

CHEMICAL ENGINEERING



UNIVERSITY OF TWENTE.

BIOCHEMICALS

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30 SEPTEMBER 2021

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IN THIS PRESENTATION:



MOTIVATION

ORGANIC ACIDS
SUGARS

PLASTICS

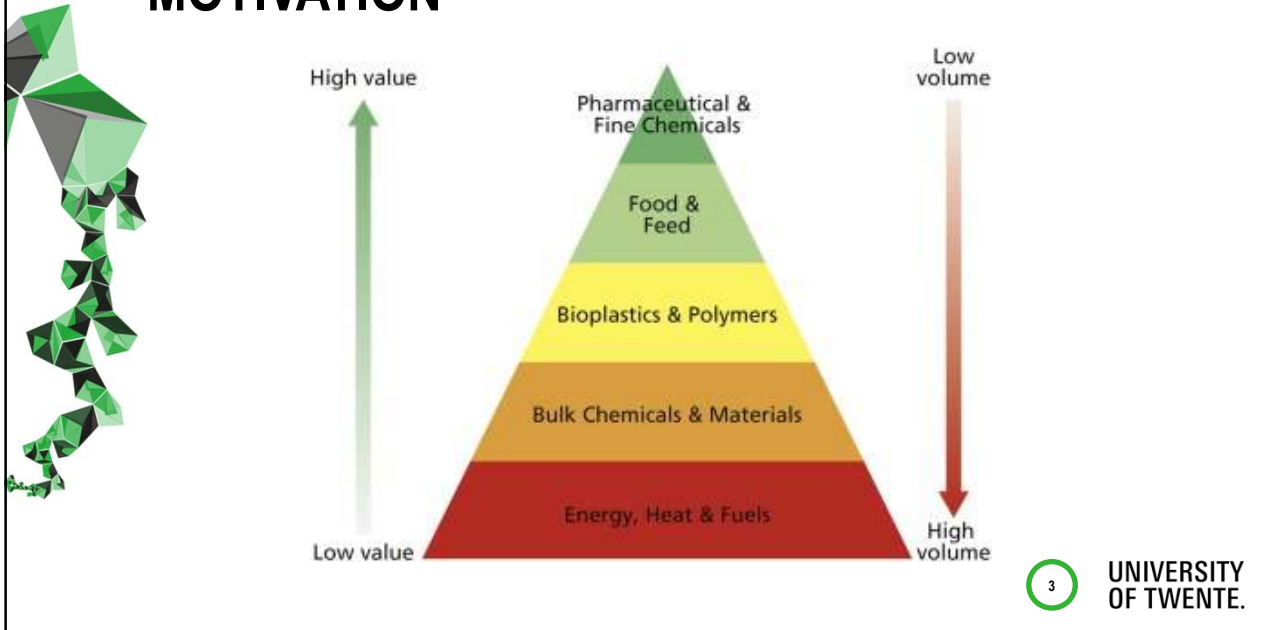
ETHYLENE GLYCOL



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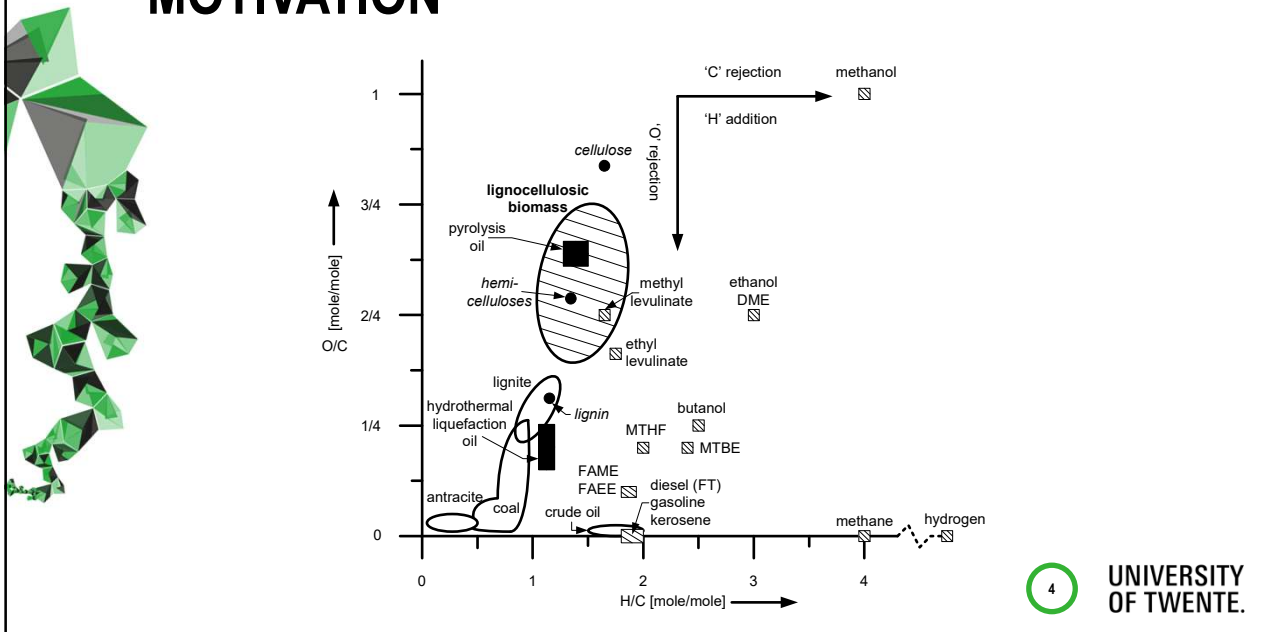
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MOTIVATION



