

Biofuels in Brazil- UPDATES

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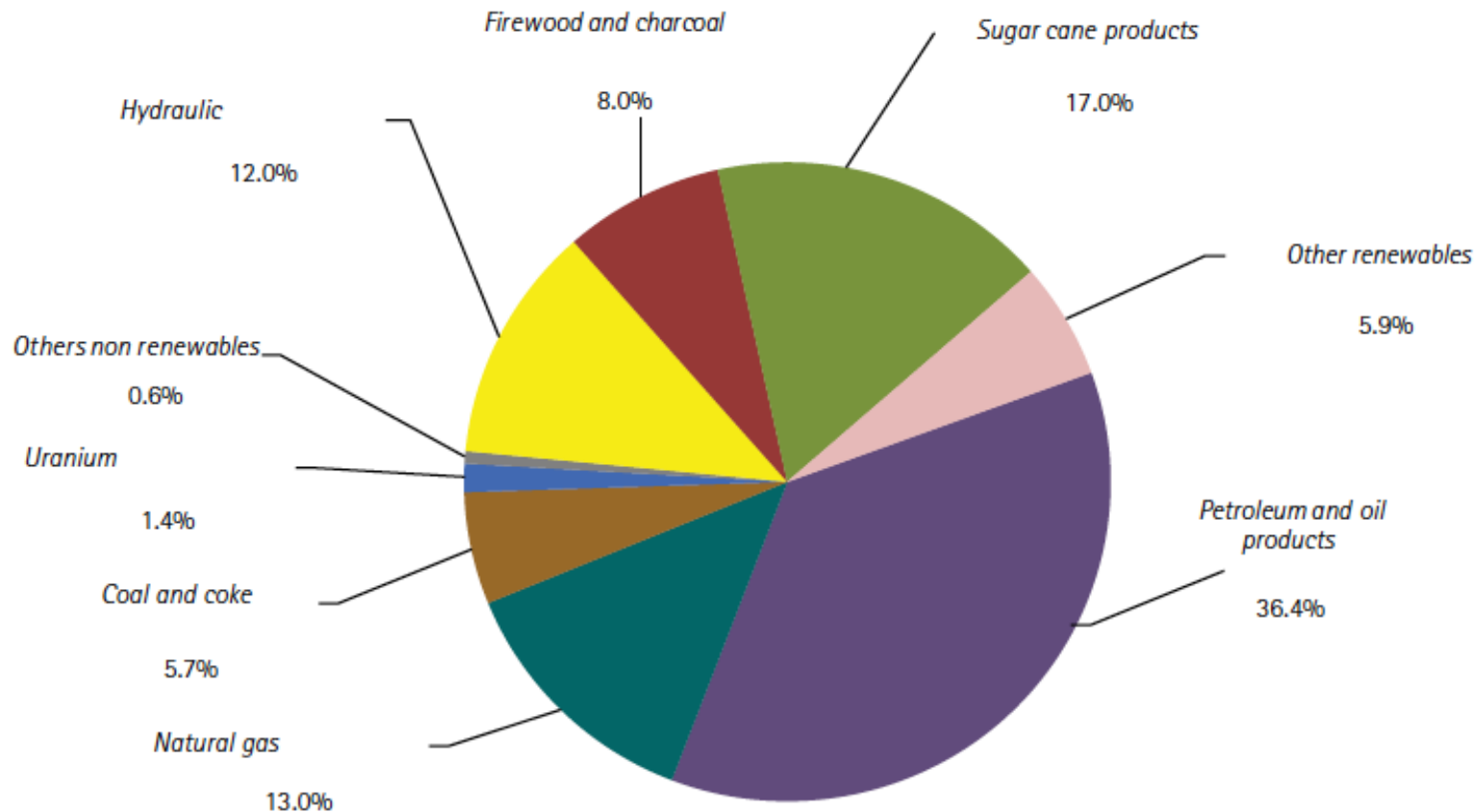
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IEA BIOENERGY TASK 39 – ITALY 2019

Domestic Energy Supply (Brazilian Energy Balance 2018 – Year 2017)



Renewable content-42.9% of the total domestic energy supply , including Hydropower

Strategy and reality

- Consistent Research Program in Biofuels and renewable energy
- Sustainable Renewable Energy
- Energy Matrix and Biorefinery Concept (biochemical routes sugar (C6 and C5) , ethanol-chemistry , Thermochemical routes for drop-in)
- Biomass in large scale (Sugar Cane-Eucaliptus-Soya Bean – others)
- Integration of Several Conversion Routes in ethanol plants - Zero CO₂ Emission (CO₂ as feedstock, microalgae, biogas from vinhasse)
- Incentive policies for improvement of the process in all steps of the production- RENOVABIO
- Hybrid cars – batteries and Flex or ethanol powered engines (October 2019 – **Flex engines started in 2003**)
- Brazil is still dependent on fossil fuels, which account for 57.1% of the domestic supply. This is a driven-force.

