WORLDWIDE PRESENCE

Leveraging its core expertise in twin-screw technology, Clextral provides its customers with complete processing lines that integrate extruders, dryers and ancillary equipment. Its reliable and innovative systems are quality and excellence benchmarks in its three key markets: Food & Feed, Green Industries and Powder Industries. Clextral is also designing and manufacturing high-precision industrial pumps for the energy and chemical markets. Its global offering includes upstream design and testing of industrial solutions, equipment manufacturing, on-site installation and full maintenance and continuous process improvement services. Based in Firminy (France), Clextral is present on all five continents, providing local support to its customers all over the World.

CLEXTRAL

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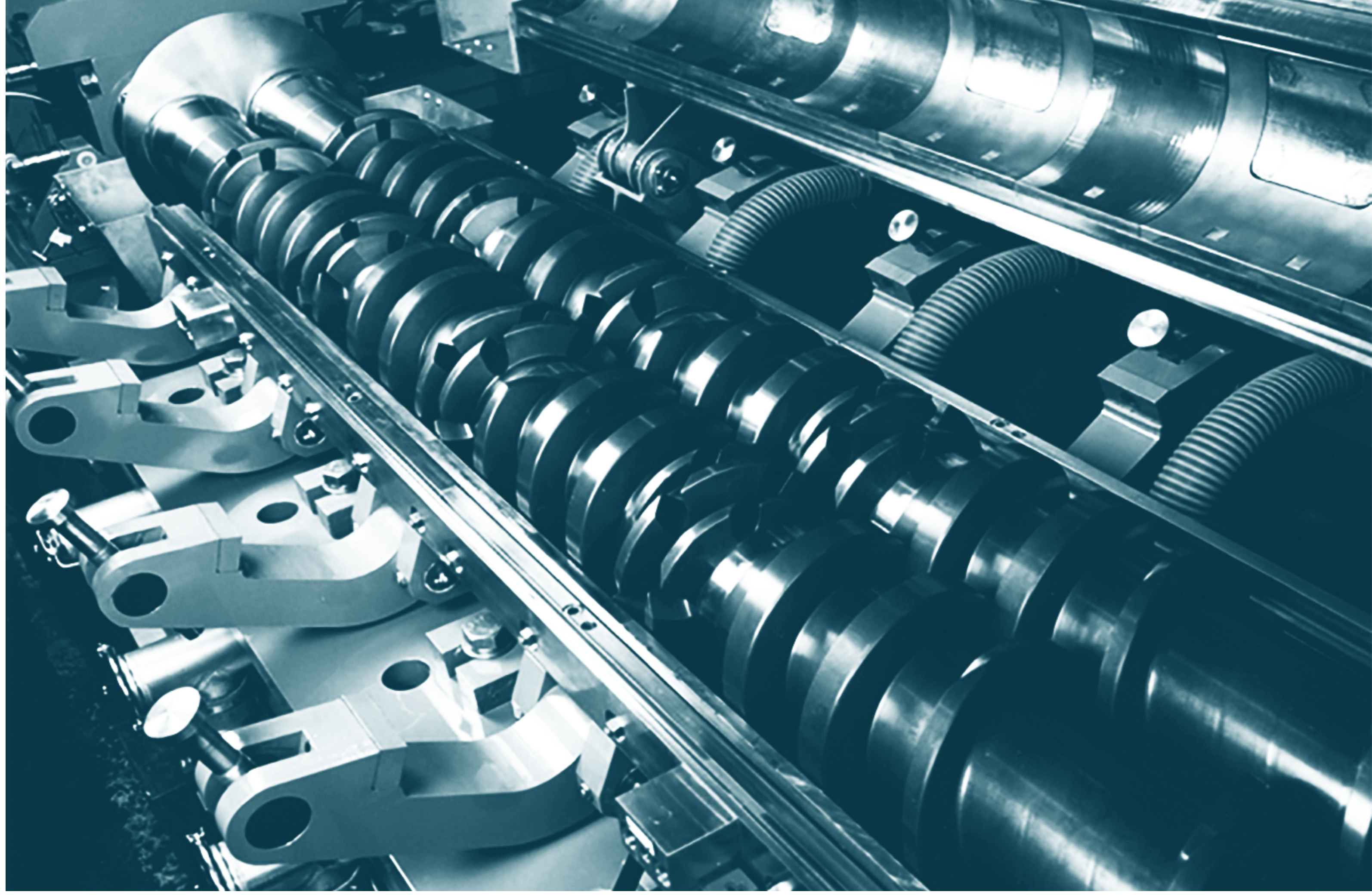
CLEXTRAL A DIVISION OF GROUPE LEGRIS INDUSTRIES



LIGNOCELLULOSIC BIOMASS CONVERSION

USING CO-ROTATING TWIN-SCREW TECHNOLOGY

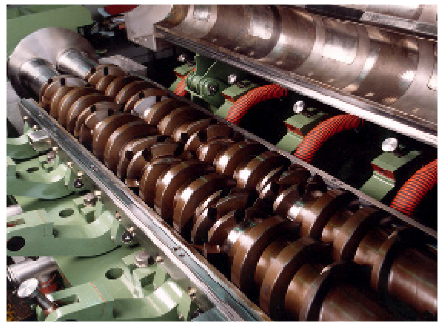
CLEXTRAL Extrusion Expertise Excellence

LIGNOCELLULOSIC BIOMASS CONVERSION

The conversion of plant biomass into biofuels and chemicals presents two major advantages for industry. First, the process can add value to commodified agricultural/forestry plants and plant residues. Second, it is a sustainable development approach that offers both environmental and social rewards.