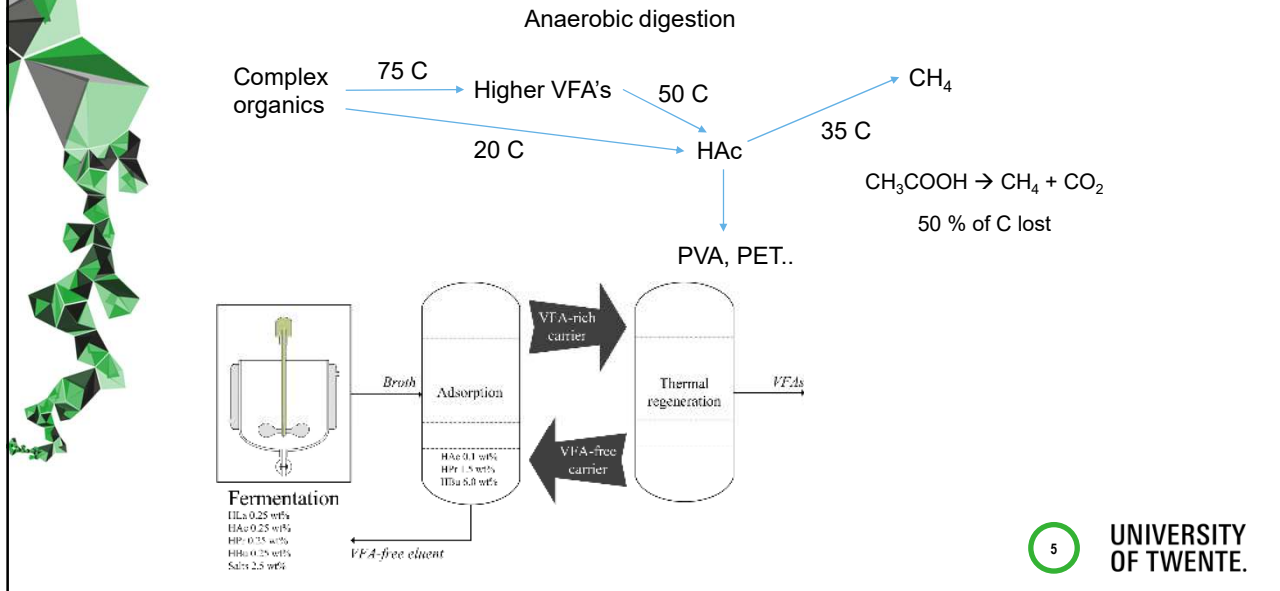
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MOTIVATION



