General Product Overview

and

Accessories for Submersible Mixers

Agenda

- ***General information - mixing***
- Applications of submersible mixers
- Technical design
- Classification of Wilo Submersible Mixers
- Accessories
- Wilo selection software

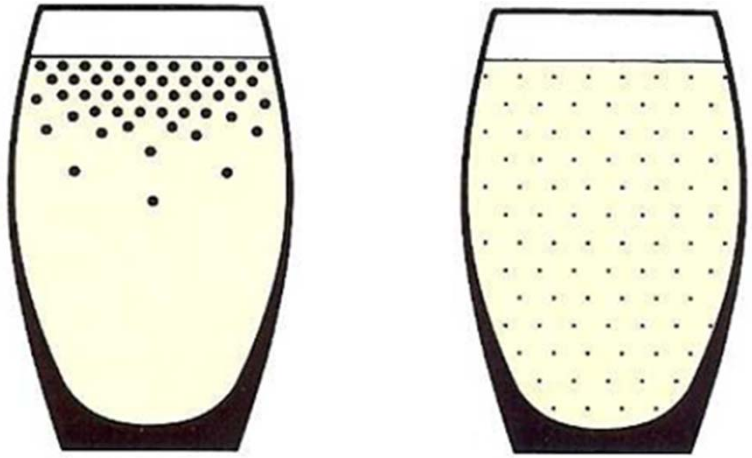
Purpose of the mixing

- **Homogenisation**
- **Suspension**
- **Homogeneous suspension**
- **Generation of flow**
  - Emulsification
  - Injection of gas
  - Intensification of exchange of heat
  - Chemical reaction

Definition of terms - homogenisation

Homogenisation

This term is generally used for "equalisation". It describes the mixing of liquids that are soluble in one another. When mixing in sludge applications > 1% dry matter is however the primary goal of the concentration gradient to bring it into a specified range, generally within a specified time.



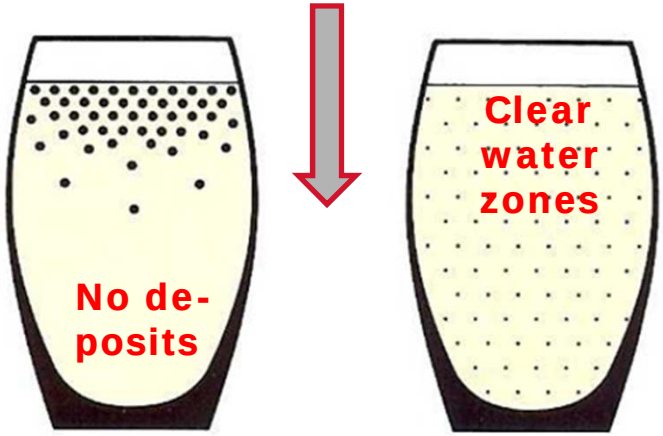
Objective:

Generation of a fully mixed condition of the contents of the tank, with as little variation as possible in the dry matter content.

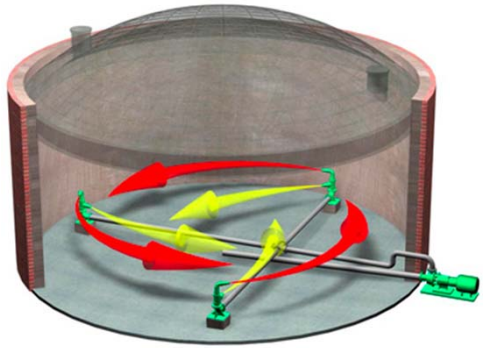
Definition of terms - suspension

Suspension

By suspension is meant the dispersion and distribution of a solid within a fluid.
Dispersion of a solid from the floor of a tank can be an important duty, and it can also be important to distribute the solid as evenly as possible throughout the fluid.



< 0,15 m/s



Objective:

The creation of a "deposit-free operation".

