



ITT

Effective Mixing to reduce Energy consumption in a digester

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Agriculture and Biogas

Engineered for life

Effective Mixing to reduce Energy consumption in a digester

- **Introduction - basics**
- ITT Flygt Standard
- Results from the survey with compact mixers
- Results of the slow running “Banana” survey
- Dimensioning of mixers
- New Mid Size and Top Entry Mixers

Fluid Technology – Global Presence

“Think Global Act Local”

North America
100 Locations

Europe
150 Locations

Mid-East/Africa
6 Locations

Asia-Pacific
34 Locations

South America
11 Locations

Australia/NZ
13 Locations

- 140 Countries
- 310 Locations
- 43 Production Facilities
- 40 Service Centers
- >2,500 Distributors

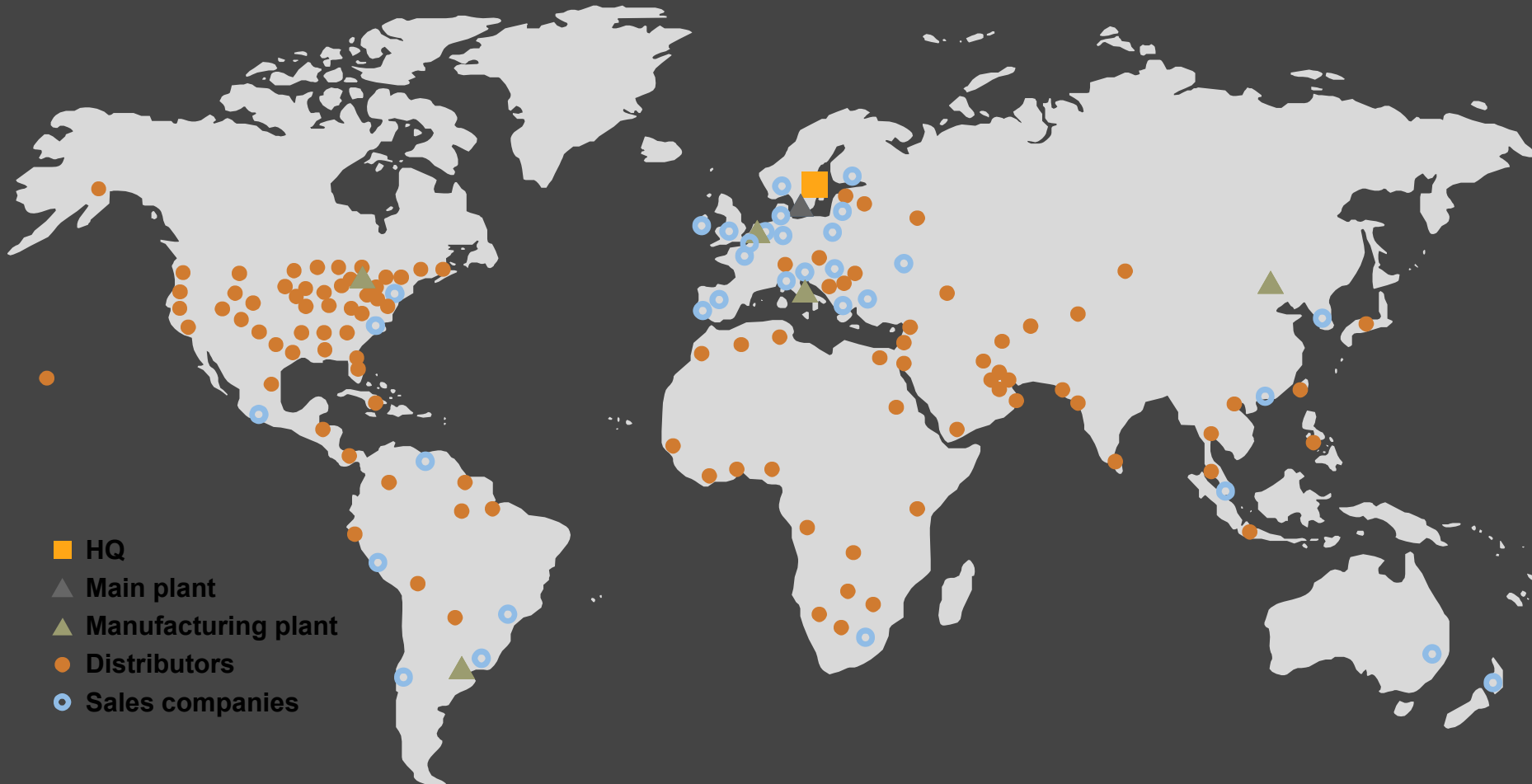
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Fluid Technology

