Technical specifications

	PYROLYSIS	HDO
Maximum reactor temperature (ºC)	700	550
Maximum pressure (atm)	1	50
Processing capacity	1,5 kg/h	1,5 L/h
Gas, maximum flow rate (L_N/h)	N_2, 200	H_2, 5
Maximum pre-heaters temperature (ºC)	400	400
Maximum cyclones temperature (ºC)	400	-
Biomass particle size (mm)	2-5	-
Reactor diameter (mm)	80	40

Analysis and characterization techniques for biomass and reaction products

- Bio-oil & vegetable oils: composition (chromatography: GC-FID and GC/MS); elemental micro analysis (CHNS-O); H_2O content (KF titration)
- Gas: gas chromatography (micro-GC)
- Biomass & char: elemental micro analysis (CHNS-O); volatile matter and thermogravimetry (TGA); ash content (muffle); surface area (BET)

Biomass conditioning

Cutter mill (0.25-20 mm); automatic sieving (0.25-4 mm); stove for drying and moisture determination

Characterization techniques of catalysts

Surface area (BET); thermogravimetry (TGA); X ray diffraction (XRD); thermal programmed reduction/oxidation (TPR/TPO); inductively coupled plasma spectroscopy (ICP); scanning electron microscopy (SEM); transmission electron microscopy (TEM); Fourier transform infrared spectroscopy (FTIR), etc.

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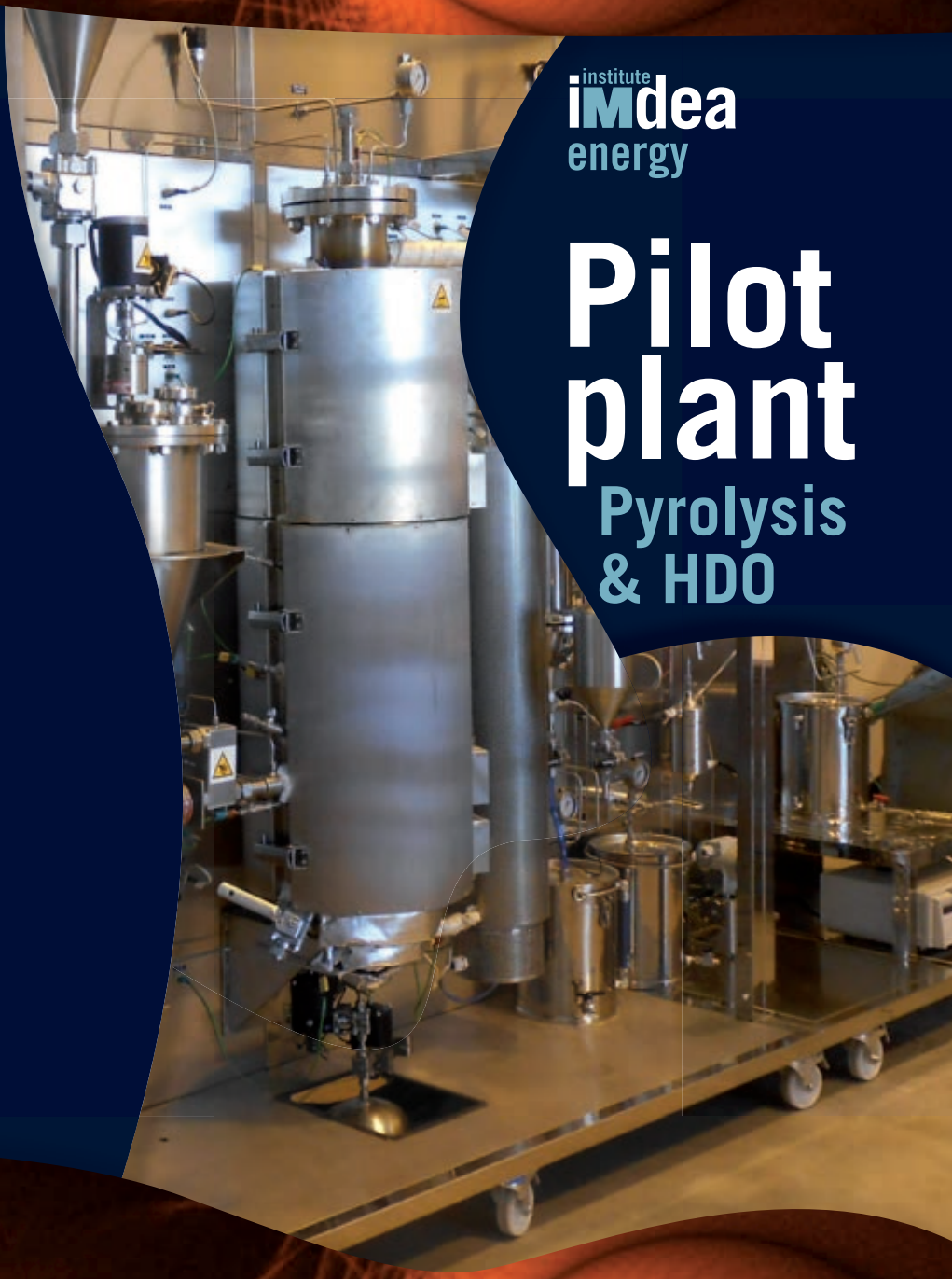