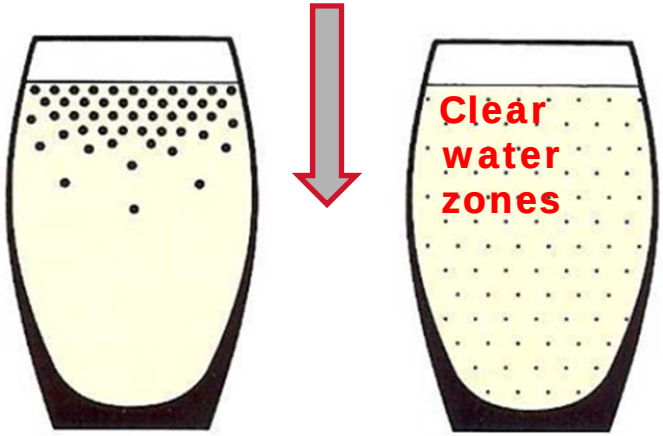
Risk:

Creation of clear water zones caused by insufficient power input and/or weak flow zones (container fittings).

Definition of terms – Homogeneous suspension

Homogeneous suspension

One speaks of a homogeneous suspension generally when all the activated sludge flocks are dispersed and evenly distributed throughout the basin. For a activated sludge tank to be regarded as containing a sufficiently homogeneous mixture, 90 % of the measured values must display a deviation ≤ 12 % of the measured average.



< 0,15 m/s

Objective:

Deposit-free operation without clear water zones.

Disadvantage:

Marginally increased power input (W/m³)

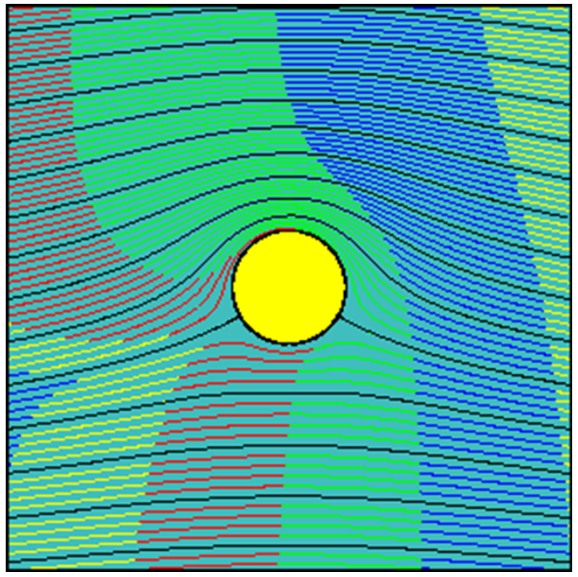
Standards:

VDMA 24656

ISO 21630

Definition of terms – flow generation

Flow generation
generation of a flow in a specific direction
over the entire flow cross-section.

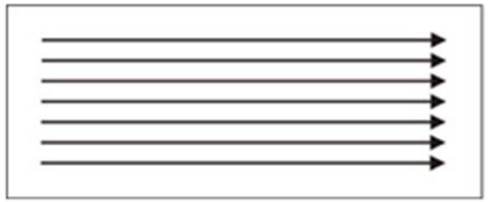


Only in a **ring and circulation tank**!!

Objective:
Deposit-free operation (sediment transport) without clear water zones and with process optimisation.