ITT Water & Wastewater



ITT Water & Wastewater around the world



ITT Fluid Technology ITT Water & Wastewater



ITT's Footprint in China



1928
First telephone
switchboard in
Shanghai

1933
Establishment of
communication
products
manufacturing
enterprises

1994
Zhenjiang Cannon
Joint Venture
Shenyang Flygt JV

1996
Flygt Shanghai
Office
ITT Industries (China)
Investment Co., Ltd.

1997
Acquisition of
Goulds Pumps
and
Its Nanjing
Plant

1998
Shanghai Goulds
Pumps Plant
CableCom
Shenzhen JV

1999
Acquisition of STX's
three enterprises in
Nantong, Xiamen and
Tianjin

2000
Acquisition of MMI
and Its plants in
Tianjin

2001
The
introduction
of Six Sigma
tools

2002
FHD
production
base in
Shenyang

2003
Sanitaire
Shenyang
production
base

2004
Acquisition
of Shanghai
HengTong
Acquisition of
WEDECO

2006
Switches
Divestiture

2007
Establishment of
the Nanjing FT
Plant
Establishment of
the Wuxi Plant
Expansion of
Shenyang Plant

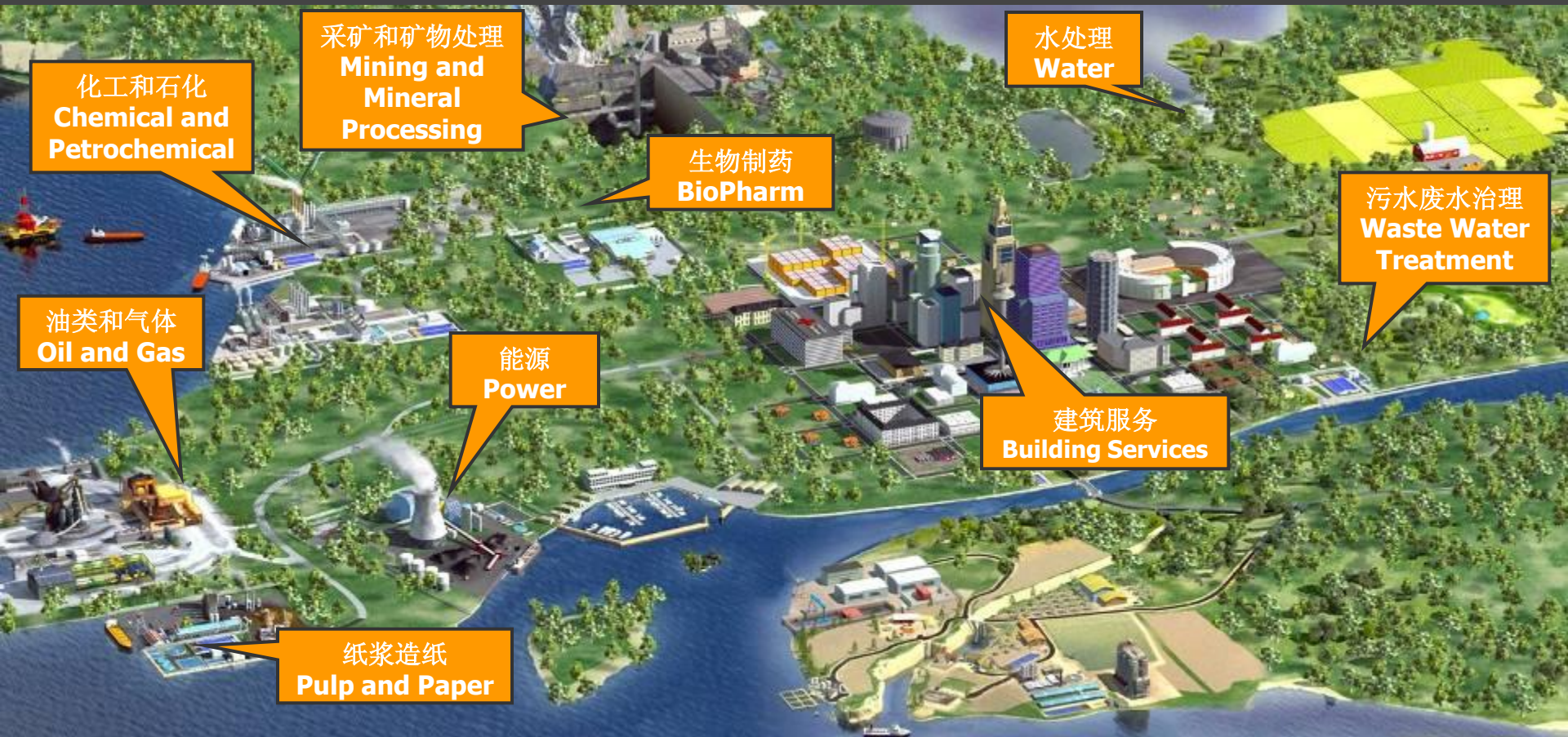
2008
Establishment
of FT IFE
organization

Overview of ITT China

- Six manufacturing enterprises in six cities
- Three management centers in Beijing, Shanghai and Hong Kong
- Asia global sourcing center in Shanghai
- A total investment of \$250 million
- 2000 employees

ITT Fluid Technology

Everything But The Pipes



ITT Water & Wastewater Shenyang Plant

- Established in Mar 1995
- Location: Shenyang New Development Zone
- Registered Capital: USD 11 million
- ISO9000 Management system was certificated in 2003
- Production: water & wastewater pumps, like G&G, Steady Pump, etc.
- Employee No. at present :173

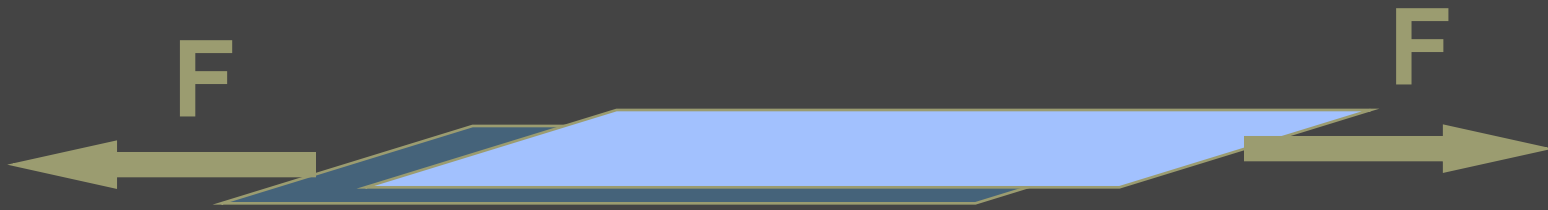


Biogas Plant

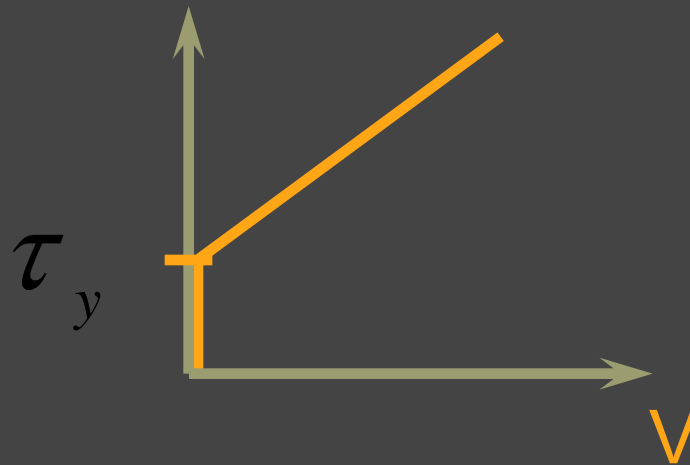


Flow limits

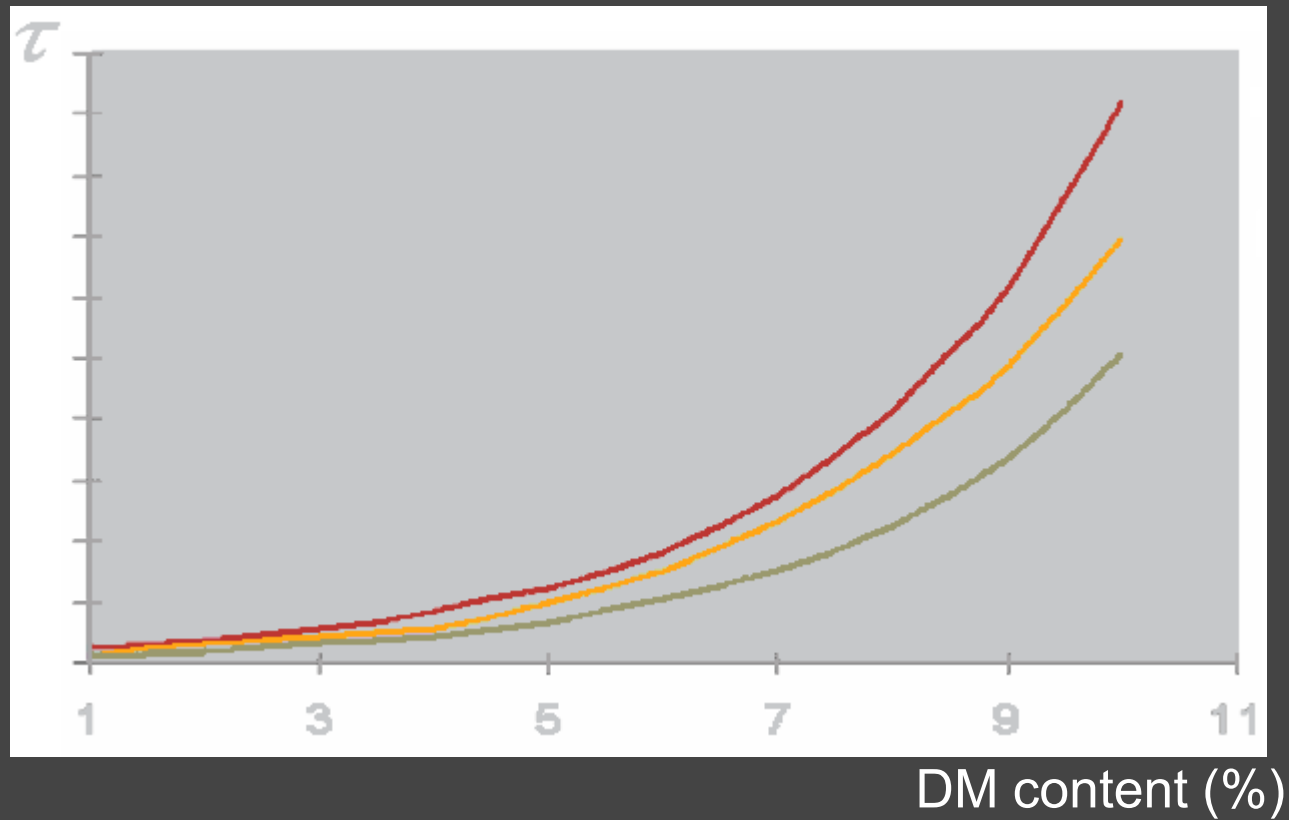
The friction has to be overtaken to move the particles



