

VOGELBUSCH  
Biocommodities

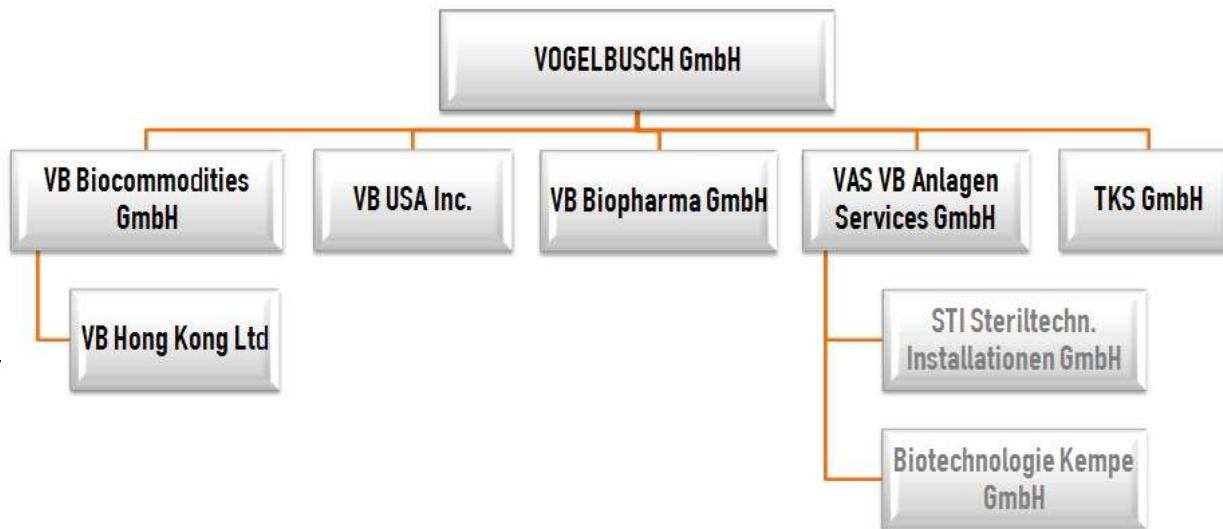
*Welcome!*

**VOGELBUSCH  
Bioethanol Technology**

# VOGELBUSCH group

| the bioprocess company

- ▶ since 1921
- ▶ independent
- ▶ staff of 120
- ▶ inhouse R&D laboratories
- ▶ branch offices in Houston and Hong Kong
- ▶ serving the starch, sugar & pharmaceutical industry



# VOGELBUSCH | ethanol technology

Process design of alcohol plants since 1921

- ▶ first bioethanol plant 1974 in Kenya, around 40 plants in Brazil
- ▶ 33 bioethanol plants since 1981 in North America, China, Europe | total annual capacity of 5 million tons
- ▶ 4 plants currently under design or construction



# Our services

We complement our clients' skills

- Pre-engineering of the process plant
- Basic process package
  - | technology & process design
  - | supply of key equipment
  - | commissioning support & operator training
- Detailed piping engineering according to European standards
- Turnkey supply