Energy Matriz and Biorefinery

- Sugar Cane- Ethanol for light cars, Ethanol for heavy engines (ethanol to Jet Fuels ?) hydrous ethanol for Flex Cars and Anhydrous- 25% blend in gasoline (E25).**
- Corngrain ethanol is starting (1.8% of total projected ethanol production)- possible way to extend ethanol plant operation period in some regions**
- Soybean (also castor oil and tallow, animal fatty)- Biodiesel (B10 in 2018)**
- Eucalyptus- Biorefinery and Co-Processing in Oil Refineries, Pellets for Electricity**
- Vinasse and Filter Cake- Biogas (Biomethane)- 276 plants in operation (3.1 millions of m³)**
- Jet Fuel – Macauba and FAME – research stage-(Fatty Acid Methyl Ester (FAME) , Fatty Acid Ethyl Ester (FAEE) – (Biodiesel) ,**
- Hydrotreating Technology isoparaaffinic processed ester and fatty acid (HEFA)**

Eucalyptus- Brazilian Production - 143.21 million cubic meters (71 million dry tons / year) 2nd Source of Lignocellulosic feedstock in Brazil (not accounting agricultural waste)

Pulp producers in Brazil

Money that grows on trees

The
Economist

Brazil's economy is crumbling but its giant pulp firms are booming

Mar 26th 2016 | TRÊS LAGOAS, MATO GROSSO DO SUL | From the print edition



Timekeeper



Like

113



Tweet

LOOK north from atop the 120-metre (390-foot) bleaching tower at the Horizonte 1 pulp mill, and all you see is plantations of tall, slender eucalyptus trees. They stretch from the factory gate, across the gentle undulations of Mato Grosso do Sul, a state in Brazil's centre-west, all the way to the horizon. "That's our competitive advantage," explains Alexandre Figueiredo, who is in charge of production at the plant. Its owner, Fibria, is the world's biggest producer of "short-fibre" cellulose pulp, which is used to make such things as newsprint, nappies and banknotes. ("Long-fibre" is used for high-grade paper and packaging.)

As its name suggests, Mato Grosso do Sul (roughly, "southern thick bush" in Portuguese) has vast expanses of *cerrado*, or tropical savannah, a chunk of which was long ago turned into farmland, some of which



Getty Images

The margins are high too

The average productivity of Brazilian eucalyptus plantations reaches 39
m³ / ha year (19.5 dry tonnes / ha year)

Source-IBA-2015

Evolutionary Engineering and the 1G Learning Curve



Learning curve of Biochemical/Thermochemical 2G Routes → important knowledge

40 years

1G
(40 years)

2G Biochemical

In 10 years?

70's



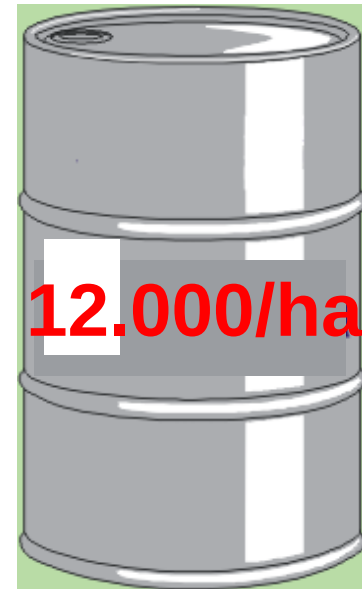
82 %

Today



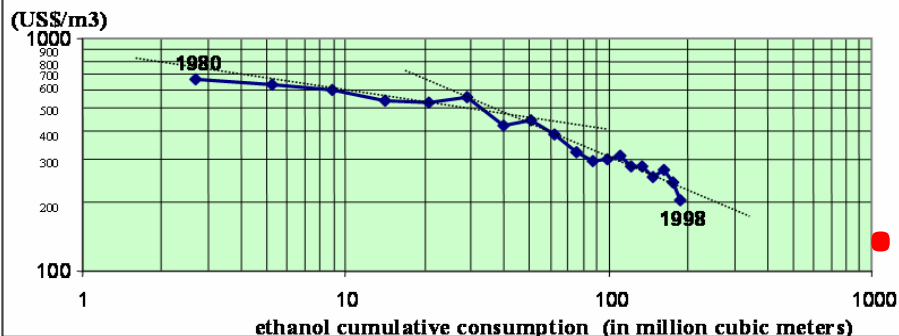
40-60 %

8.5 Millions ha
Sugar 36 Mt
23 Billions liters



2 Millions ha- Sugar 4.5 Mt,
80 Mt of Sugar Cane-
1 Billion liters

Ethanol cost "learning curve"



Goldemberg, J.