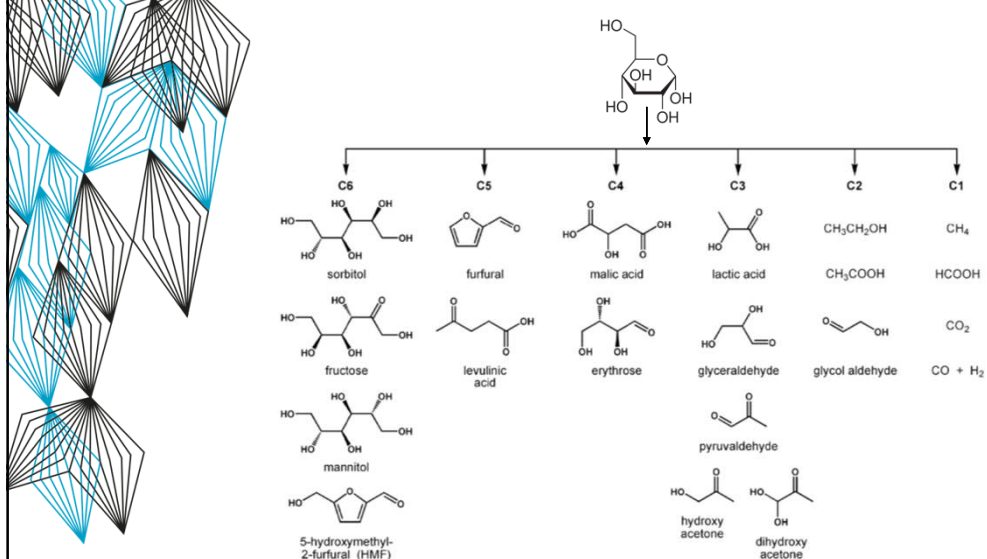
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ORGANIC ACIDS



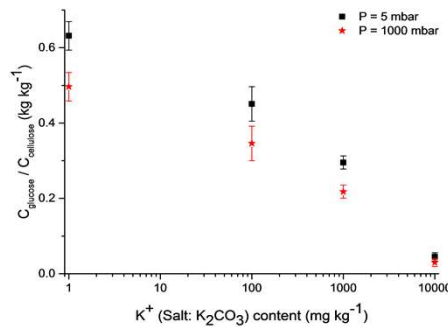
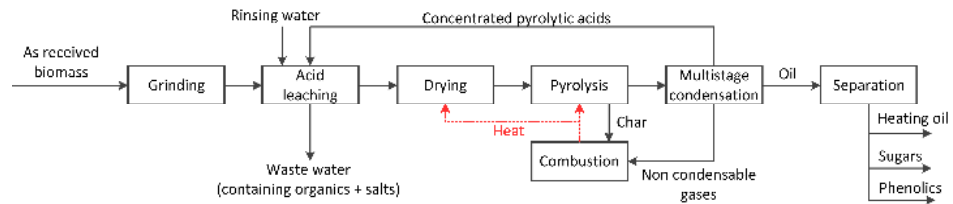
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SUGARS FROM PYROLYSIS

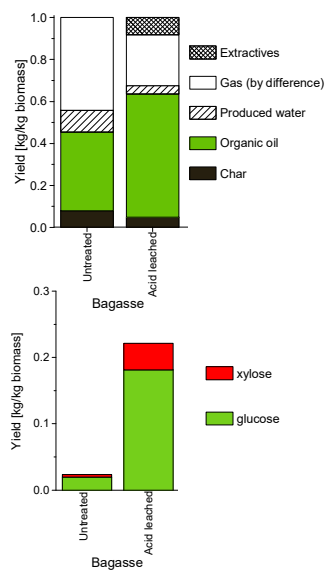


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SUGARS FROM PYROLYSIS



SUGARS FROM PYROLYSIS



Techno-economic evaluation (case bagasse 50 ton/h)

Annual operating costs (million €/year)			
Item	Untreated	Acid leached	Acid leached + sugars
Electricity	18.1	18.1	28.1
Steam	0.0	0.0	2.5
Water	0.7	2.1	2.4
Capital depreciation	5.1	11.0	14.0
Operation & maintenance	4.0	4.0	4.0
Char waste	0.6	0.0	0.0
Annual sales (million €/year)			
Heating oil	0.0	0.0	0.7
Sugars	0.0	0.0	82.5
Char	0.0	0.0	0.0
Steam	0.0	0.0	2.5
Net	0.0	0.0	0.14