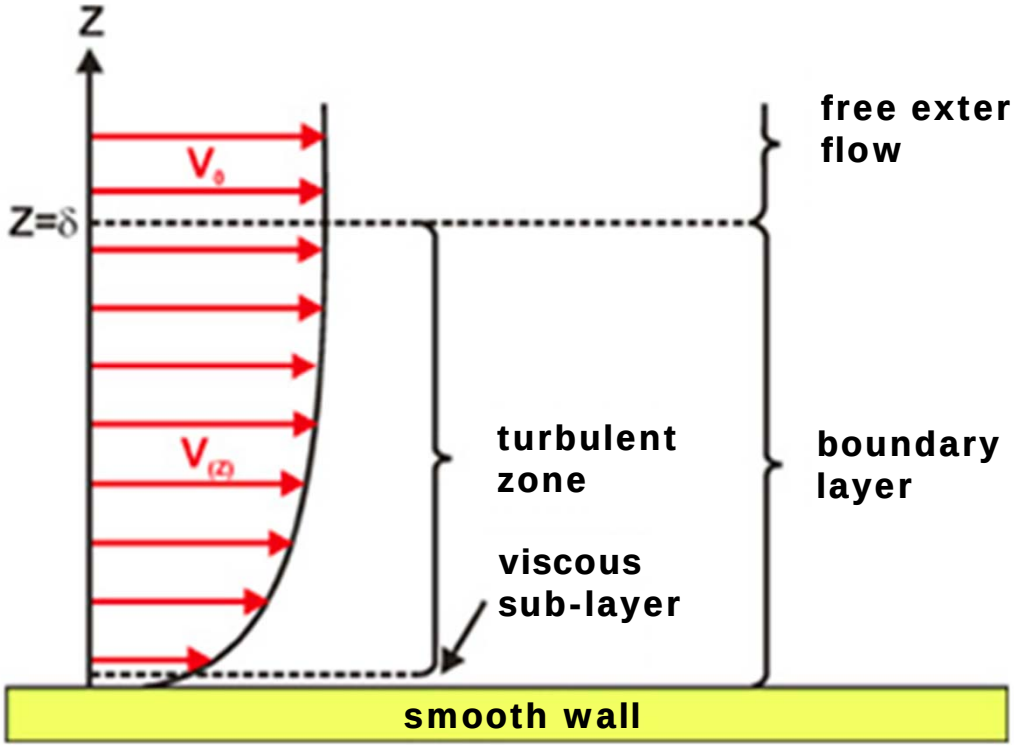
Risk:
No circulation flow if the aeration input is too high
Clear water zones in case of a to low power density (W/m³)

Definition of terms – flow generation



laminar flow:
lower losses
⇒ lower power input

turbulent:
high losses
⇒ high power input

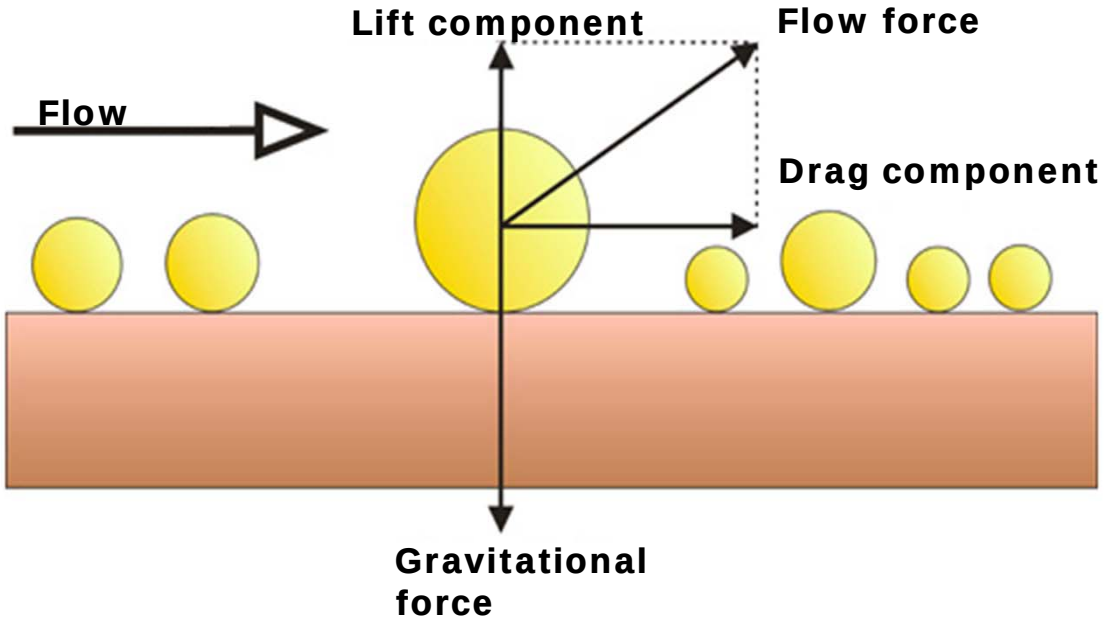


flow profile in a ring and circulation tank
(straight tank sections)