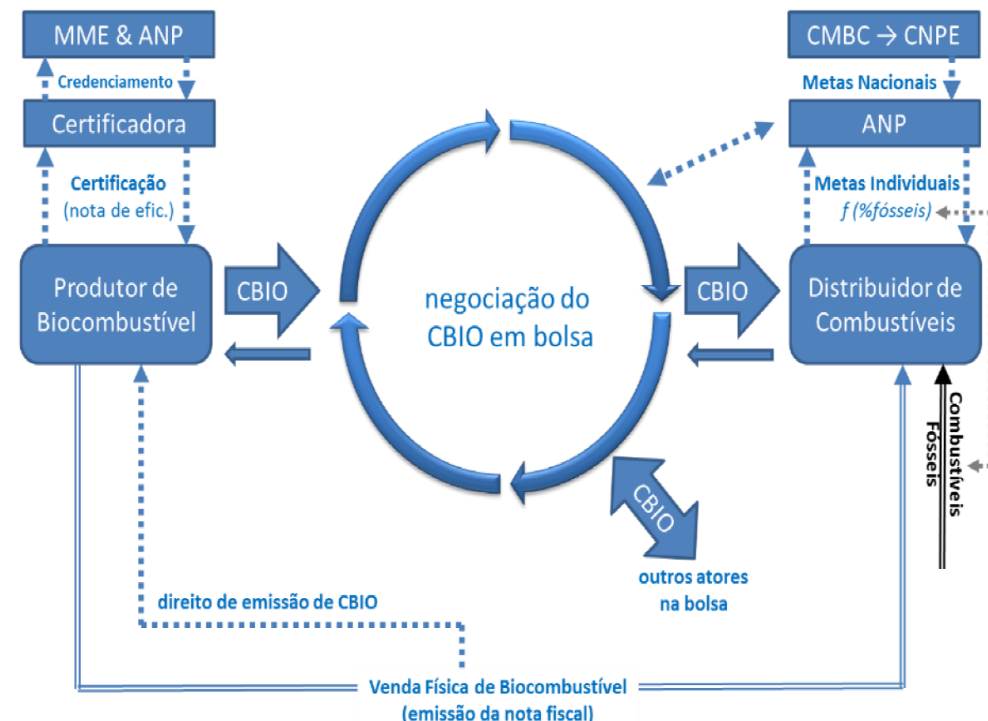
**1 ton of sugar cane
(80 ton/hectare) produce:
250 Kg of bagasse
120 Kg of Sugar
85 Liters of ethanol**

Use less than 1 % of arable land

**US\$ 20-25 cents → production cost of
1 liter of ethanol (70% due to sugar cane)**

The New Brazilian RenovaBio Policy Framework

- Annual decarbonization targets set by the government for a minimum 10-year period;
- Issuance of GHG emissions reduction certificates, named “CBio” in Portuguese (an acronym for “Crédito de Descarbonização” – Decarbonization Credit);
- Biofuels production certification through life cycle analysis.
- One CBio corresponds to a reduction of one ton of carbon dioxide equivalent (CO₂eq), in comparison to fossil fuel emissions.
- As a result of this policy, the government plans to increase ethanol production from the current 30 billion liters to around 50 billion liters by 2030 and raise biodiesel from 4 billion to 13 billion liters in the same period.
- At the same time, it estimates a savings of 300 billion liters of imported gasoline and diesel in the coming years.
- An increase of 10 million hectares is also projected in the planted area dedicated to bioenergy.



(MME, 2017)

Final Remarks

- Bioenergy can play a critical role in supporting sustainable development, including broader rural development
- Bioenergy is critical to secure a renewable energy matrix
- Energy from hydro, solar and wind can provide electricity but bioenergy unique characteristics make it an especially interesting option
- **Several scenarios with biomass and evaluation of integrated conversion routes have to be considered**
- The bioenergy business is an opportunity for innovation
- International cooperation can drive the bioeconomy
- **Economic viability is essential → society, in general, is not to pay more because it is renewable- criteria of circular economy have to be met.**