shear stress
(F/A)



Shear stress



Flow limits – Viskosity

- mixed organic material belongs to the structural viscose or non-Newtonian fluids
- The viscosity is changing during mixing

The Viscosity is the important value but you can not measure it!

Flow limits - DM-content %

The limit can be measured experimentally only, because:

- You never know the substrate in advance
- You can reach the limit under 10 % or over 15 % depending on the material
- Generally fresh material like corn silage is more difficult to mix than „predigested“ material like manure

The DM is the best measurable value for orientation

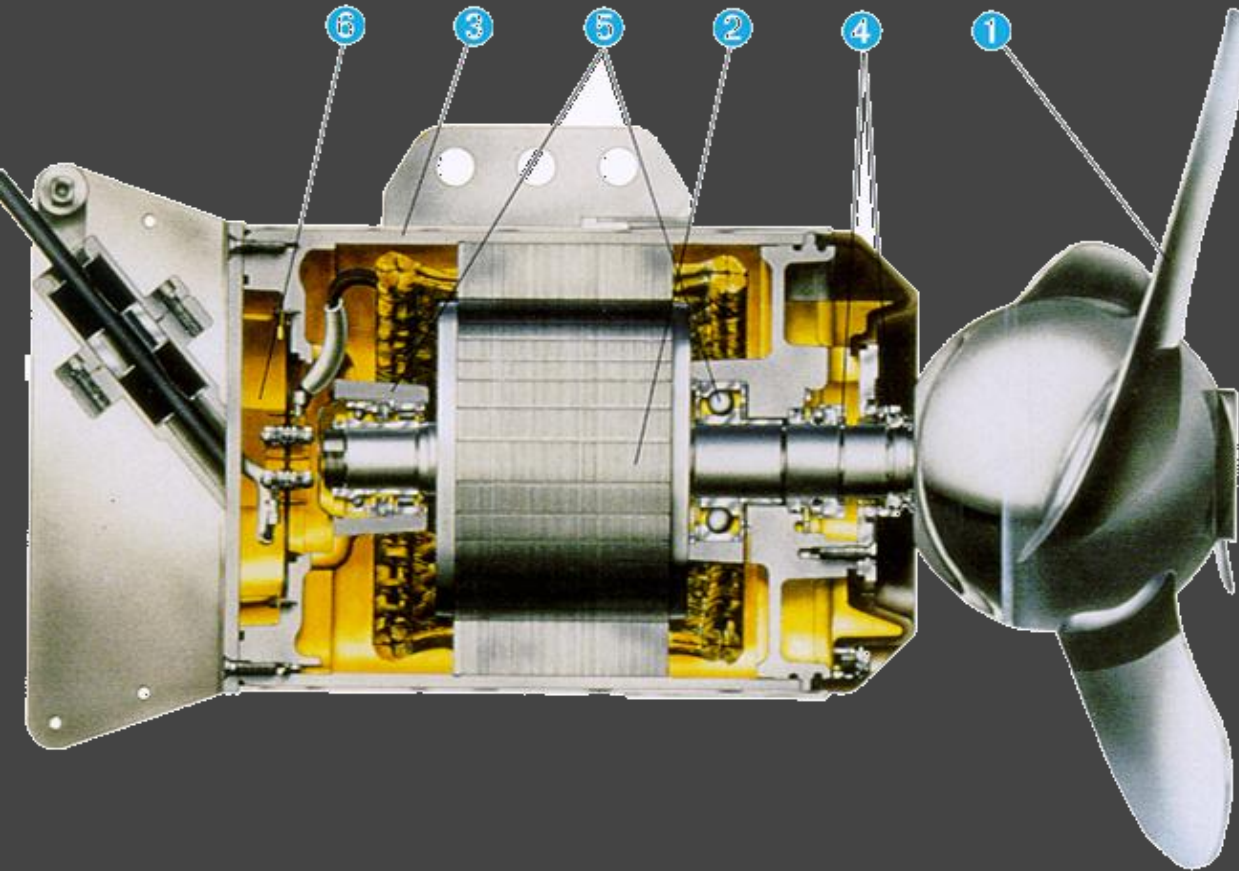
Flow limits – Thrust based mixing

- The flow limit is reached if the media flowing the „short way“ back to the propeller
- We call that „short cut“
- Outside this limit you can mix only with a kneading technique

