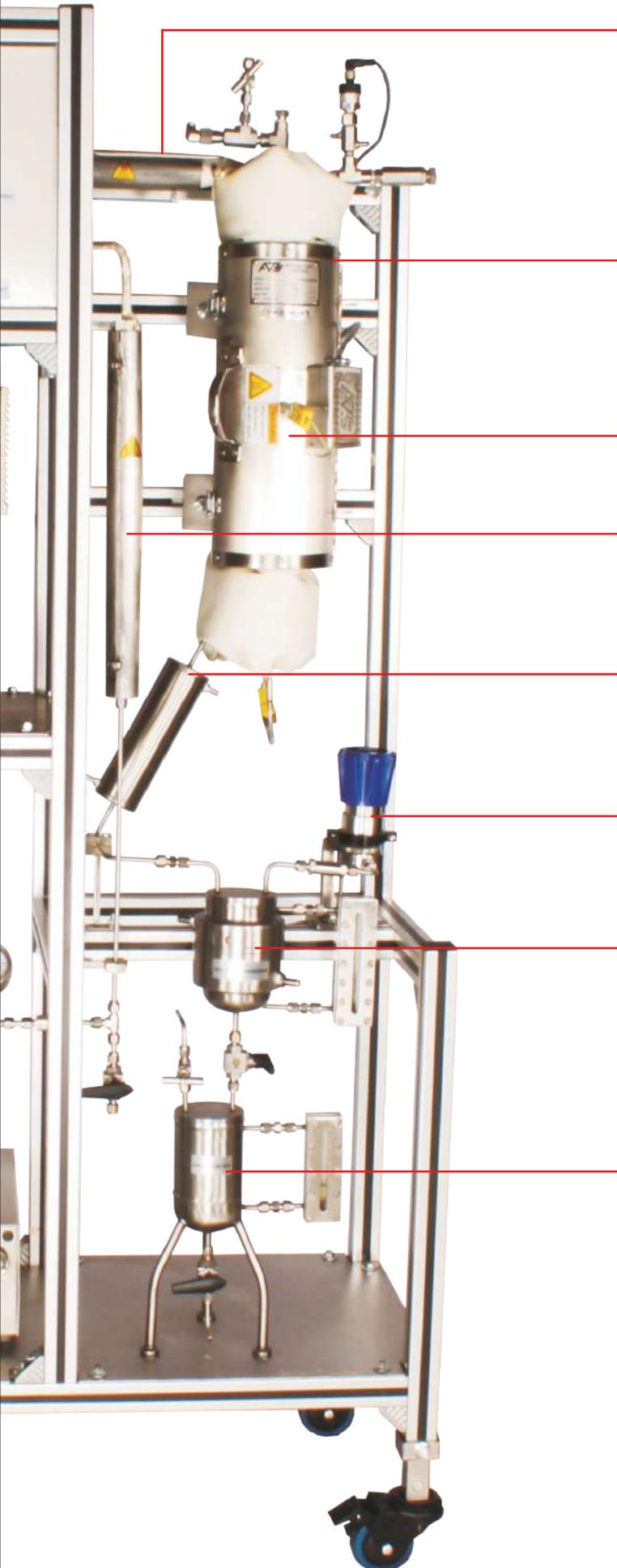
## Liquid Feed Vessel

- Ambient temperature
- High temperature - either jacketed or electric heating

## Liquid Pump

- HPLC
- Diaphragm metering
- Syringe
- Gear
- Peristaltic





#### **Pre Heater**

- Heating with line heater / ceramic band heater

#### **Reactor – Tubular with catalyst support**

- Downflow
- Up flow
- Both up flow and downflow
- Multiple reactors in series / parallel

#### **Furnace / jacket heating with thermic fluid**

#### **Vaporizer**

- Heating with line heater / ceramic band heater

#### **Condenser**

- Spiral
- Double pipe
- Shell & Tube

#### **Back Pressure Regulator**

- Manual
- Automatic

#### **Gas-Liquid Separator - Jacketed**

#### **Liquid Product Collection Vessel**



# Fixed Bed Reactor System

- Biojet Fuel - Series System
- Volume: 2.5L
- Design pressure: 170 bar
- Temperature: 500 °C
- MOC: SS316