Integrated Circular Process → Zero Generation Process → Chemicals

Zero CO2 emission

LEVULINIC ACID

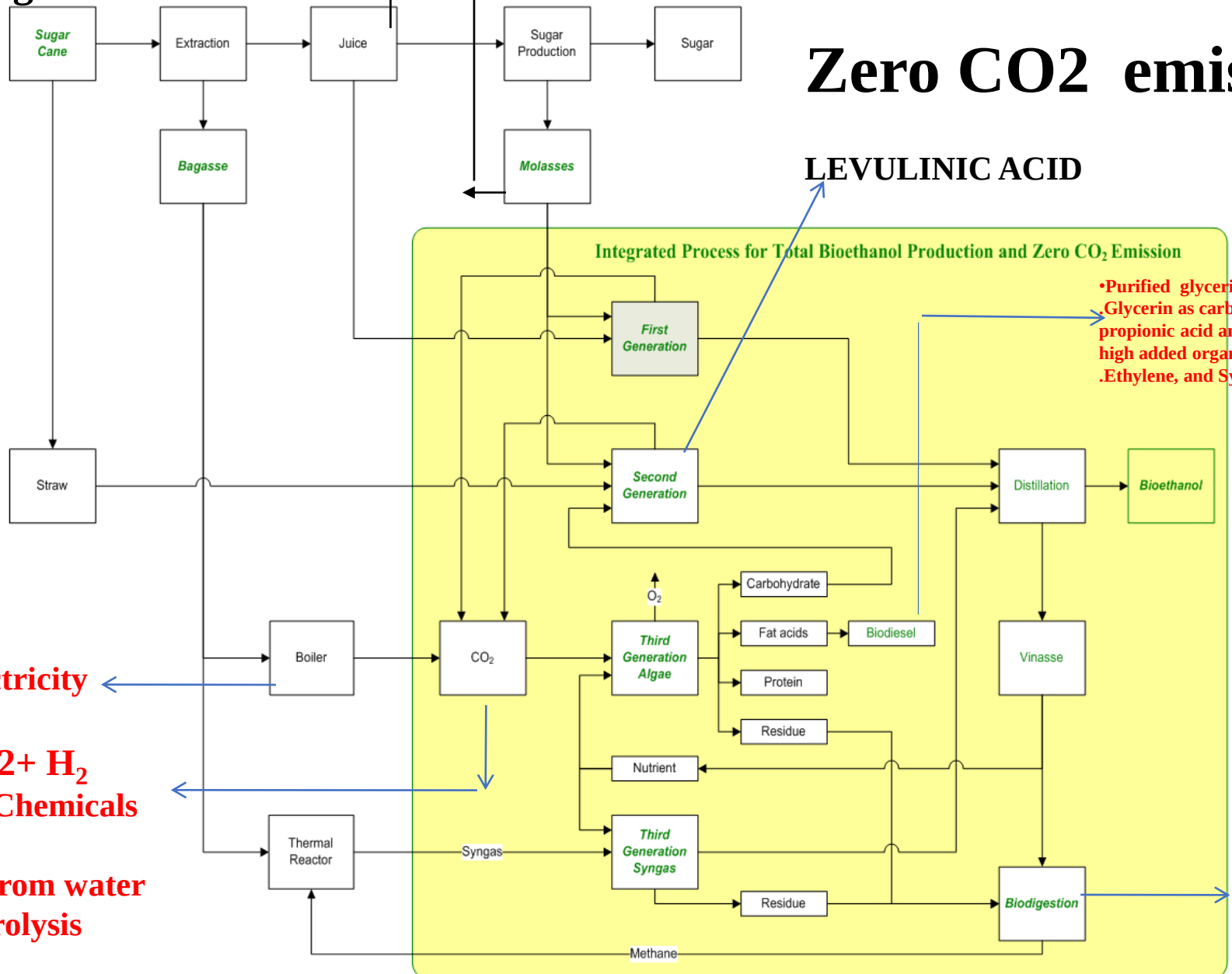
Electricity

CO2+ H2
for Chemicals

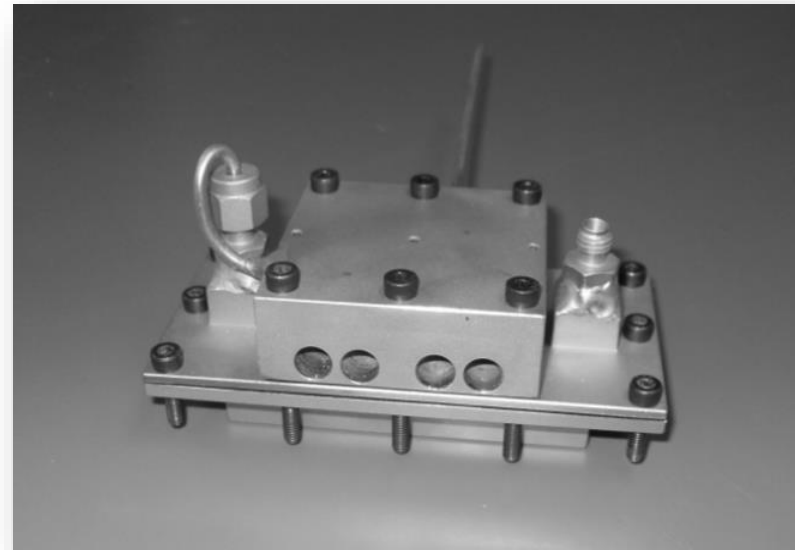
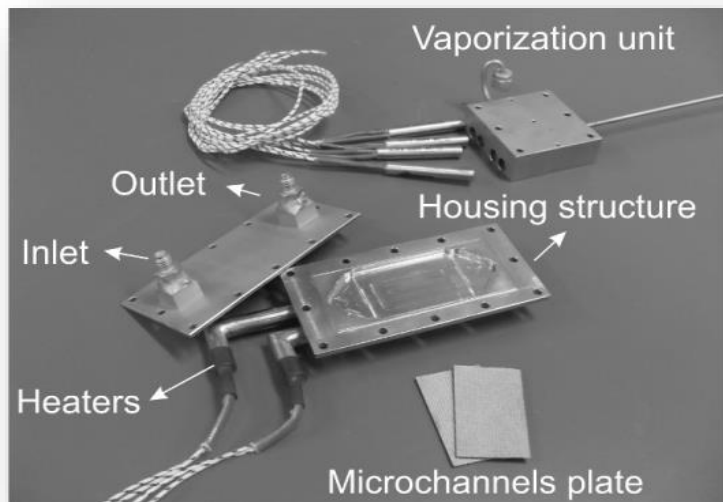
H2 from water
eletrolysis

•Purified glycerin for pharmaceutical
Glycerin as carbon source for
propionic acid and other