Effective Mixing to reduce Energy consumption in a digester

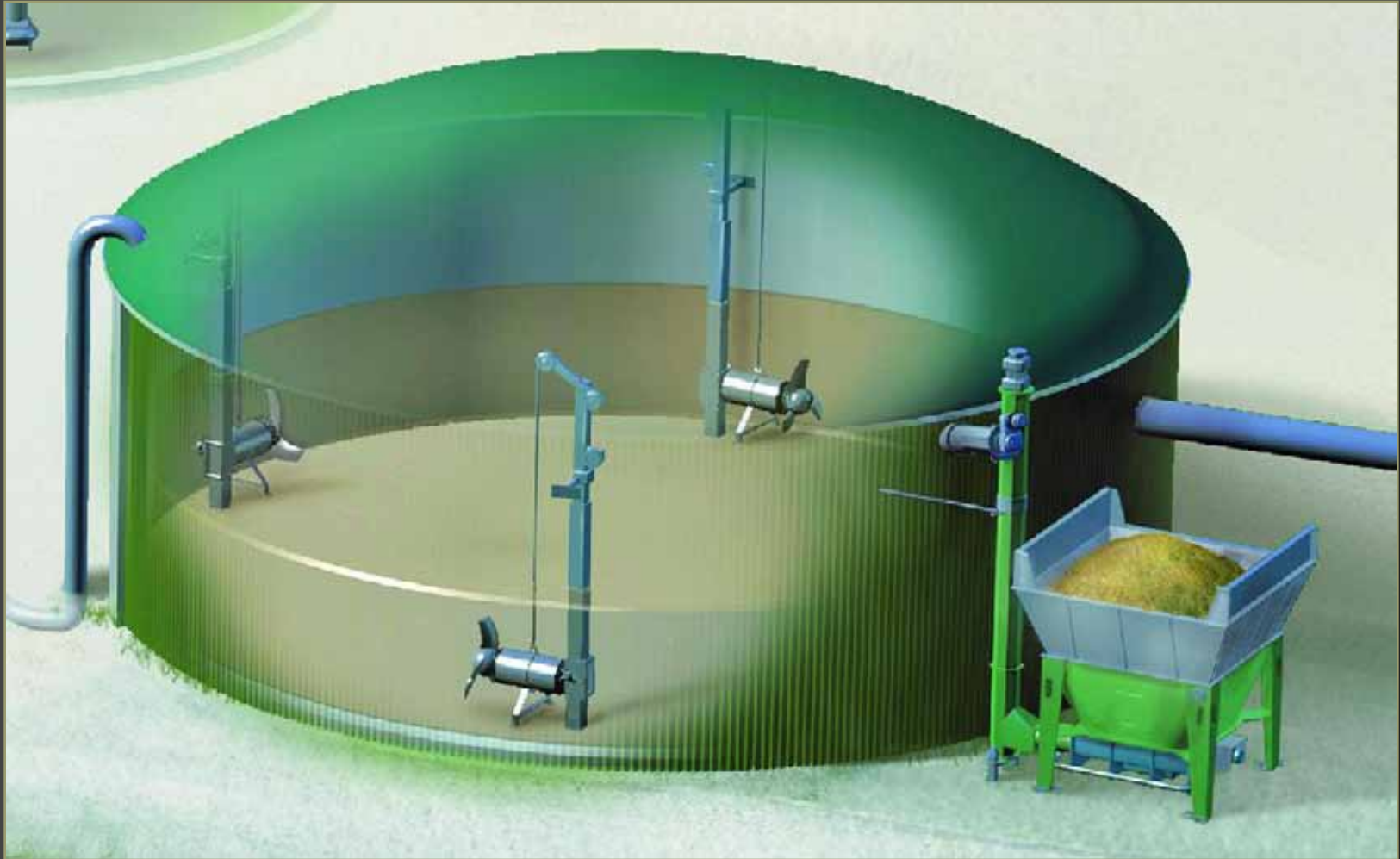
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Submersible Mixers For Biogas



- Marine propeller
 - SS or duplex SS blades
- Double acting mech. seal
- No reducer
- Class H insulation
- WL70° rating
- Up to 25 kW

ITT Flygt Standard



ITT Flygt Standard

The ITT standard is related to Flygt mixers 4600 series up to 25 kW

- The selection is based on the thrust!
- Traditionally it is calculated in installed power in W/m^3 digester volume
- Our recommendation: **minimum 20 W/m^3**
- Nowadays we show it in thrust per volume

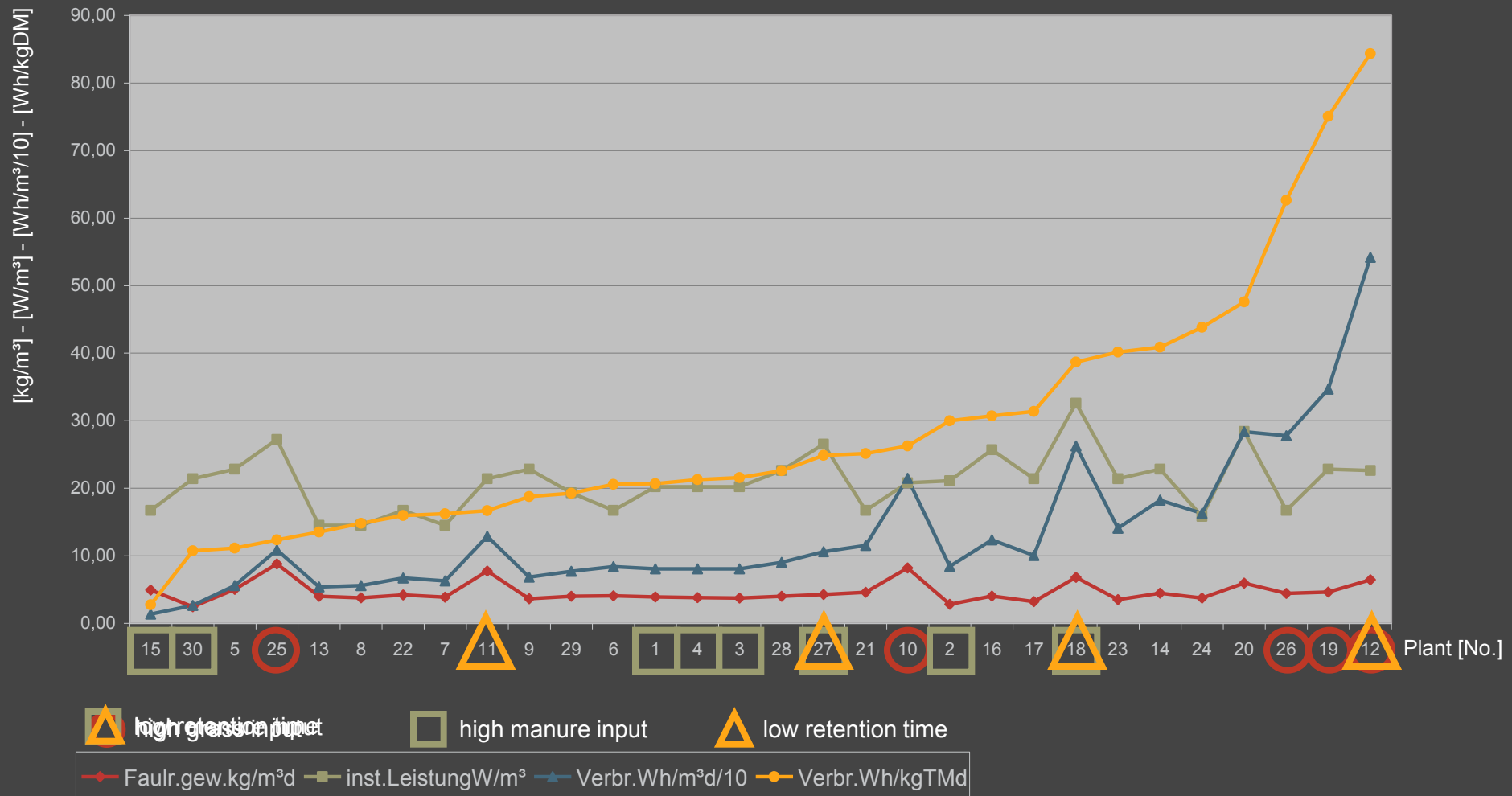
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Key data

- Volume load (kg DM / m³ x d) digester volume. DM and not organic DM!
- Energy consumption
 - by volume (Wh/m³ x d)
 - by volume load (Wh/kg x d)
- Calculation factor for different materials:
 - corn silage as “base material” has the factor 1
 - manure as “pre-digested material has 0,5
 - Gras silage and other heavy material has 2
- retention time (digester volume m³/daily load m³) = days

Energie consumption of 30 plants



Volume load (kgDM/m³d)

inst. power (W/m³)

Energy cons. by vol. (Wh/m³d)

Energy cons. by vol. load (Wh/kgd)



