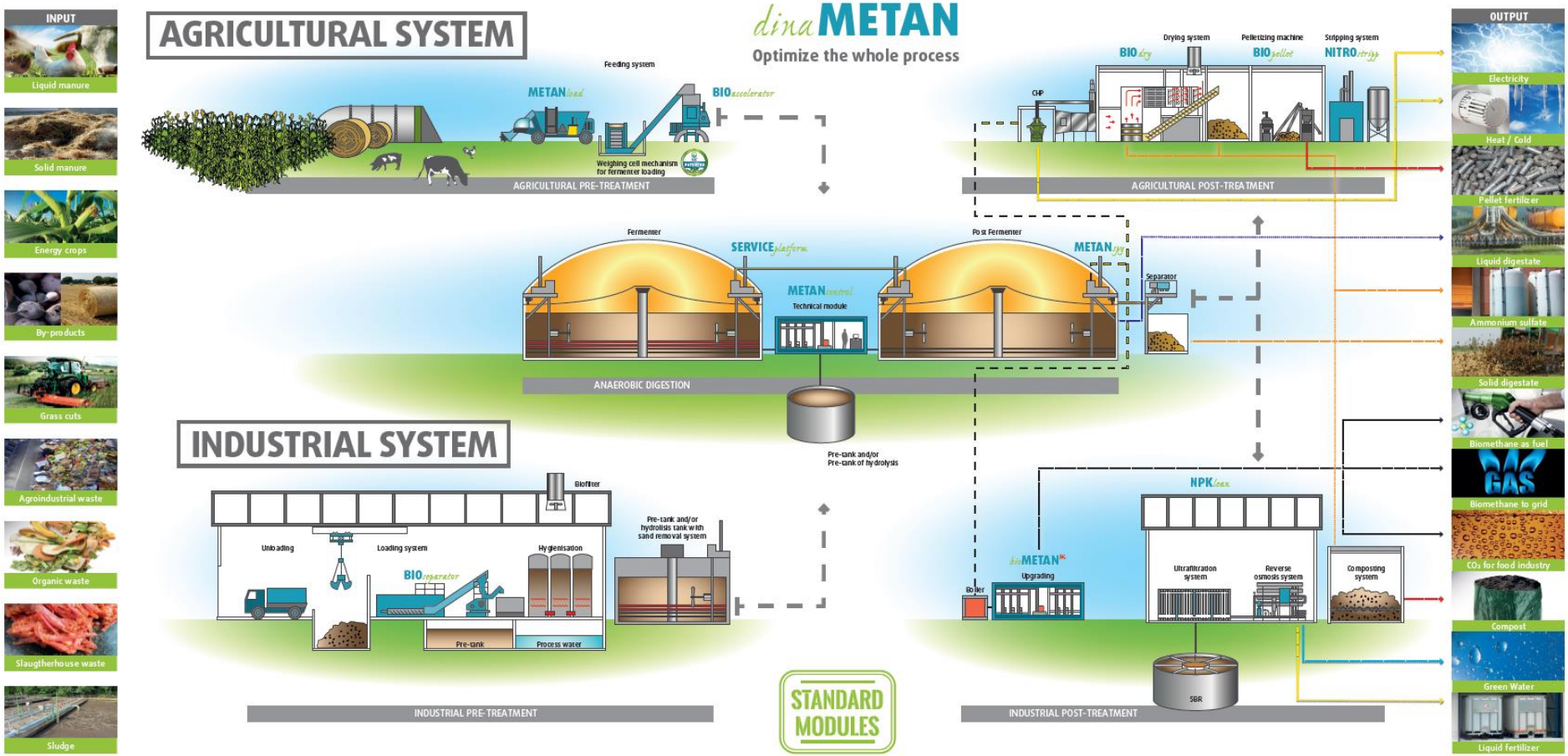
Esbjerg, 25th August 2016

BTS®
part of
TS energy GROUP
harvesting energy!