# Process design targets

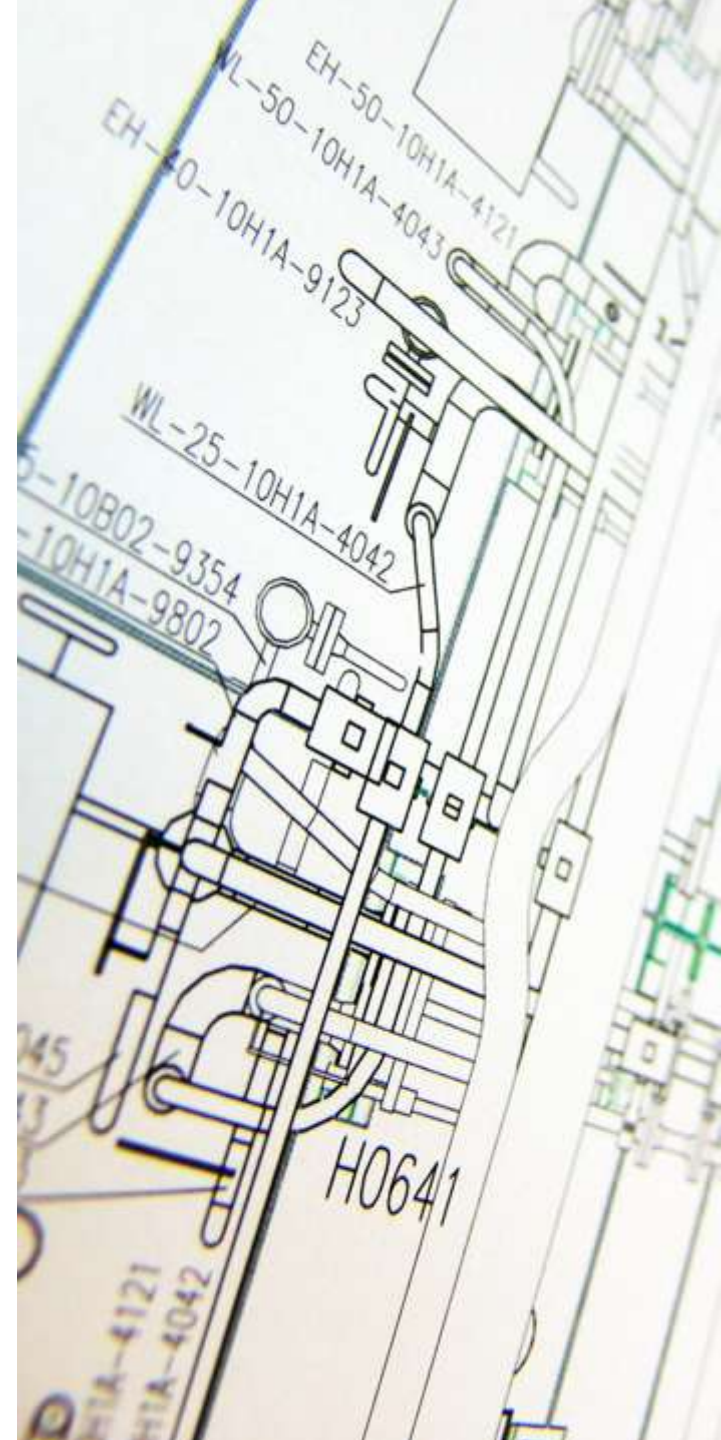
We make biotechnology work

Top performance in terms of

- ▶ Product quality
- ▶ Process economics
- ▶ Environmental impacts

To optimise the

- ▶ Long-term cost-benefit ratio for the plant



# Design options : Subject to feedstock & product quality (1)

We find solutions that meet our client's needs

## Raw material preparation

- ▶ Starch  
milling, liquifaction, saccharification
- ▶ Sugar  
pasteurisation, stripping, sludge removal

## Fermentation (normally continuous)

- ▶ Without yeast recycling - together with fibers or sludge
- ▶ With yeast recycling - without fibers or sludge

# Design options : Subject to feedstock & product quality (2)

We find solutions that meet our client's needs

## Distillation|rectification|dehydration

- ▶ Simple column system: power or low grade alcohol
- ▶ Advanced column system: high purity alcohol
- ▶ Additional dehydration unit: dehydrated alcohol

## Stillage evaporation

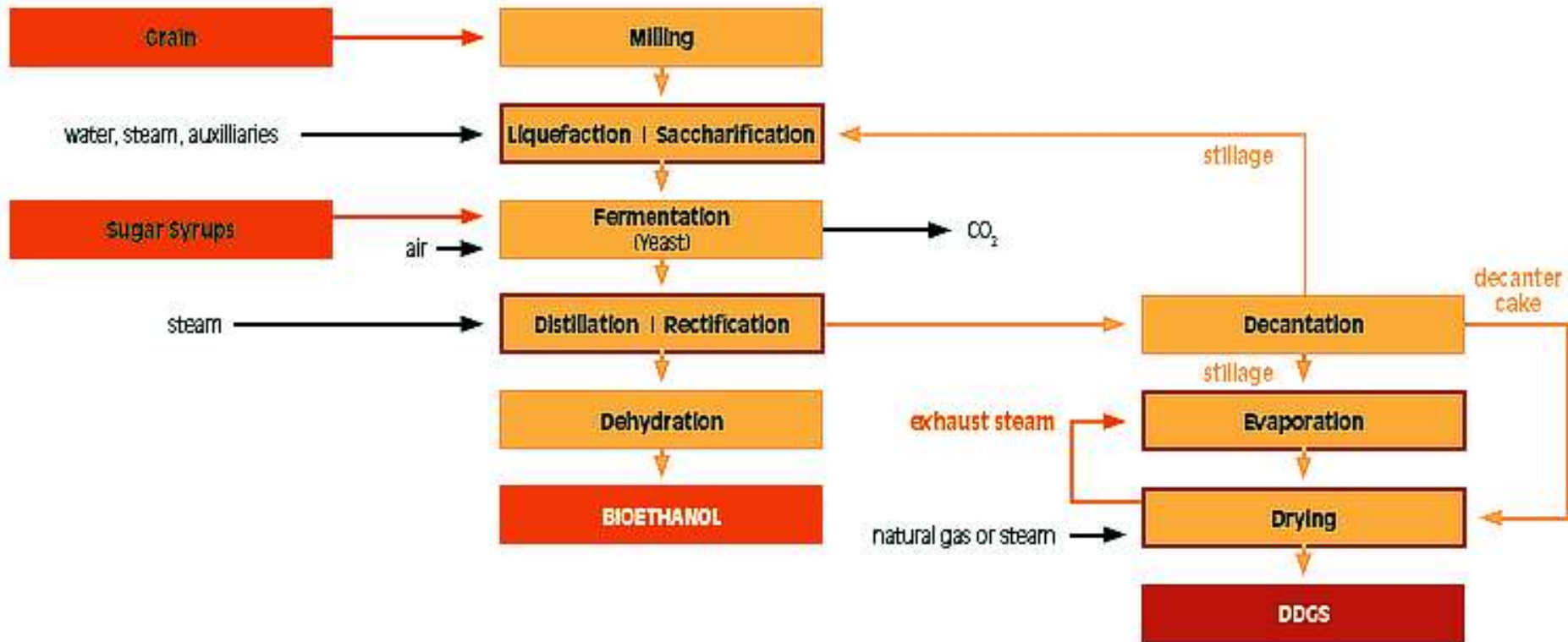
- ▶ Including decantation in case of fibres