Energie consumption of 30 plants

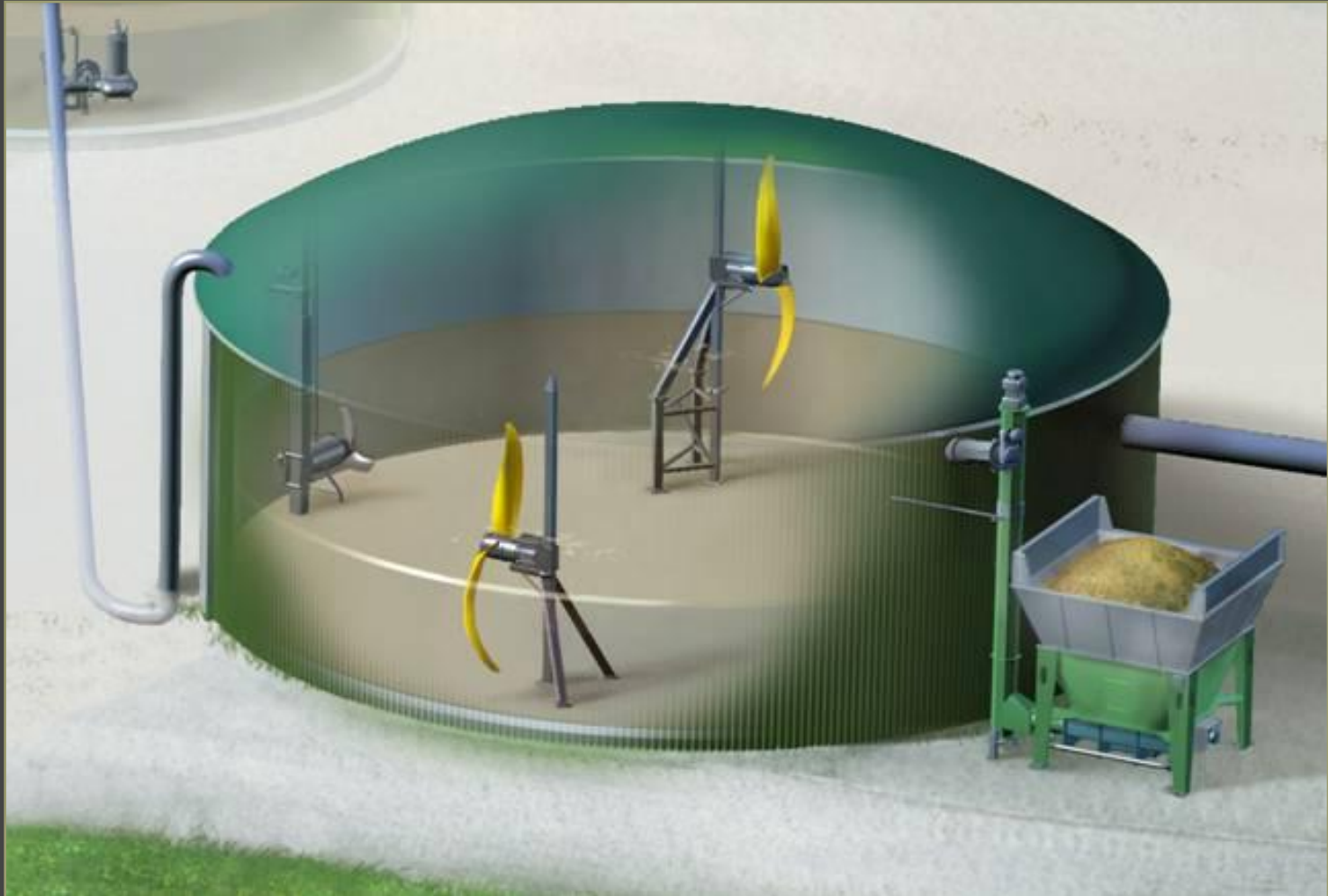
Results:

- Thrust reserve is reducing the energy consumption especially with high volume load
- manure decrease the demanded thrust
- high manure content increase the digester volume and the energy consumption
- grass, grain and poultry manure increase the demanded thrust

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Mixer in Biogas Plants



Results from Banana research

Digester:

diameter 25 m / filling height 5,5 m

- **Installation A:** 4 x 13 kW

- **Installation B:** 2 x 13 kW

2 x 5,7 kW, 42 UPM ø 2,5 m

Results from Banana research

		A	B	reduction %
Installed power	W/m ³	21,4	15,0	30
volume load	kg DM/m ³ d	6,5	7,7	higher gas production!
energy consumption	Wh/m ³ d	129	73	43
energy consumption	Wh/kg	19,8	9,4	52

Results from Banana research

- The basis for both test should be comparable
- but they have been much more difficult for banana
- with the high load we got very good results
- the combination of high thrust/energy banana and compact mixer for crust mixing is the best
- banana and compact mixer are relative easy to maintain
- low risk of losses during maintenance

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Dimensioning of mixers

all you need to get a tank mixed is:

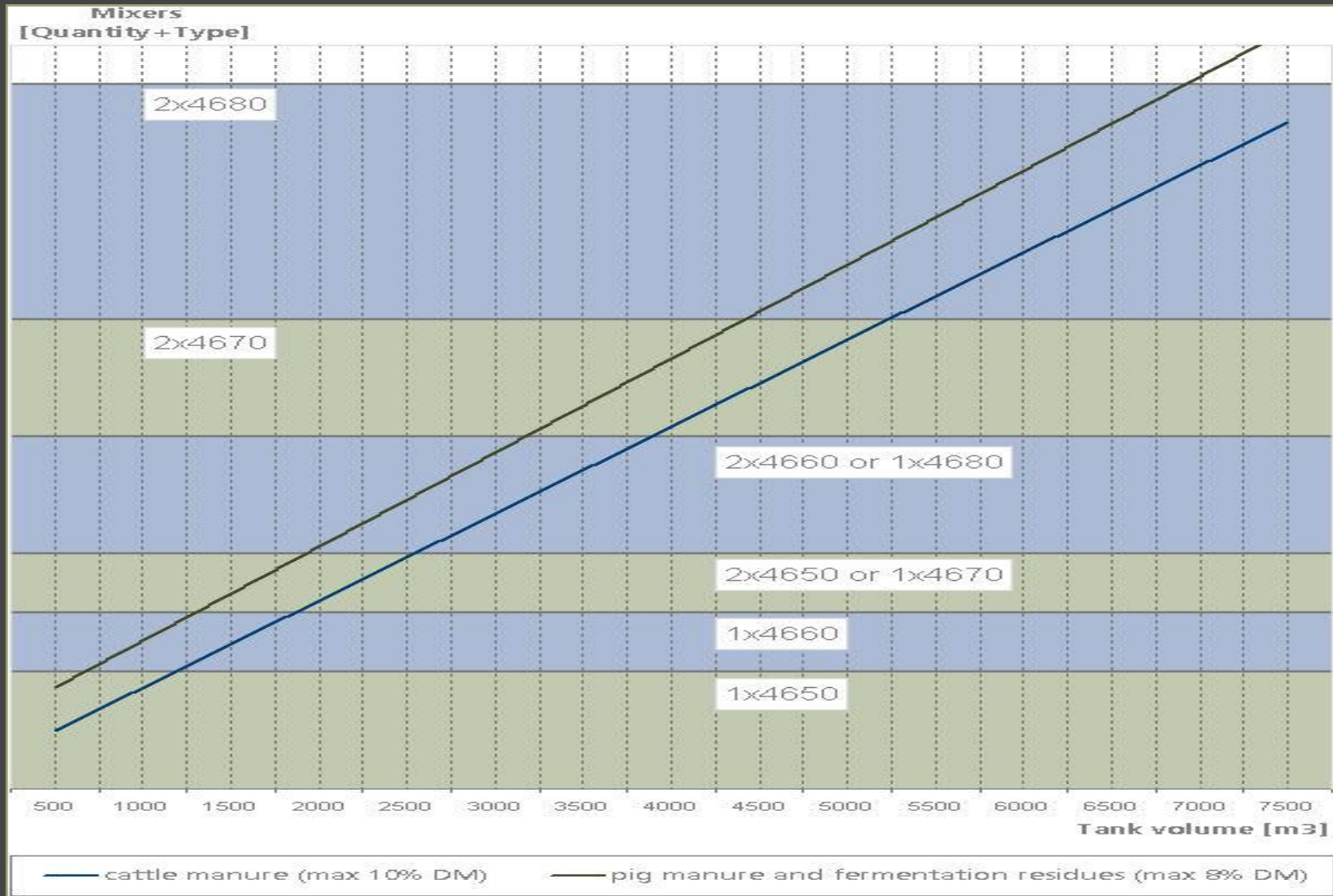
thrust !!!