Transport of grains of sediment

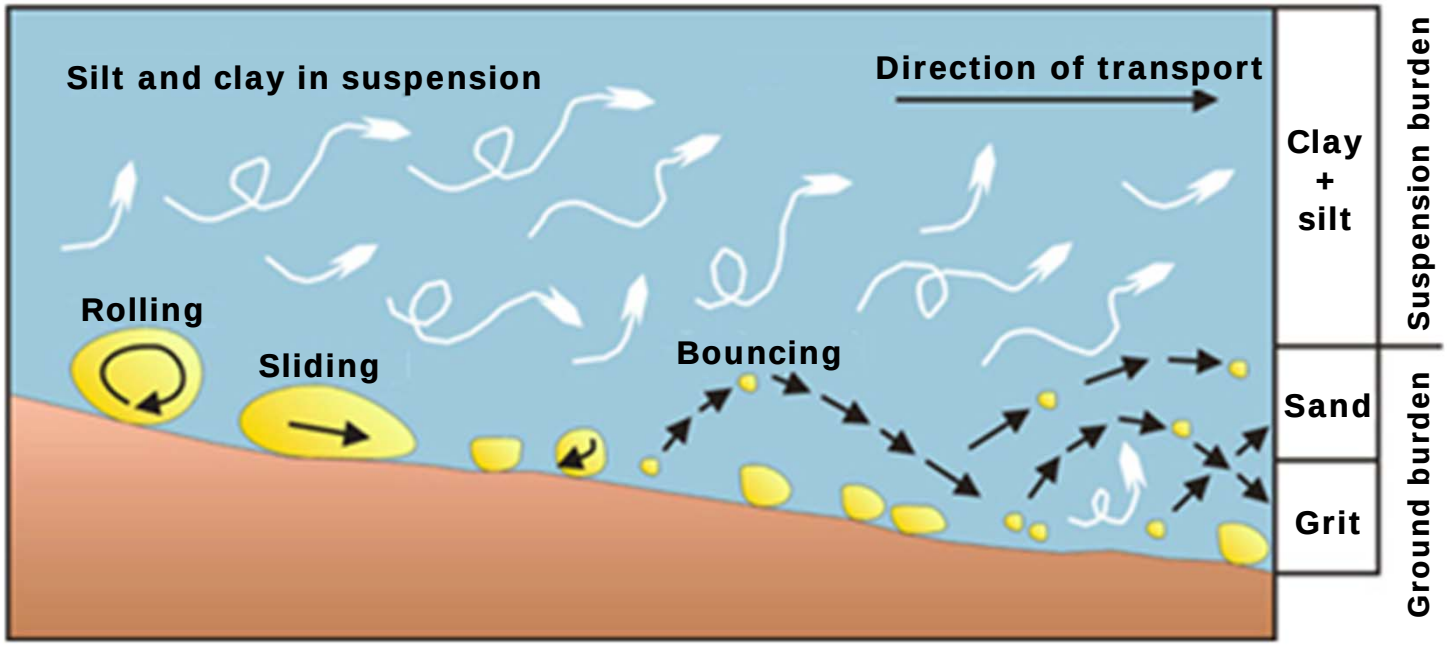
Sediment transport

Various forces are exerted by a flowing medium on particles lying on the floor of a tank. When a critical speed (determined by the type and size of the particle) is exceeded briefly or continuously, the particle is picked up by the medium and transported.



The flow force is the resultant of the horizontally acting drag force and the vertically acting lift force. These forces act against the gravitational force.

Transport of grains of sediment



Components of medium and small grain size (sand / grit) are largely transported as ground burden, components of smaller grain size, such as silt or clay are largely transported as suspension burden.