## Stillage drying or incineration

- ▶ DDGS by drying stillage concentrate and fibres from grain
- ▶ Steam generation by incineration of molasses stillage concentrate

# Ethanol process diagram

□ processes with high energy consumption





# Energy saving process design

Within process groups and the plant as a whole

Decanted stillage re-used in raw material preparation

- ▶ *capacity and steam demand for stillage evaporation is reduced*
- ▶ *latent heat of hot stillage is utilized in liquefaction*

Fermentation efficiency: high alcohol content in fermented mash

- ▶ *reduced capacity and steam demand for distillation and stillage evaporation*

Thermal integration

- ▶ *recovery and reuse of secondary energy from recycled process streams: distillation | rectification | evaporation | dehydration | DDGS drying*

# Thermal integration solutions

There is no "one size fits it all"

## Rectification & dehydration (mole sieve)

- ▶ *practically no steam demand, using latent heat of feed vapors (rectified alcohol)*

## Atmospheric distillation/rectification & evaporation

## VB Multipressure distillation

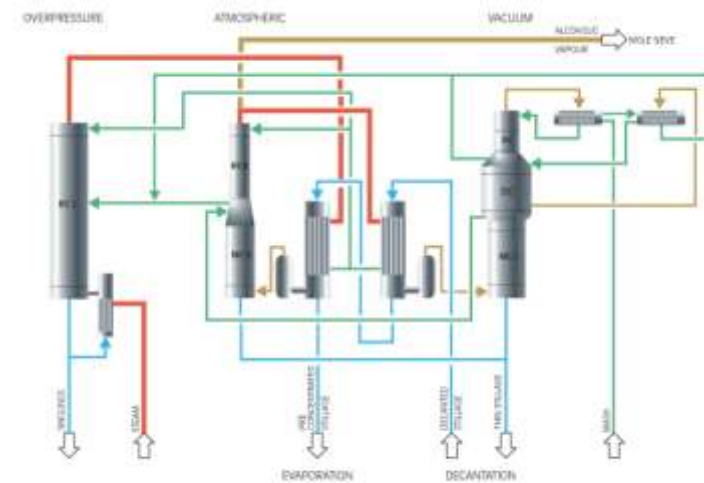
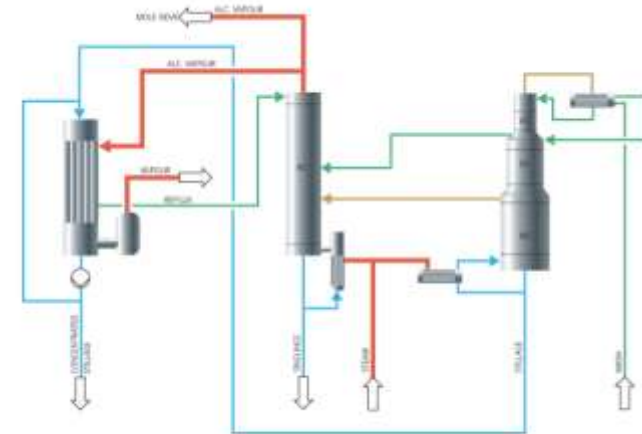
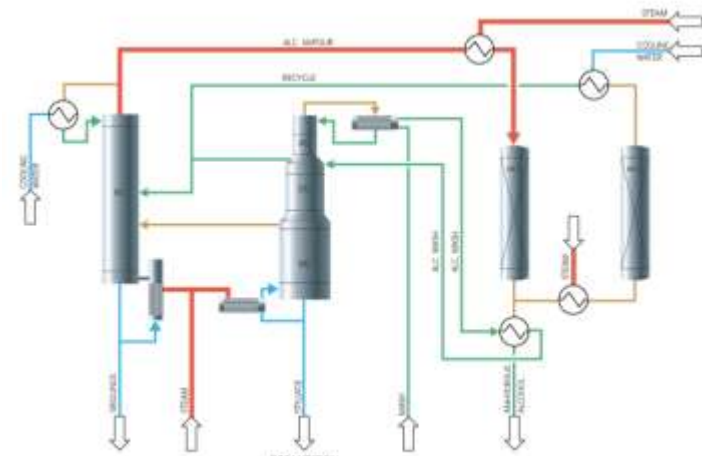
- ▶ *using latent heat of rectified alcohol vapors for distillation and dehydration*