Dimensioning of mixers

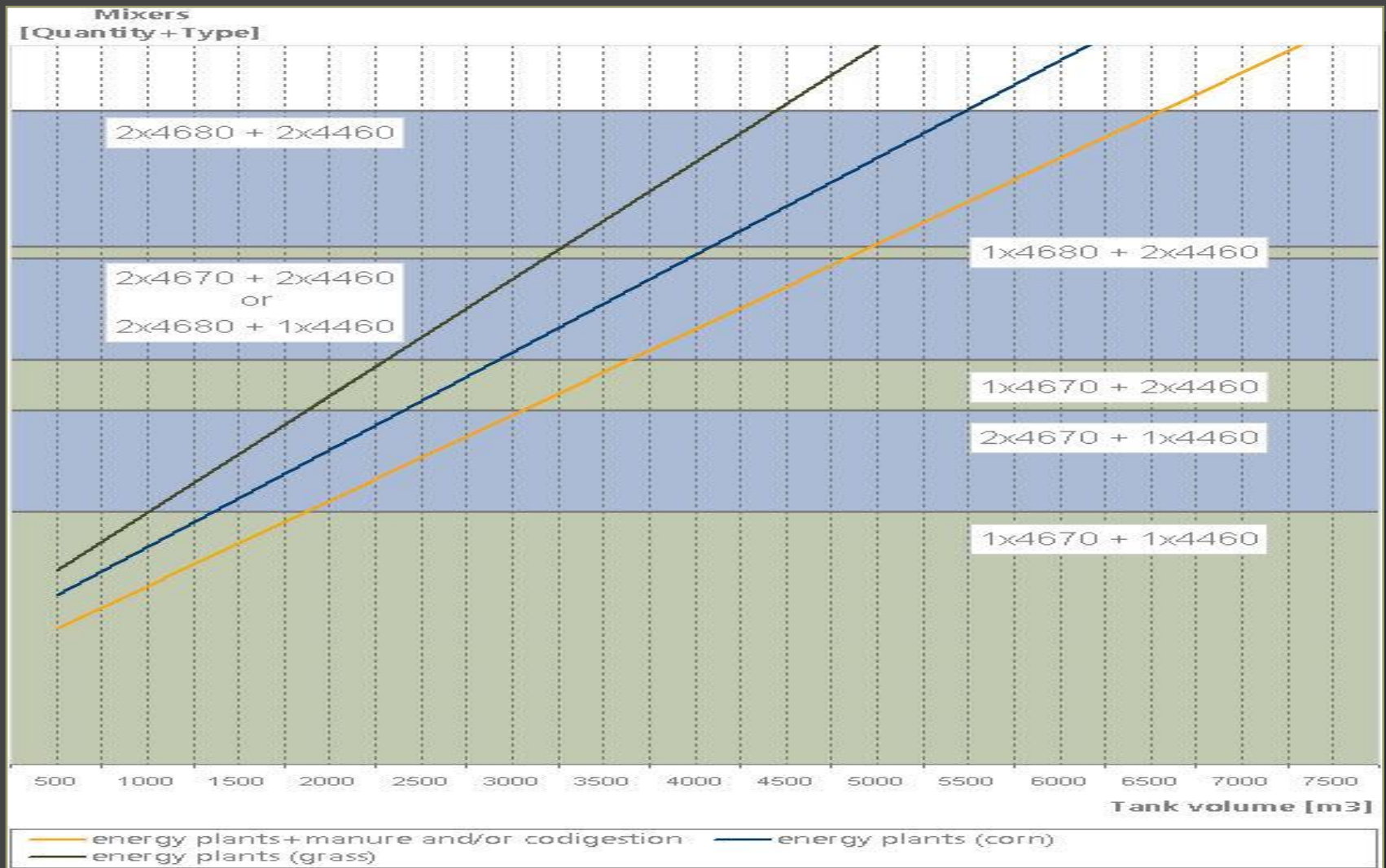
The specification of all Flygt mixers are based on the thrust

- The needed thrust is depending on the tank size and the medium (viscosity)
- The dimensioning of Flygt mixers takes place with the help of the software program MIDS.
- Our selection charts show the needed mixers in relation to the tank size