Process criteria

Sludge > 1% DM

- **Mixing time**
  Quality factor of the mixing

Objective:

- complete homogenisation of the entire volume of the tank within a range determined in relation to the dry matter content

Activated sludge < 1% DM

- **Energy consumption**

Objective:

- the generation of an average calculated flow velocity
- Operation without deposits

Introduction

Submersible mixers:

Due to their universal application possibilities today‘s methods of modern sewage treatment can‘t be imagined without them.

Meanwhile Submersible Mixers have become an important part of the machinery equipment for sewage treatment plants

General Information

Wilo Submersible Mixer Program

Agenda

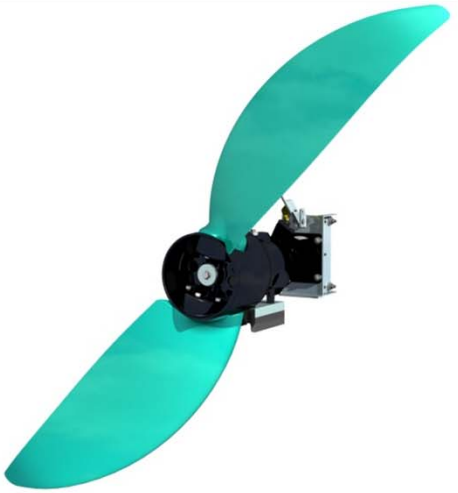
- General information
- ***Applications of submersible mixers***
- Technical design of the submersible mixers
- Classification of Wilo Submersible Mixers
- Accessories
- Wilo selection software

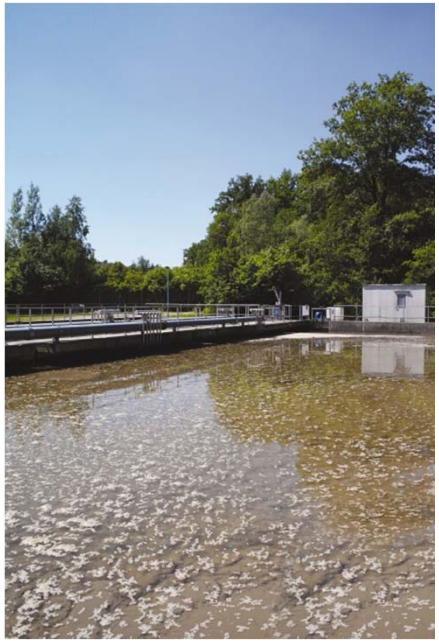
Submersible mixers in municipal sewage treatment (application examples)

- Equalization tank
- Activation tank
- Nitrification tank
- Denitrification tank
- Oxidation ditches
- Phosphate elimination tank
- Digester tank
- Reaction basin
- Sewage sludge basin
- Hygienization tank
- Lime milk tank
- Contact basin
- Neutralization tank
- Storm water retaining basin

Application of Submersible Mixers in Sewage Treatment

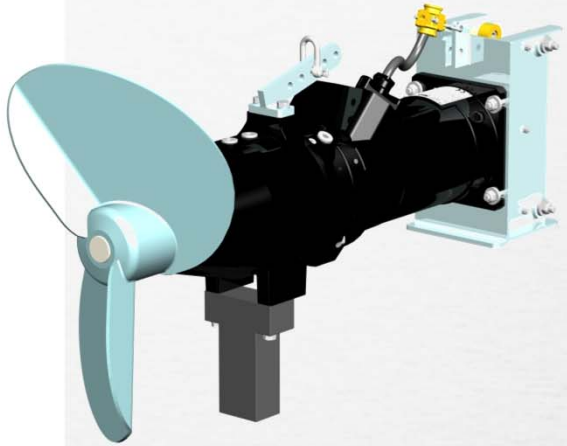
- Activated sludge
- Nitrification (aerobic)
- Denitrification (anoxic)
- Phosphate elimination (anaerobic)
- Reaction basin
- Contact basin