Aims of the AD plant operator

- High and constant production
- Higher efficiency by using the products (yield)
- Lower costs
  - Optimization of the input material
  - Reasonable use of side-products
    - On farm
    - From market

Different contests, specific systems and many feeding opportunities



Indexes of biological efficiency

- Utilisation of the whole potential degradable organic matter
- Less energy expense necessary to maintain the microorganisms
- Higher concentration of CH_4/biogas

Efficiency/proposal for measurement

- Methane/potential fermentable organic matter (pFOM)
- pFOM fermented /pFOM added

Fodder composition

Fresh matter

Water (humidity)

Dry matter

Anorganic substance (Ashes)

Organisc matter (OM)

- Fermentable OM
  - Carbohydrates
  - Proteines
  - Fats
- Non fermentable OM
  - N fixed to fibre
  - Lignin
  - Fibre fixed to lignin

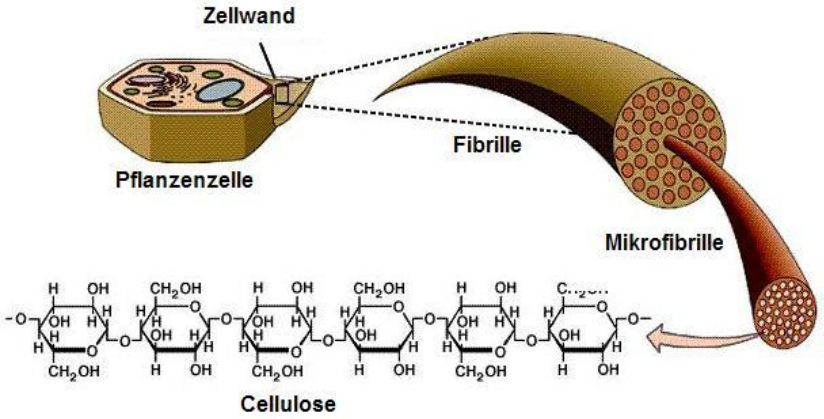
Knowing exactly the fodder composition

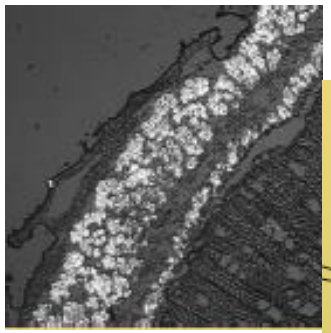
- Analysis in laboratory
  - Fast
  - Reliable
  - Precise
- Determination of all substrate components
  - Especially the fermentable and non fermentable quotes

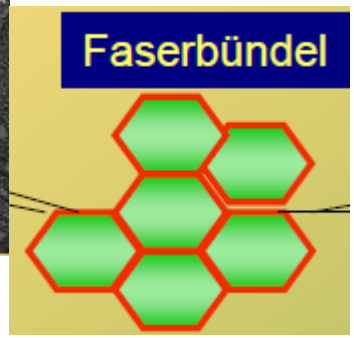
Predict the biological reaction

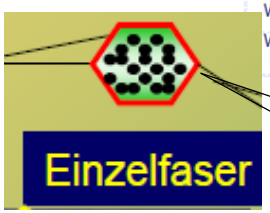
Univerity of Bologna and BTS created a dynamic system:

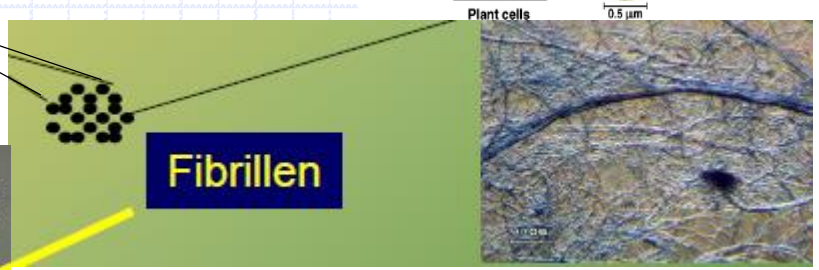
- Bacterial development in the fermenter
- Kinetic degradation of all substrates
- Methane production
- Quantity and quality of the digestate
- Total efficiency of the fermentation process