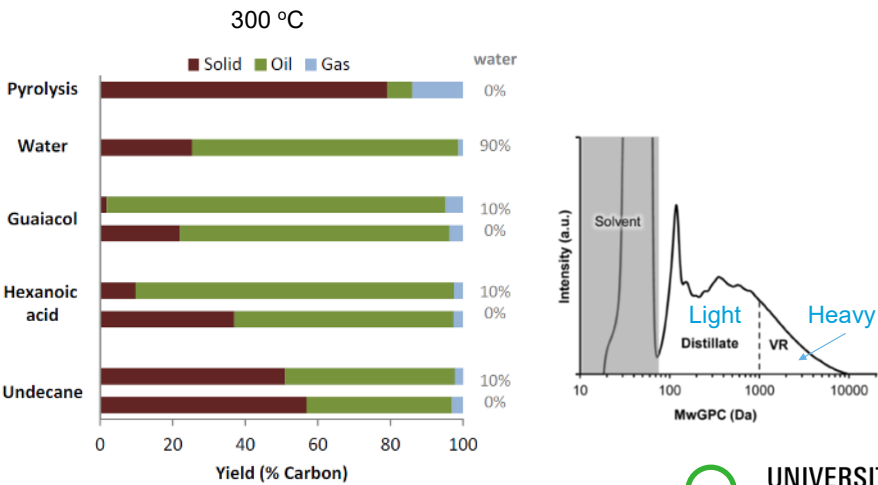
PLASTICS: LIQUEFACTION

Our work was on bio-plastics originated from our work on liquefaction

	Pyrolysis	Direct Liquefaction
T, °C	450 - 550	300 – 400
P, bar	~1	50 – 350
Reaction Environment	Gas / Vapor	Liquid (solvent)
Liquid yield, % on C basis	50 - 60	75 - 95
H ₂ O content liquid, %	15-35	< 5
O content liquid, %	35 - 45	12 - 20
Mol Weight, Da	18 - 2x10 ³	18 - 2x10 ⁴

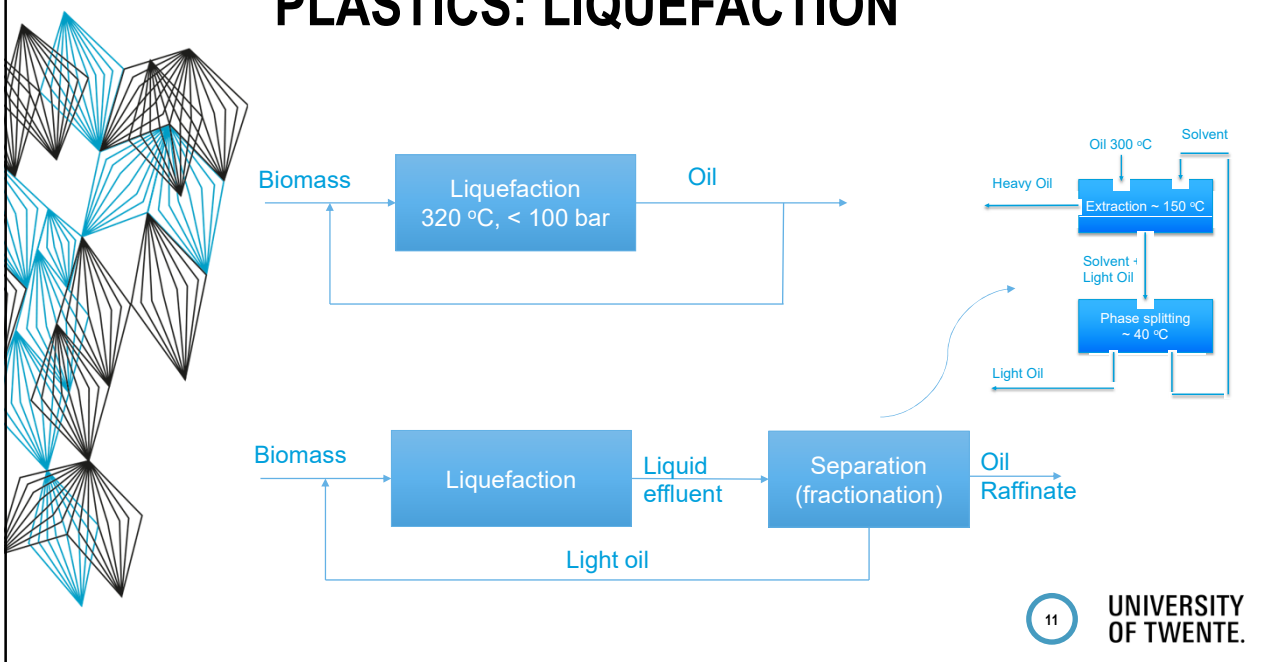
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PLASTICS: LIQUEFACTION



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PLASTICS: LIQUEFACTION



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PLASTICS: LIQUEFACTION

Improved understanding of chemistry and role of solvent (still work to do)