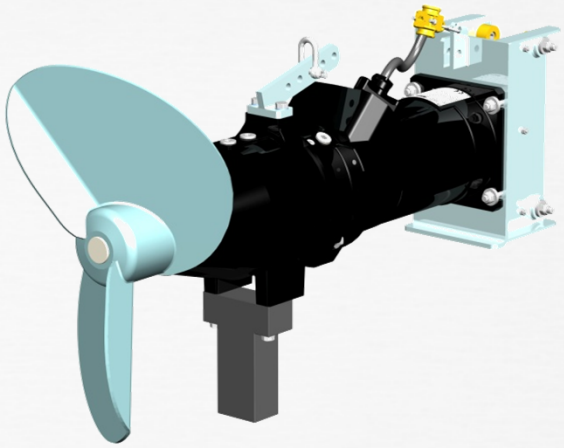


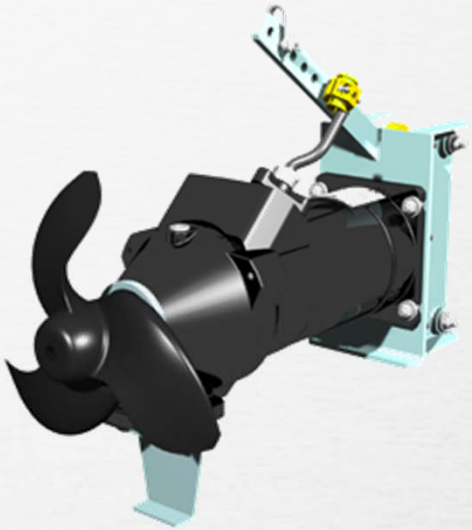
Application of Submersible Mixers in Sewage Treatment

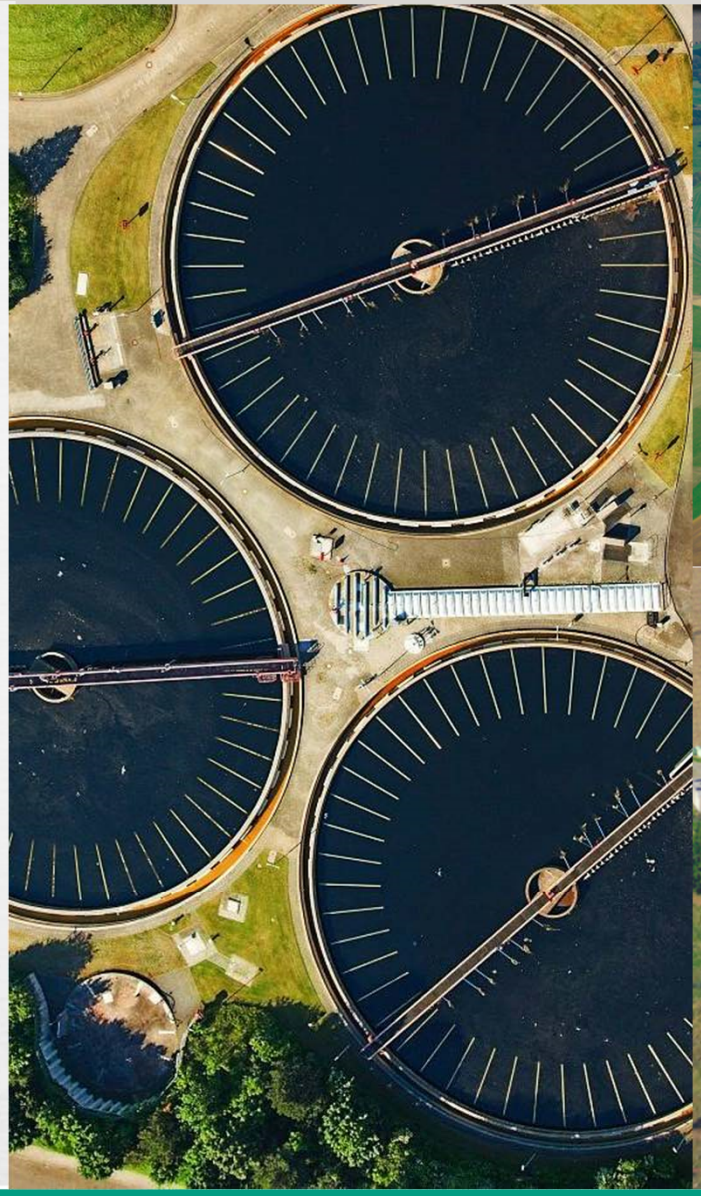
- Sludge storage tank
- Digester
- Static sludge thickener