- Pilot plant vapor skid
- Volume: 3.5L
- Design pressure: 20 bar
- Temperature: 650 °C
- MOC: Nickel 201



- Simple vapor phase condensation reactor
- Volume: 1.5L
- Design pressure: 100 bar
- Temperature: 600 °C
- MOC: HC276

# Fixed Bed Reactor System



- Carbon capture
- Volume: 50mL
- Design pressure: 30 bar
- Temperature: 600 °C
- MOC: SS316

- Vapor phase reaction
- Volume: 550mL
- Design pressure: 20 bar
- Temperature: 700 °C
- MOC: HC276



- Metal oxide reduction / oxidation
- Volume: 12L
- Design pressure: 20 bar
- Temperature: 600 °C
- MOC: SS316



# Fixed Bed Reactor System



**Fixed bed plant - skid mounted nitrilation reaction lab setup for acetonitrile with two reactors in parallel configuration**

- Volume: 5L
- Pressure: 5 bar
- Temperature: 500°C
- Material: Inconel 625



**Twin reactor setup with parallel configuration**

- Reactor - 1, 500mL, 5 bar, 1100 °C, HC 276
- Reactor - 2, 500mL, 60 bar, 650 °C, HC 276
- Steam reforming & Fischer-Tropsch reaction

# Fixed & Fluidized Bed Reactor System



## Pilot Plant for Bio-fuel

- Reactor - 1, 600mL, 5 bar, 950 °C, Inconel 625
- Reactor - 2, 1700mL, 60 bar, 480 °C, Inconel 625
- Production of bio-oil & Fischer-Tropsch synthesis



## High pressure vapor phase hydrogenation system

100mL, 200 bar, 700°C, SS 316 skid with enclosure



## Fluidized bed reactor

Volume 700mL, 10 bar, 1100 °C, Inconel 625

- Fluidization of alumina



# Fluidized Bed Reactor System

## SALIENT FEATURES

- Volume: 500mL to 200L
- Pressure range: up to 12 bar
- Temperature range: up to 1050°C
- A fluidized bed reactor is a vertical cylindrical tube having 2 sections i.e., reaction section & disengagement section.
- Even temperature distribution throughout the burning zone, while solid catalyst particles are freely suspended using gas of high velocity.
- Product is collected from top & solid residue collected from the bottom.
- Solid feed: Batch/Continuous.
- Uniform particle mixing.
- Uniform temperature gradients.
- Catalyst/solid can be fed from top/bottom while gas/liquid is fed from the bottom.
- Explosion proof plants for hazardous area.

## APPLICATIONS

- Conversion of coal-derived products
- Syngas generation
- Pyrolysis reactions
- Biomass / coal gasification reactions
- Conversion of gaseous reactants into fuels
- Liquefaction reactions, etc.



Pyrolysis reactor system  
Hybrid system of fixed & fluidized bed

# Fluidized Bed Reactor System



- Process: Air-blown fluidized bed gasification
- Gauge pressure: 10 kg/cm<sup>2</sup>
- Design temperature: 1000 - 1050 °C
- Gasification rate: 60 - 150 kg/hour
- Gasifier
- Coal feeding system
- Gaseous reactant supply system
- Bottom ash extraction system
- Cyclone with fly ash collection system
- Gas cooling and cleaning system
- Exhaust system and flare stack