Very high oil yield (> 90 % C) can be obtained

Several processes proposed and studied experimentally

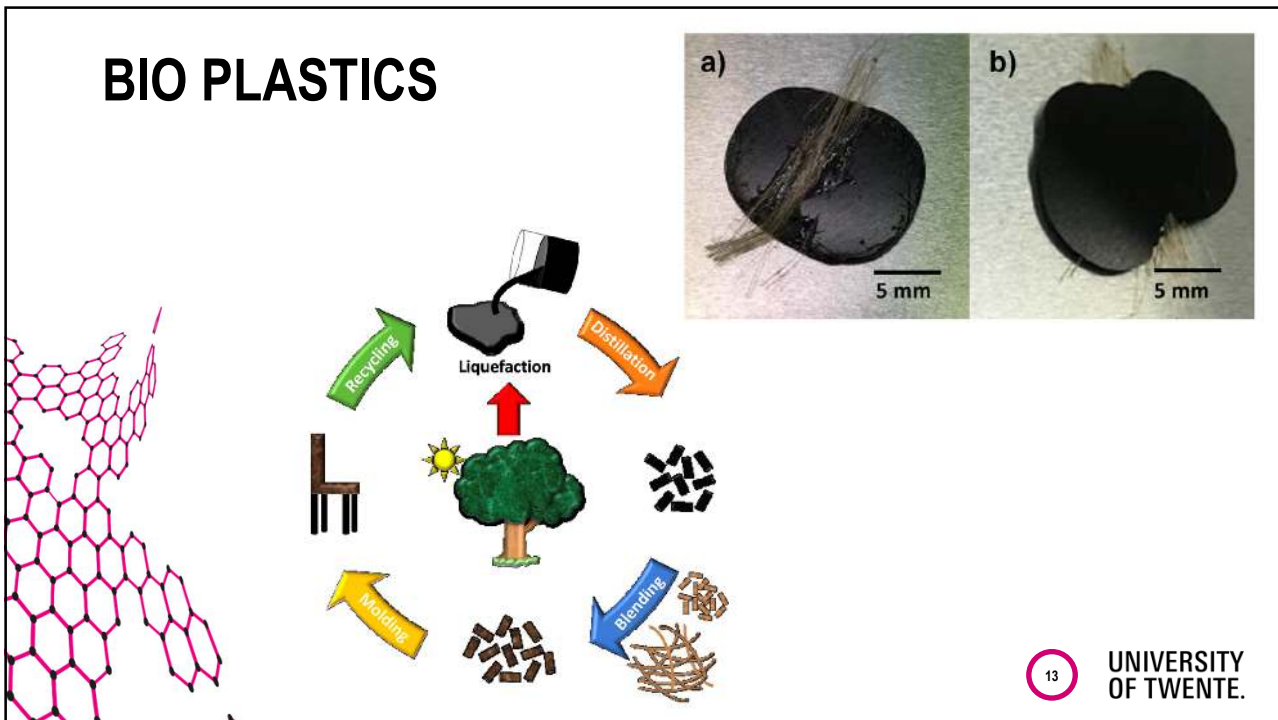
Liquefaction/ Pyrolysis	Oil yield (C%)	Oil characteristics ^a (dry)			Energy requirement ^b (% of wood HHV)	Production cost ^c (\$/bbl)	De- centralized
		H/C _{eff}	MCRT (w%)	HHV (MJ/kg)			
Light oil	90	0.6	40	31	8	60	Yes
VGO	58	0.8	35	33	4	64	No
LCO	57	0.7	33	30	3	61	Yes
Pyrolysis	54	0.4	26	22	8	83 ^d	Yes