Application of Submersible Mixers in Agriculture

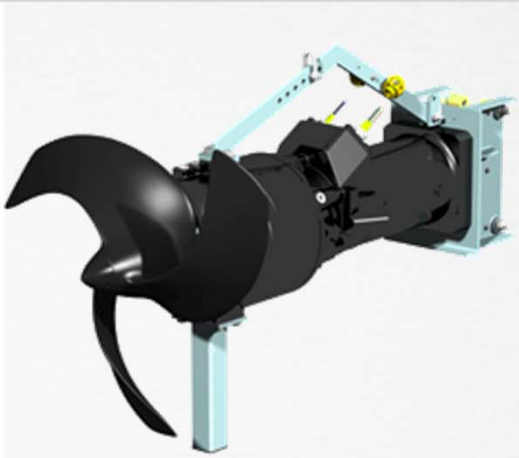


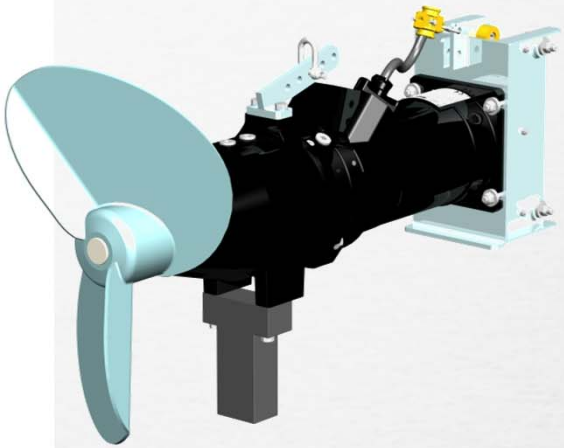




Application of Submersible Mixers in Industry

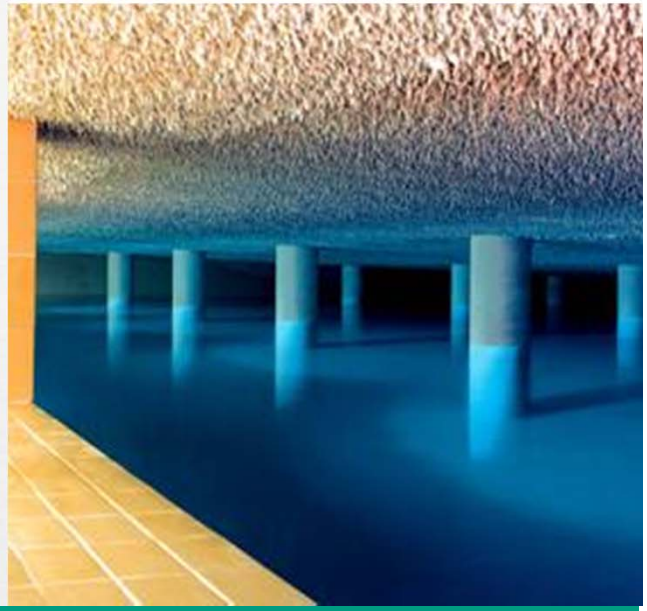
- Bentonite suspensions
- Biochemical reactors
- Pulp and paper industry
- Neutralization
- Painting plants
- Cooling towers





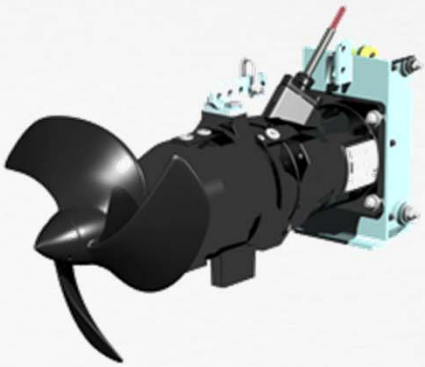
Submersible Mixers for Drinking Water Applications