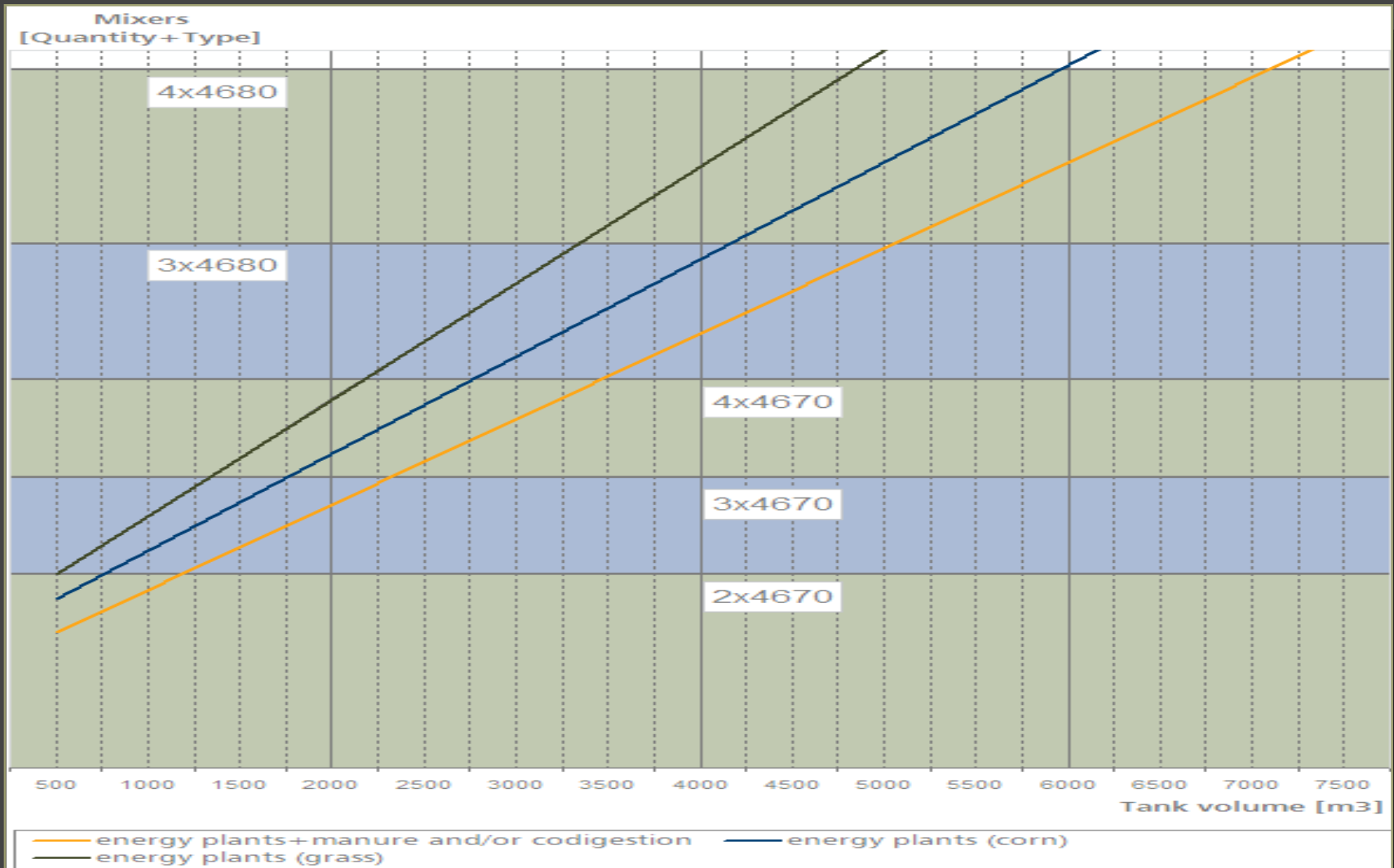
Mixer selection chart



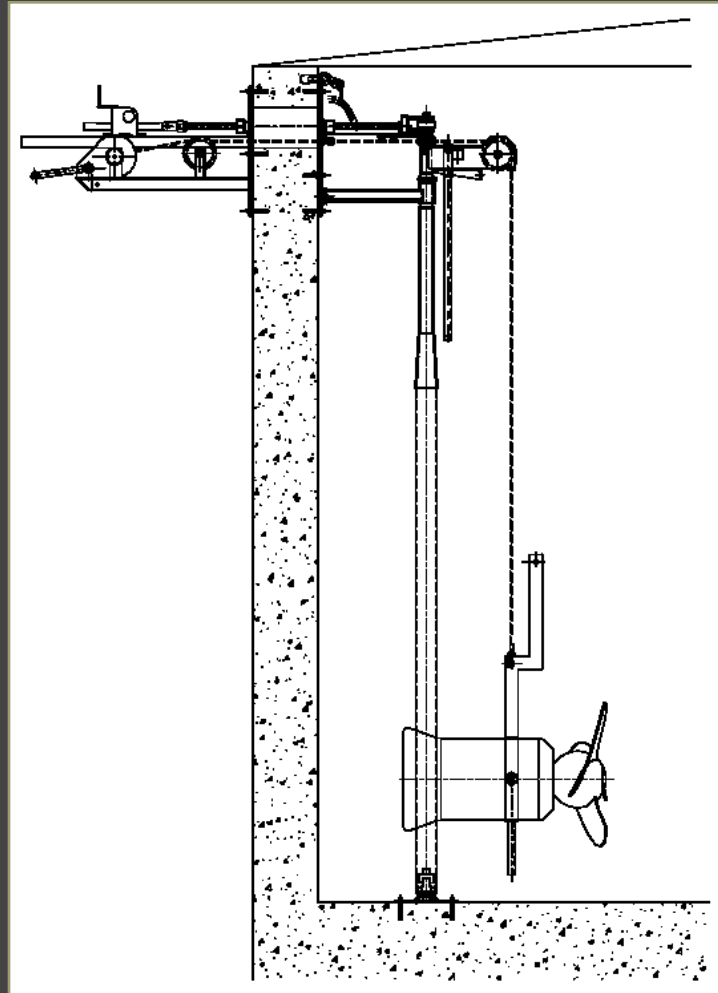
Mixer selection chart



Mixer selection chart



Installation



Installation



Installation



Installation



Installation



Banana in Biogas Plants



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New mixer generation

- The development of a new mid size mixer which is an option to compact mixers
- Nearly half energy needed