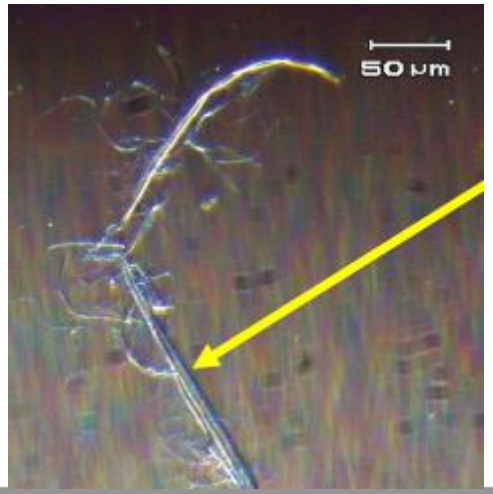


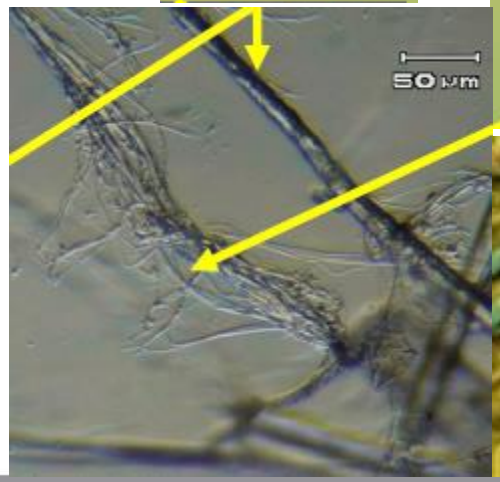


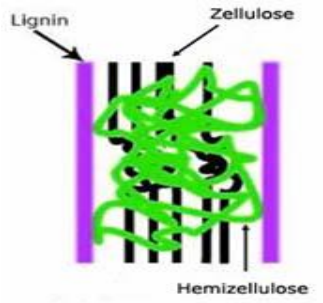


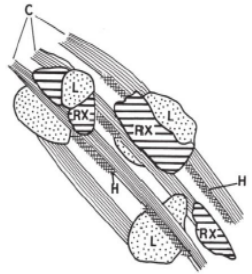






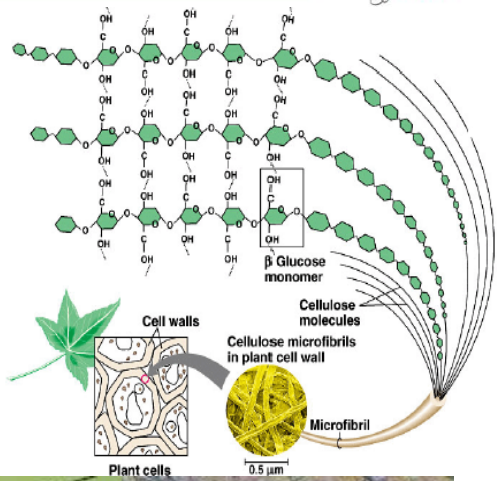




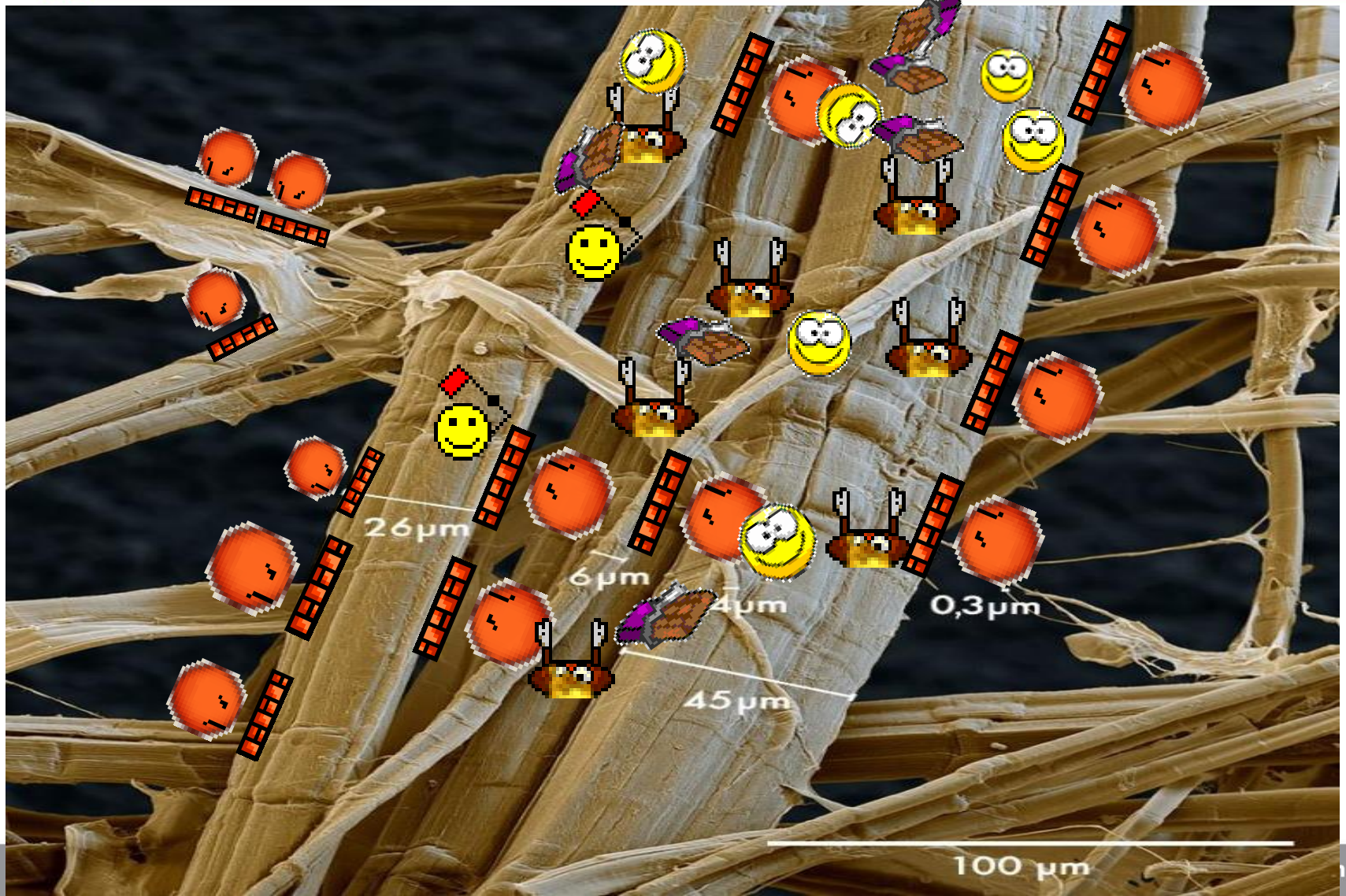


C Cellulose fibres
L Lignin
H Hemicellulose
RX Xylane

Quellen:
www.tucows.vc-graz.ac.at
www.kennmadsen.dk



Biomass under the microscope



BIOaccelerator

Structure of the cell

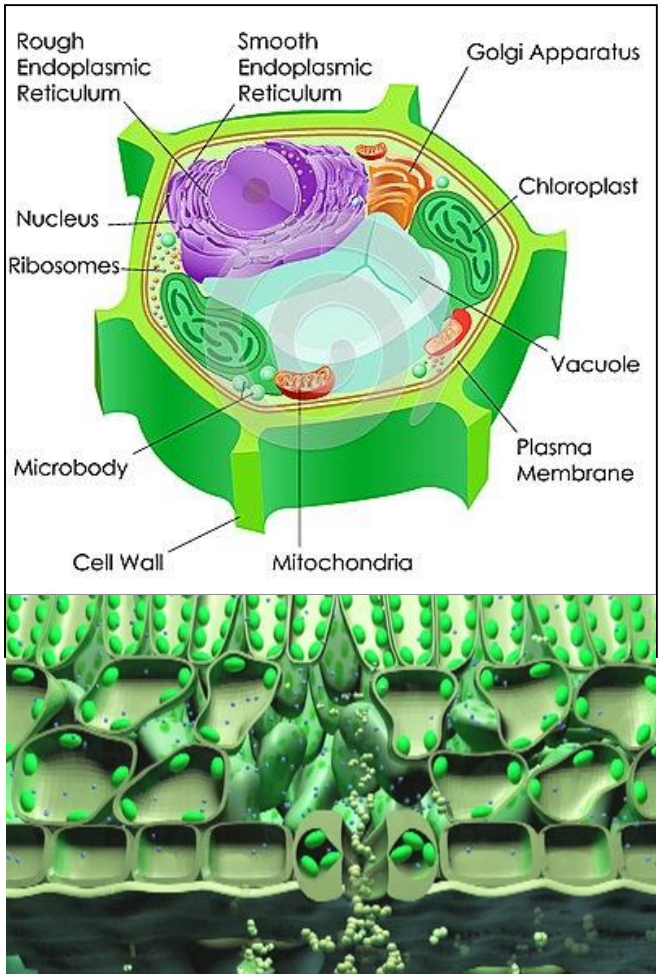
Hemicellulose