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Pilot plant

Pyrolysis & HDO

Pyrolysis & HydroDeOxygenation (HDO) pilot plant

IMDEA Energy Institute has a modern pilot plant for the production and development of advanced liquid biofuels (similar to gasoline, diesel and kerosene) from lignocellulosic biomass. This pilot plant consists of two main sections: pyrolysis and HDO, which are able to work independently or in series.

The PYROLYSIS section is capable of processing a biomass feed of up to 1.5 kg/h, is where biomass flash-pyrolysis is performed. It consists of a fluidized bed reactor, in which the biomass sample is fed by an auger distributor from a two interconnected hoppers system and fluidized, together with a sand bed, using a pre-heated N_2 flow. In addition, it has a heated system of three cyclones in series, followed by a bio-oil condenser (shell-tubes heat exchanger) and a double-filter cold gas cleaning system. The bio-oil fraction production is maximized by selecting the most adequate operation conditions. In addition to the liquid fraction, two other products are obtained: a carbonaceous solid residue (char), and a non-condensable gas mixture (CO, CO_2, etc.), which is analyzed in a continuous mode by a micro-GC.

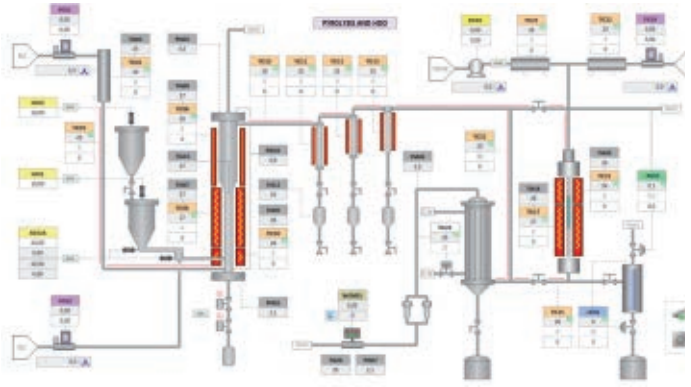
The HDO section is able to process a bio-oil or vegetable oil feed of up to 1.5 L/h. It consists of a downdraft fixed-bed reactor in which the catalyst is loaded. H_2 and bio-oil feeds are pre-heated and introduced from the top of the reactor. The reaction products from the reactor bottom, are continuously separated by a gas/liquid separation system. This reactor is employed for the evaluation of the hydrodeoxygenation (HDO) catalytic activity of different systems under high-pressure of hydrogen (up to 50 atm) to produce advanced liquid biofuels.

This plant is designed to operate continuously for long periods of time at steady state in any of its operation modes, and this fact increases the reliability and representativeness of the experimental results. Moreover, it is fully automatic and programmable with regards to safety aspects, operation and data collection.

IMDEA Energy Institute owns a modern and complete set of scientific equipment with multiple techniques for the analysis and characterization of both the reaction products and the catalytic systems used.

The pyrolysis and HDO pilot plant is fully automated and configured to be capable of functioning in any of its operation modes: thermal/catalytic pyrolysis of biomass; HDO processing of any kind of oil (pyrolysis bio-oil and vegetable oils) and even the HDO treatment of the bio-oil generated in situ by the pyrolysis reactor.

Pilot plant process diagram



Services

- Preparation (milling and sieving) and characterization (proximate and ultimate analyses) of any kind of biomass (residues, sawdust, energetic crops, etc.).

- Thermal/catalytic pyrolysis of biomass (forestry, agricultural or industrial residues, etc.) at steady state operation conditions for prolonged periods of time by means of the double-hopper biomass feeding system.

- HDO of bio-oil (from biomass pyrolysis or vegetable oils) at steady state operating conditions with a continuous gas/liquid separation system and gas product continuously analyzed.

Studies of the catalytic activity of any catalyst in HDO process and assesment of their long term stability.