## VB Multipressure distillation with split columns

- ▶ *heat input (steam) re-used up to 2 times*

## DDGS drying & evaporation

- ▶ *zero life steam demand for stillage evaporation*

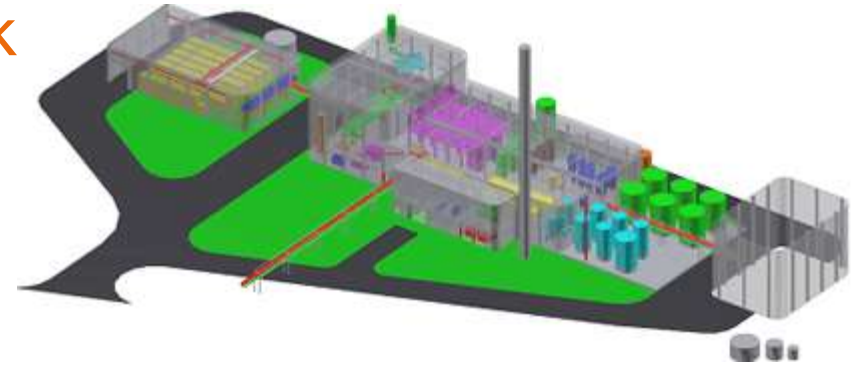


# SHOW CASE PROJECT

## Inbicon | Kalundborg | Denmark

### 2G demonstration plant

process design  
for distillation and dehydration  
5400 tpa bioethanol from wheat straw



integration of  
1G and 2G technology

start-up in fall 2009  
on occasion of the  
UN Climate Summit

# SHOW CASE PROJECT Lantmännen Agroetanol AB | Norrköping | SE bioethanol plant

distillation and dehydration  
470,000 l/d bioethanol  
2008



# SHOW CASE PROJECT

France

bioethanol plant

process design for

400,000 l/d bioethanol

2008



# SHOW CASE PROJECT

Cargill Inc.  
bioethanol plant

process design for  
1.190.000 l/d bioethanol from corn hydrolysate  
2008

**SHOW CASE PROJECT**  
Penford Products  
Cedar Rapids, Iowa | USA  
bioethanol plant

process design  
for 450,000 l/d  
bioethanol  
2008



# SHOW CASE PROJECT

Altra Biofuels | Cloverdale, Indiana | USA

bioethanol plant

process design

908,000 l/d bioethanol

2008





# SHOW CASE PROJECT

Abengoa Bioenergy | Ravenna, Nebraska | USA

bioethanol plant

process design for

908,000 l/d bioethanol

2007



# SHOW CASE PROJECT

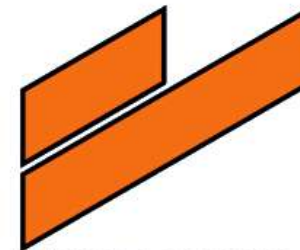
## Jilin Fuel Ethanol Co | China

### bioethanol plant

world's largest bioethanol plant 1.25 mio l/d  
design capacity 2.5 mio l/d  
2003



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VOGELBUSCH

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services for the biotechnology  
industry on a global basis  
since 1921

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