high added organic acids
.Ethylene, and Syngas Production

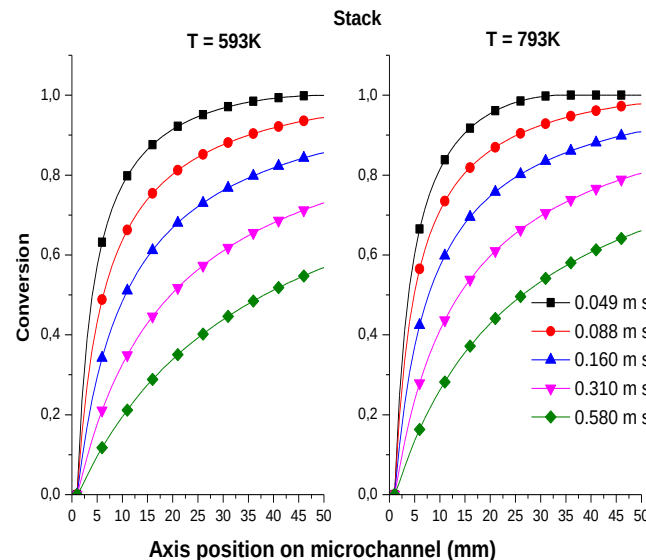
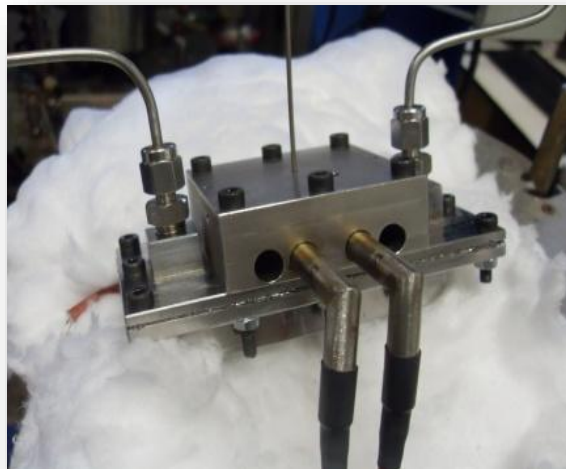
Fertilizer



Microchannel Reactor- H₂ from Ethanol



Final microreactor assembly containing microchannels plates.



Case	593 K	
	[kg s ⁻¹]	V [L h ⁻¹]
A	8,477E-08	3,39
B	1,478E-07	5,91
C	1,905E-07	7,62
D	2,268E-07	9,07
E	2,565E-07	10,26