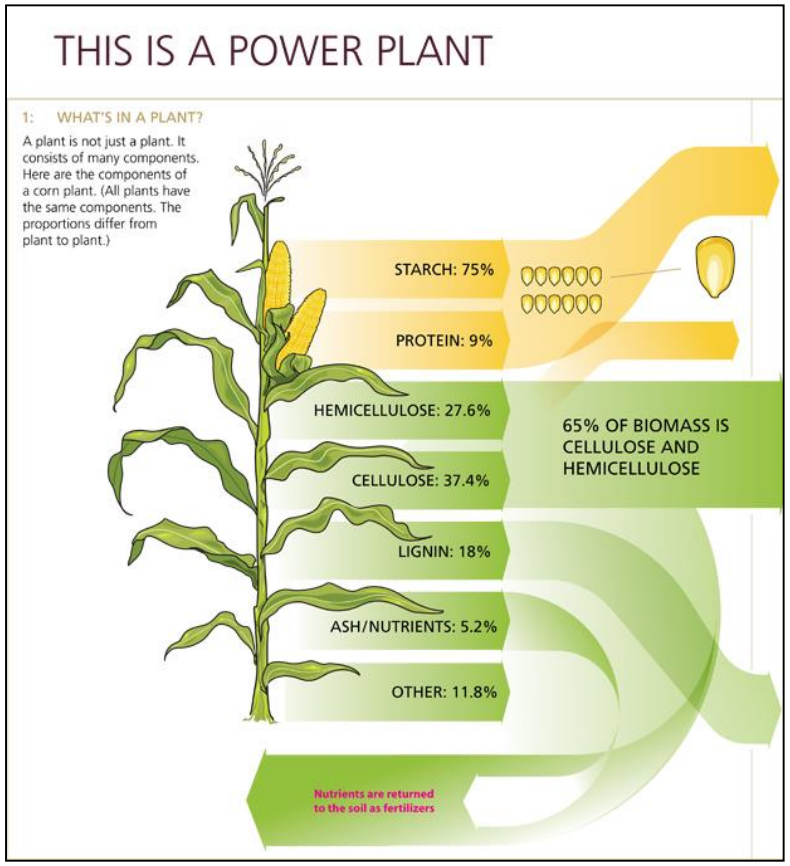
Cellulose

Lignin

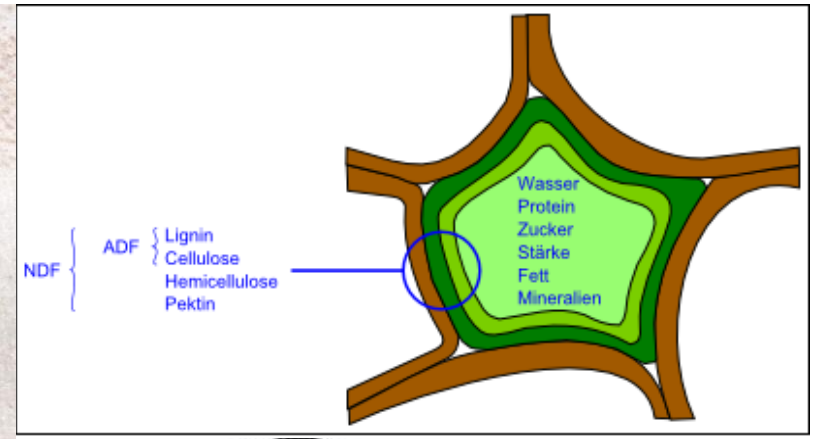
interior of the cell

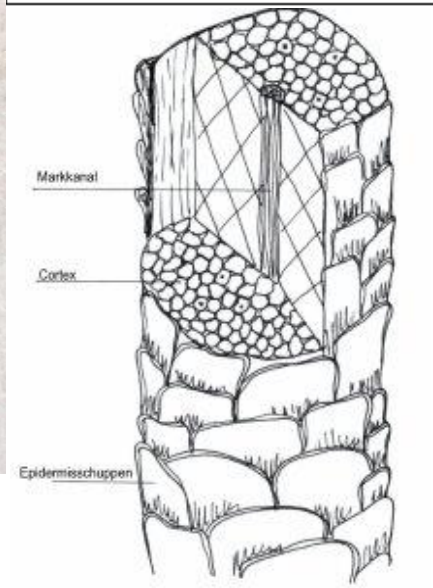
Botanic composition





Botanic composition





Cow Fistula

Fistula on the cow:
fermentation samples
directly from the rumen

A new method: Biogas fistula

- It is necessary to know the kinetic degradation of the organic matter in time
- Usually there are used pilotfermenters in laboratory
  - But it is impossible to describe the kinetic degradation