The most abundant source of renewable carbon on the planet, lignocellulosic biomass can be processed with biochemical or thermoconversion techniques to replace products from petrochemical resources. Reactive extrusion is a technology that is proven highly effective in pretreating lignocellulosic biomass for conversion into second generation biofuels.

Clextral Twin Screw Extruders (TSEs) perform biomass treatment for paper pulp, peat analog and other applications around the world

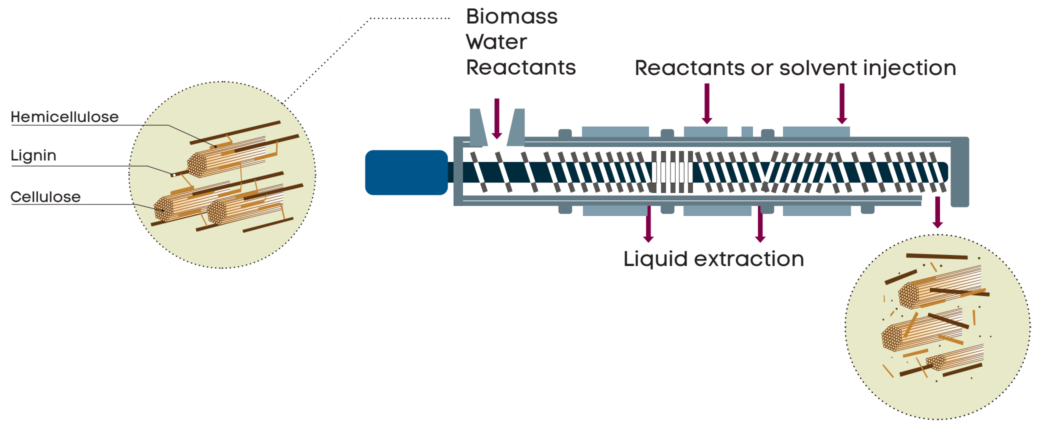


Opened TSE

Defibering by TSE

INTENSIFIED PROCESS USING TWIN SCREW EXTRUDER (TSE)

Two identical, co-rotating and intermeshing screws are fitted on splined shafts. Parts for injection of liquids and gases are located on the sleeve.



One or multiple operations can be achieved simultaneously with Clextral twin screw technology

Main advantages of the process:

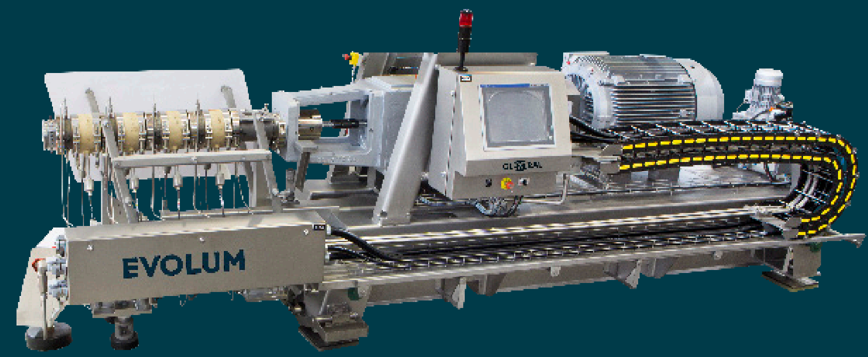
- Continuous process
- High product consistency
- Mechanical treatments adapted according to the needs of the processes
- High efficiency chemical mixing accelerates reaction times and generates savings on reacting agents
- Compact units -> small space requirement
- Flexible units -> quick start & stop, operate at various capacity

Various treatments performed using Twin Screw Extruder

- Succession of shearing and compression work zones
- Speeded up chemical reactions
- Solid-liquid separation

EFFICIENT AND CONTINUOUS CHEMICAL REACTIONS:

- Temperatures to 400°C
- Temperatures regulation through heating and cooling devices
- 25 to 240 mm screw diameters; screw design optimized for process scale-up
- Power : 2kW up to 2 MW
- Capacity to 5 BDT/h, depending on process requirements
- Range of metallurgy
- Versatile technology



WIDE RANGE OF LIGNOCELLULOSIC BIOMASS

A main advantage of using this type of lignocellulosic biomass is that it does not compete with food production crops for agricultural land.

Wood biomass

- Wood sources: eucalyptus, poplar, willow...
- Wood chips
- Forest thinnings, bark, sawdust

Crop residues

- From cereals: straw, stalks, corn stover
- From sugar crops : sugar cane bagasse

High yield crops

- Miscanthus, sorghum...

Long fibers

- Cotton, hemp, flax

Grasses