↳ 7.5 kW instead 13 kW

↳ 11 kW instead 18.5 kW

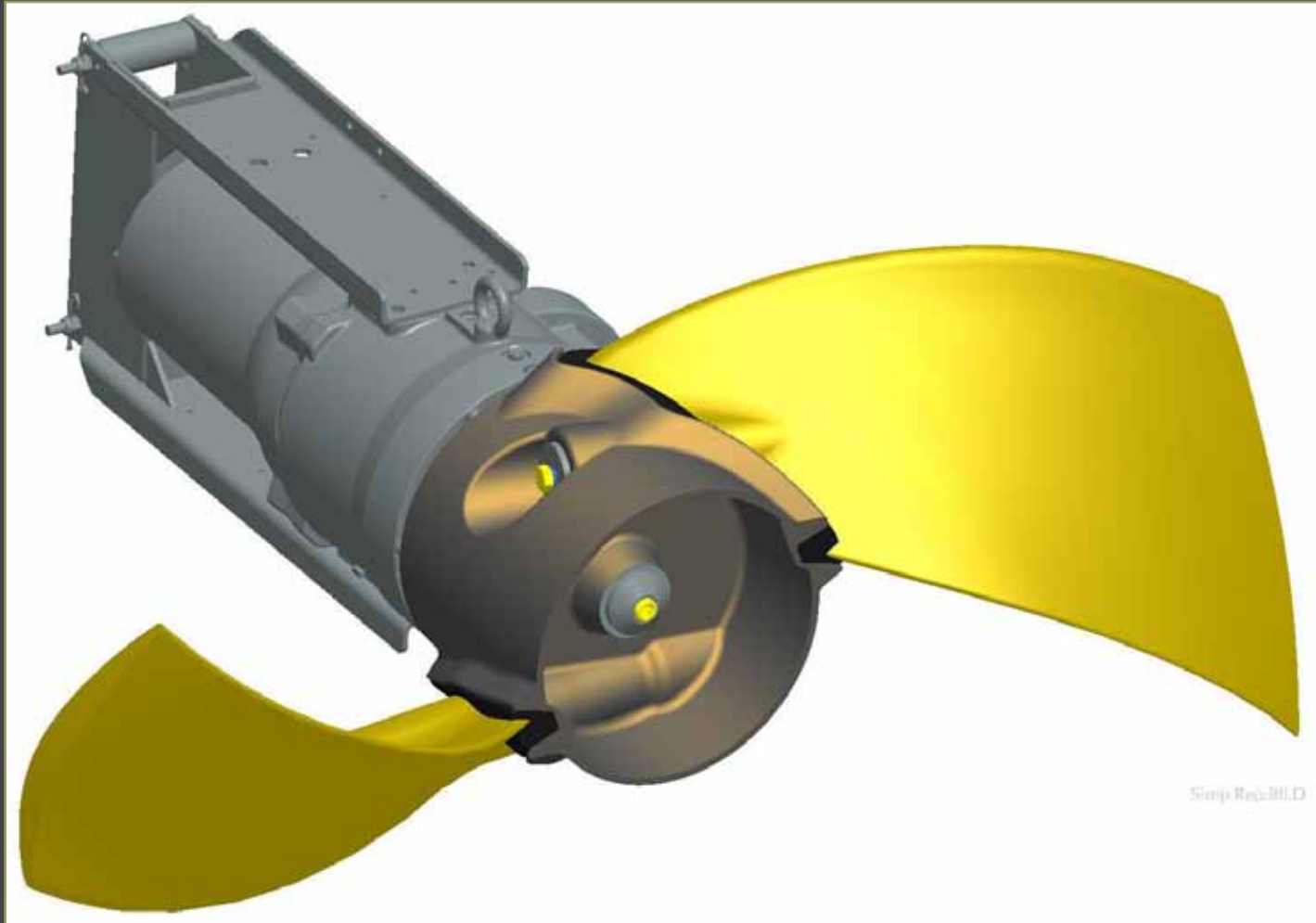
Propeller Banana 1,4 m

78 rpm 11kW

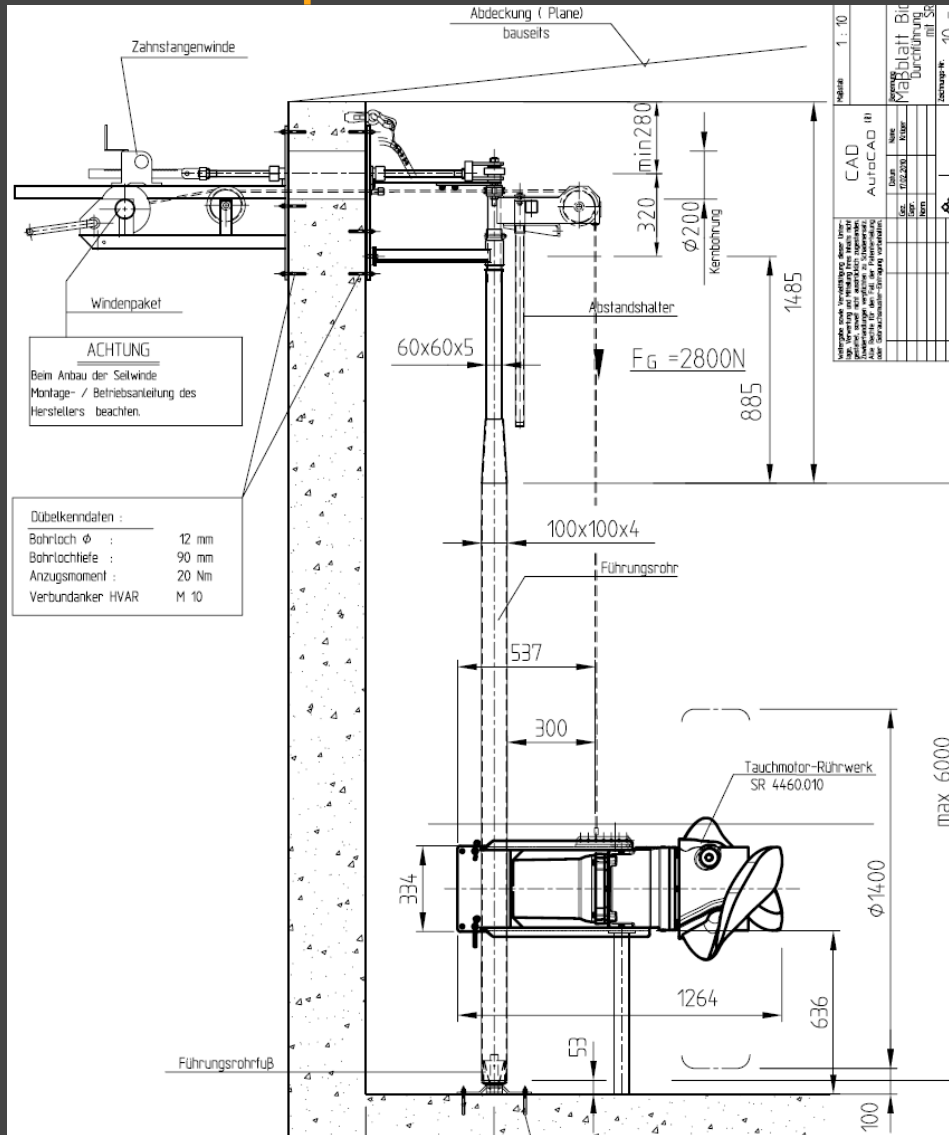
67 rpm 7.5 kW

Weight 315/285 kg

New mid size mixer 4460 2-pole



4460 Mid Size 2-pole



Introducing the Flygt TEA's

TEA's for a range of applications

- Biological treatment
- Digesters
- Sludge tanks
- and more...

Treatment



Digesters to 2000m³



Digesters to 5000m³



Why Top Entry Agitators?

- low
 - ↳ Power consumption
 - ↳ Life Cycle Cost (LCC)
- All wetted parts of high alloy steel (4860/4870)
- Good process results
- Maximum uptime



SY4850 Agitators

Standard execution



With two Flygt Banana impellers and bottom support

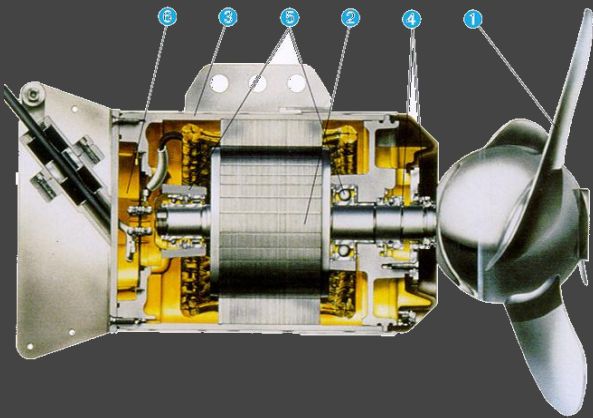
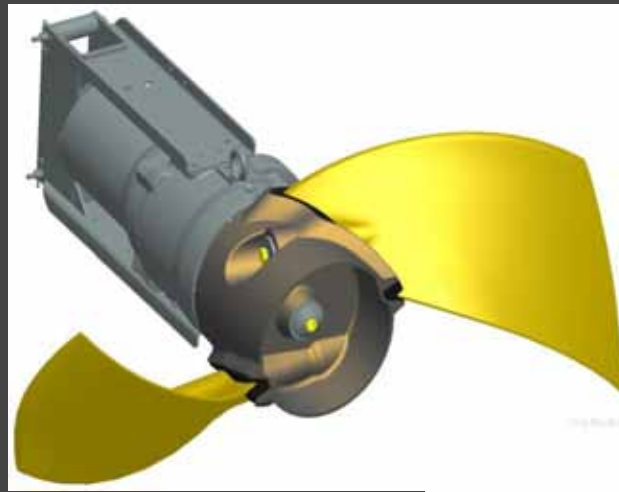


With two 3-bladed hydrofoils and with bottom support



ITT Water and Wastewater Mixing Solutions

For the optimal solution to your mixing needs!



Thank you for your attention