- Doubt about the reproducibility of what really happens in practice

Preparation of samples to be analysed in laboratory

A new method: Biogas fistula

Introduction of the samples into the biogas plant.

It’s possible to retrieve the bags at any time to analyse the non fermented matter.

METAN lab

BTS part of TS energy GROUP

- The first laboratory specialized in biogas in Italy
- More than 3,000 analyses of fermenters per month
  - pH, FOS/TAC
  - all kinds of acids
  - DM, oDM
  - N, Ammonium
  - Micronutrients
  - Electric conductibility
  - Redox potential
  - NDF, ADF, ADL
  - XP, starch, fat, sugar

BIO optimization

Prof. Formigoni A.

BTS Biogas with University of Bologna

Dynamic forecast model for:

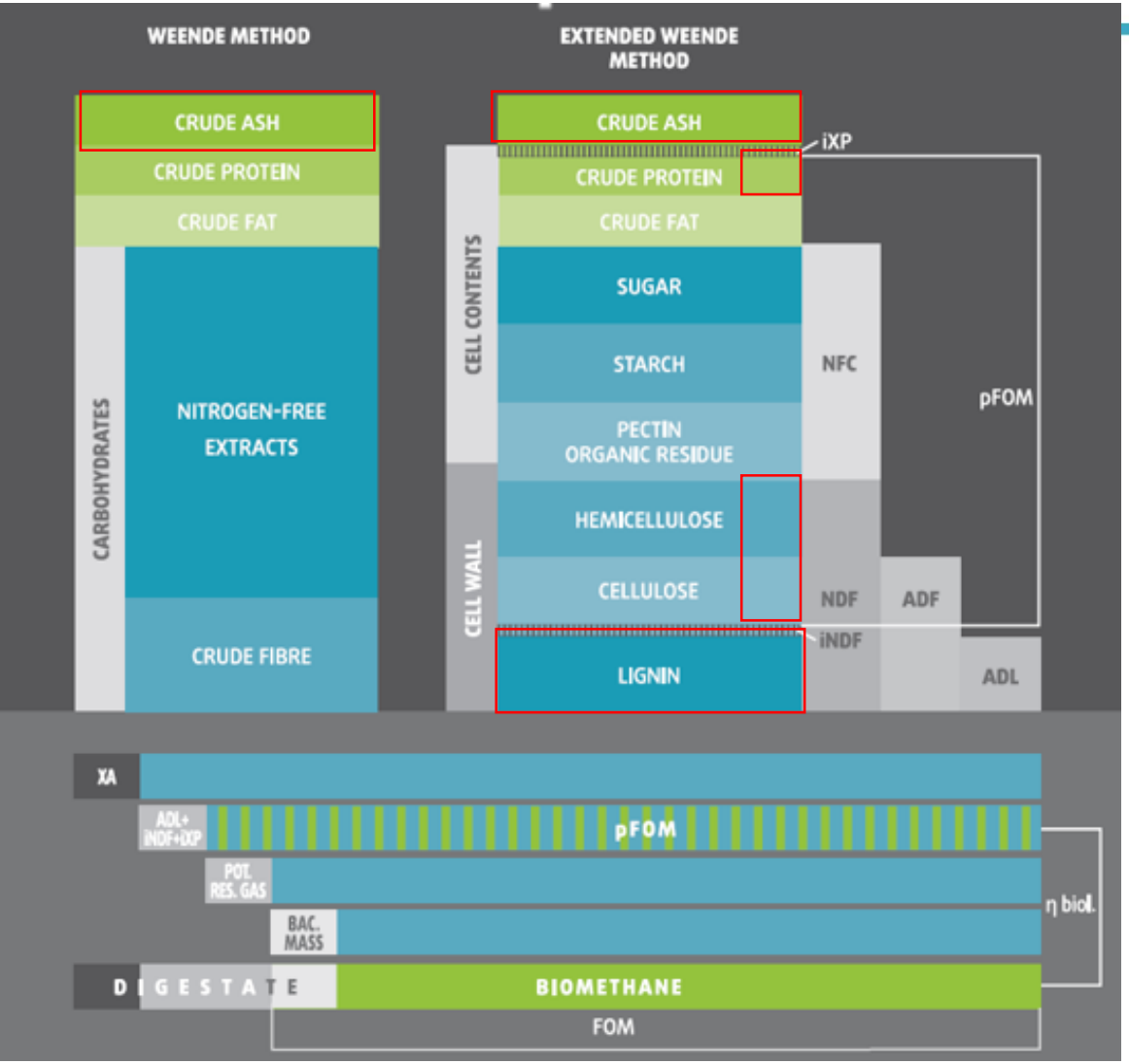
- Development of the bacterial grow
- Kinetics of degradation for every single substrate and the ration mix
- Production of methane/electric energy
- Quantity and Quality of the digestive product
- Global efficiency of the fermentation process
- Economical efficiency for the diet costs