Oil is still too heavy and has too high cooking tendency

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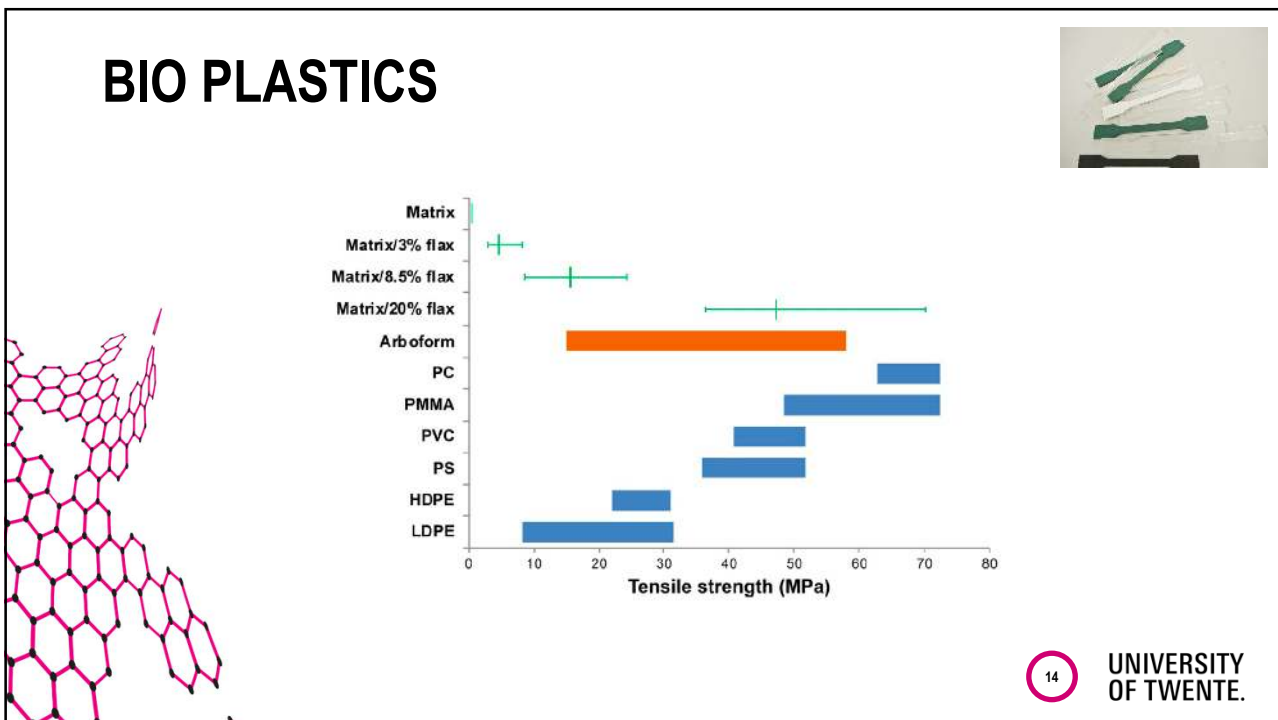
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BIO PLASTICS



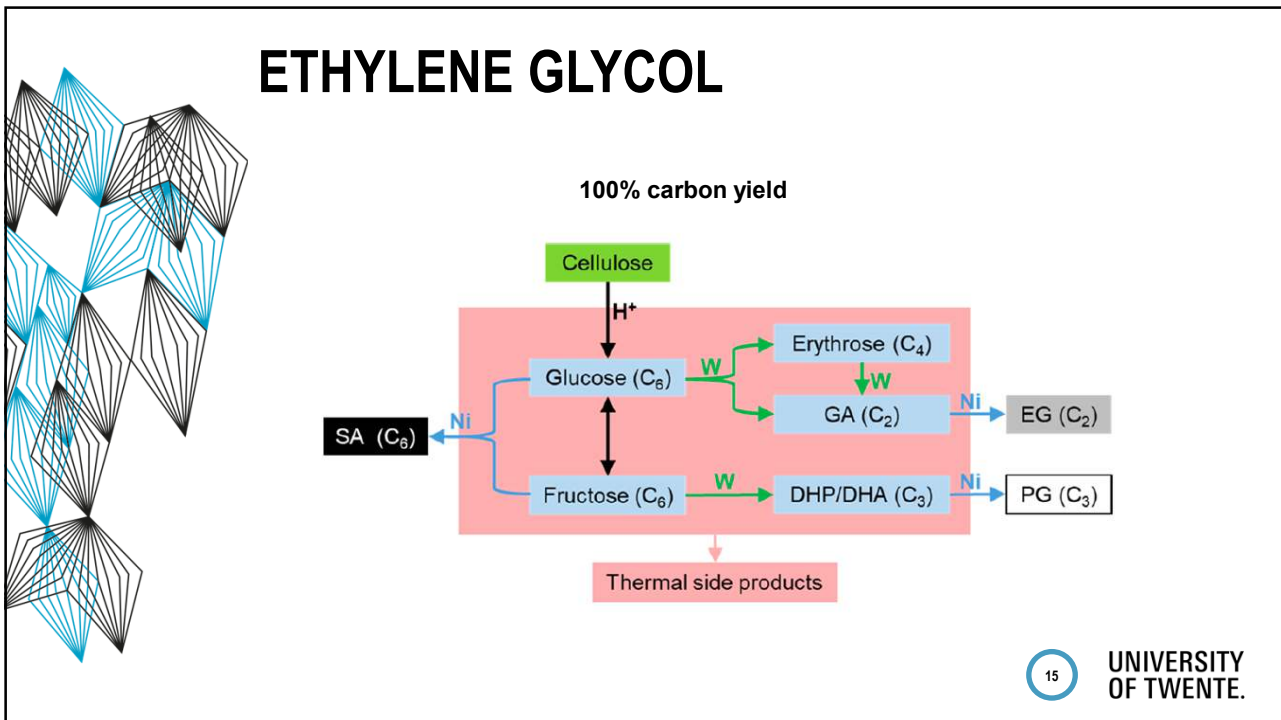
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BIO PLASTICS