# Fluidized Bed Reactor System

- Design pressure:- 5 Bar
- Design temperature:- 1000°C
- MOC:- Inconel 625

## Gas panel - MFC

- Thermal
- Coriolis

## PLC based control panel

- Manual – PID
- PID + touch panel
- PLC + SCADA

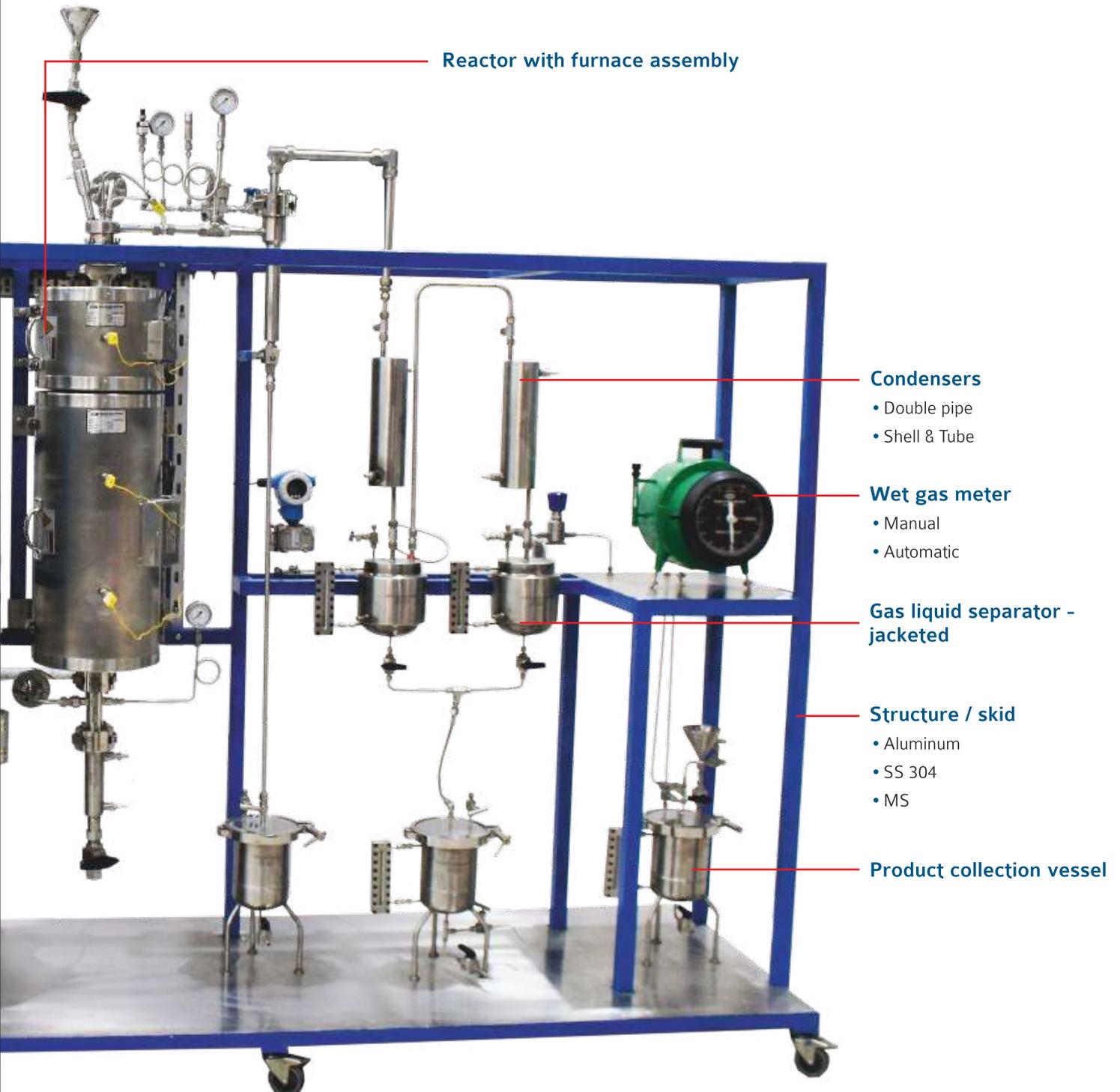
## Liquid feed vessel

- Ambient temperature
- High temperature - either jacketed or electric heating

## Liquid pump

- HPLC
- Diaphragm metering





Reactor with furnace assembly

**Condensers**

- Double pipe
- Shell & Tube

**Wet gas meter**

- Manual
- Automatic

**Gas liquid separator - jacketed**

**Structure / skid**

- Aluminum
- SS 304
- MS

**Product collection vessel**



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