Influence factors for the digestion:

- Retention time (TR)
  - Passing velocity (Kp)
- Constant of hourly degradation (Kd)
  - Intrinsic characteristics of the substrate
  - Treatment – exposed surface

Knowing Kp and Kd we can calculate the degraded substrate in the fermenter

Weende Method



Non fermentable matter

pFOM potentially fermentable organic matter

Own consumption of the bacteria

Potential residue gas

FOM
fermentated organic matter

dinaMETAN

BTS part of TSenergyGROUP

Retention time for each tank

Plant Name:

workshop bts

V Hydrolyse [m3]:

0.0

V Fermenter [m3]:

2850,00

V Post Fermenter [m3]:

2850,00

CH4 / Biogas [%]:

52,00

Engine Efficiency [%]:

39,00

Energy Target [MW]:

1,00

	Volume	Days	Specific Loading
Hydrolyse			
Fermenter			
Post Fermenter			
Total			

Energy Production

Product	Amount [t]	Dry Matter [t]	FOM [t]	CH4 [m3]	Expected Energy / Day [kWh]
Cattle slurry 8%DM ingrasso					
Corn Silage med.BTS 2013 IT 33.5%DM					
Cornmeal					
Triticale Silage 30.5%DM media					
Wheat Bran average N°265					
Recirculate					
Total					

Cost – optimization

Product	Amount [t]	Expected Energy / Day [kWh]	Cost / t [EUR]	Cost / kWh [ct]	Cost Diet [EUR]
Cattle slurry 8%DM ingrasso					
Corn Silage med.BTS 2013 IT 33.5%DM					
Cornmeal					
Triticale Silage 30.5%DM media					
Wheat Bran average N°265					
Recirculate					
Total					

Calculation for the TMR

Fermentable Mass

Organic DM

org. DM / DM

pot. ferm.org. DM / DM

ferm.org. DM for CH4-Prod . / DM

ferm.org. DM for bac.gr. / DM

n.ferm. DM / DM

pFOM

ferm.org. DM for CH4-Prod. / pot.fermb. org.DM

ferm.org. DM for bac.gr. / ferm. org.DM

org.DM n.ferm / pot.fermb. org.DM

Details of the degradation

Post Fermenter	Quantity [t]	Proteins [t]	Azote [t]	N ADIP [t]	Lost N-NH4	Total remaining N	Ashes [t]	NDF [t]	Lignin [t]	Remaining Bacteria	Lipid Fat [t]	Starch [t]	Sulfur [t]	Other [t]	Dry Matter [t]	ndf_d	ndf_nd
Cattle slurry 8%DM ingrasso																	
Corn Silage med.BTS 2013 IT 33.5%DM																	
Cornmeal																	
Triticale Silage 30.5%DM media																	
Wheat Bran average N°265																	
Quantity in tons																	

Products which are not enough degraded in the ration mix?