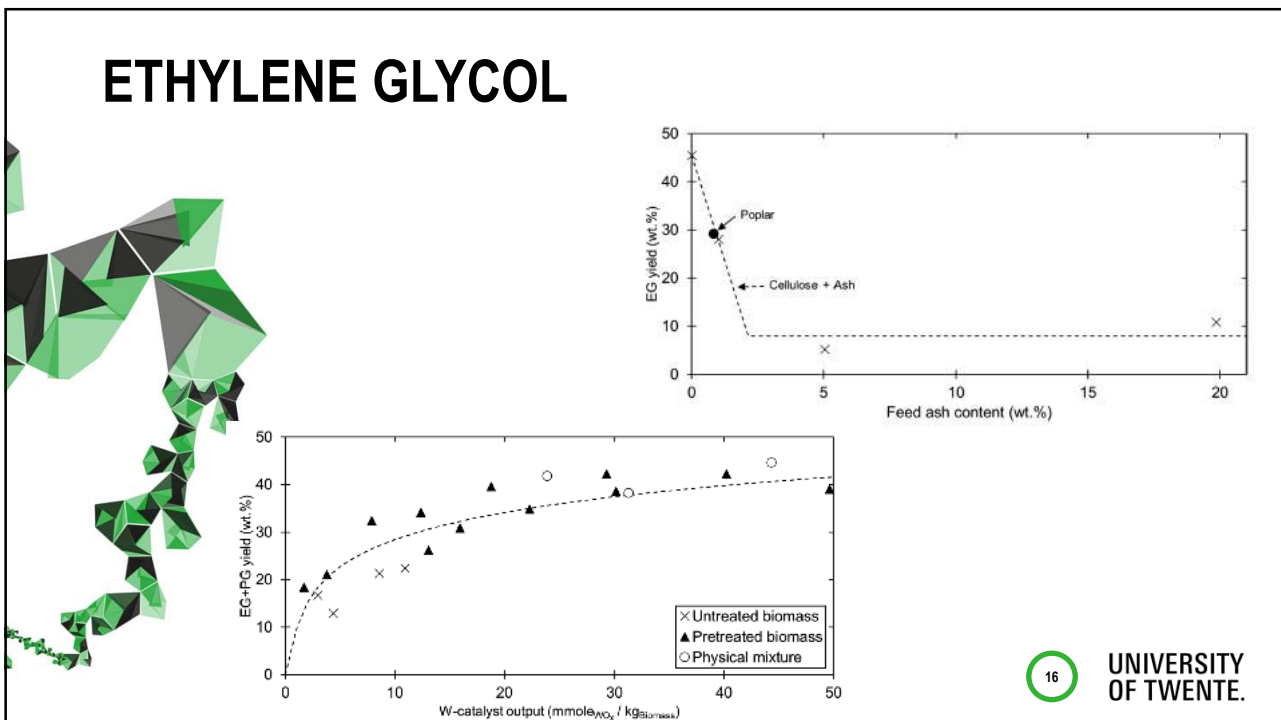
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ETHYLENE GLYCOL