Post Fermenter	Quantity [t]	Dry Matter [t]	ndf_d	ndf_nd
Cattle slurry 8%DM ingrasso				
Corn Silage med.BTS 2013 IT 33.5%DM				
Cornmeal				
Triticale Silage 30.5%DM media				
Wheat Bran average N°265				
Quantity in tons				

Output

	Quantity [t]	% of Total Quantity	% of Dry Matter
Quantity			
Dry Matter			
Proteine			
Azote			
N ADIP			
Lost N-NH4			
Total remaining N			
Ashes			
NDF			
Lignin			
Remaining Bacteria			

Recirculation

Yes / No?

BIOaccelerator

Treatment
Materiale grezzo

Expected Energy / Day	kWh	
Energy Target / Day	kWh	

ferm.org. DM for CH4-Prod. / pot.fermb. org.DM

ferm.org. DM for bac.gr. / ferm. org.DM

org.DM n.ferm / pot.fermb. org.DM

Treatment
Bioaccelerator R

Expected Energy / Day	kWh	
Energy Target / Day	kWh	

ferm.org. DM for CH4-Prod. / pot.fermb. org.DM

ferm.org. DM for bac.gr. / ferm. org.DM

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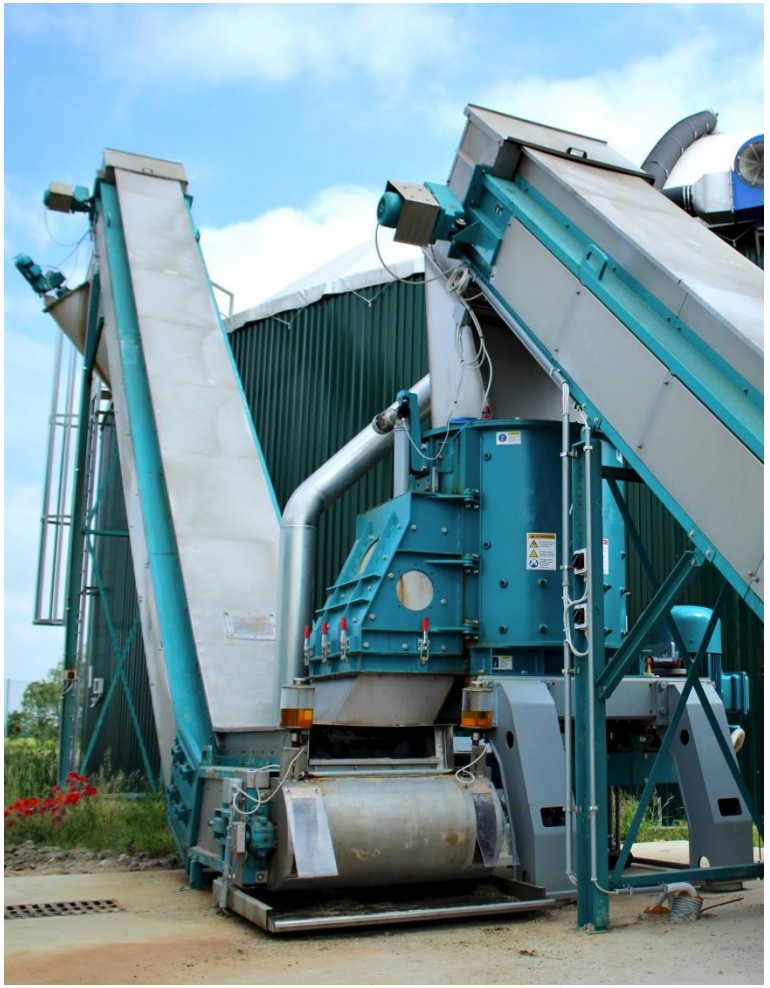

Thank you
for your attention!

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