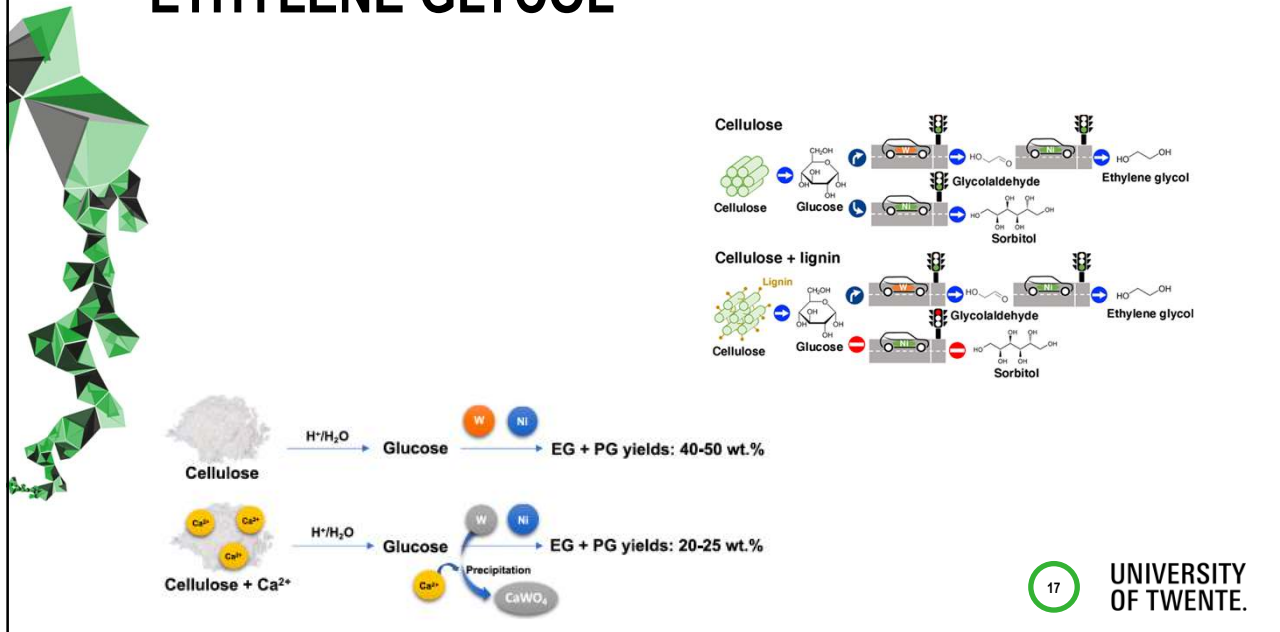
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ETHYLENE GLYCOL



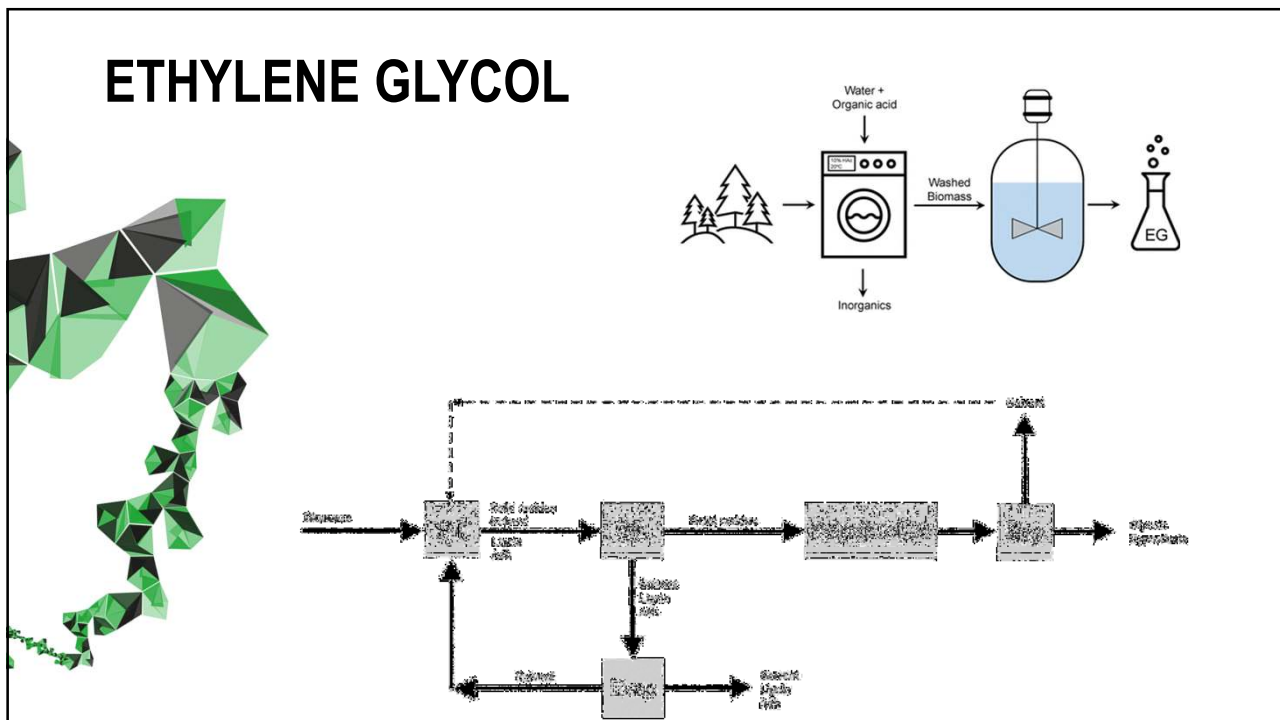
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ETHYLENE GLYCOL



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ETHYLENE GLYCOL



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CONCLUDING REMARKS



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