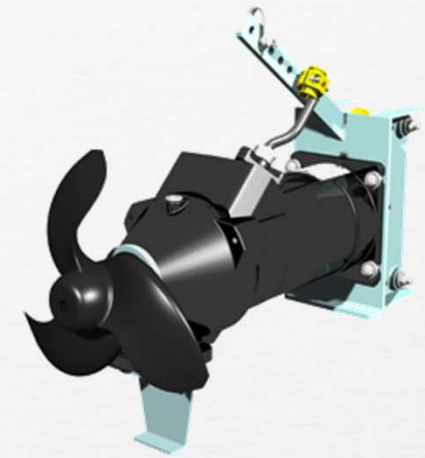
- Drinking water treatment



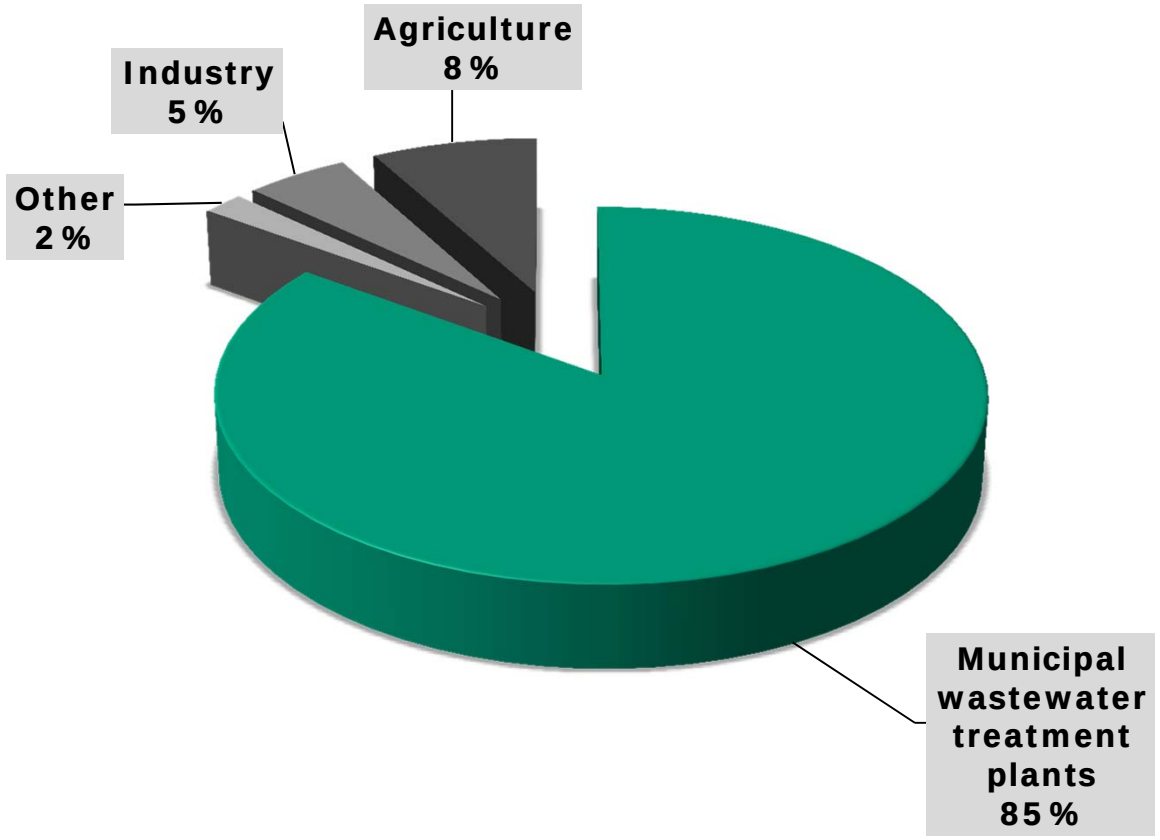
Submersible Mixers in Other Applications

- Equalization tank
- Neutralization
- Cleaning of storm water tanks

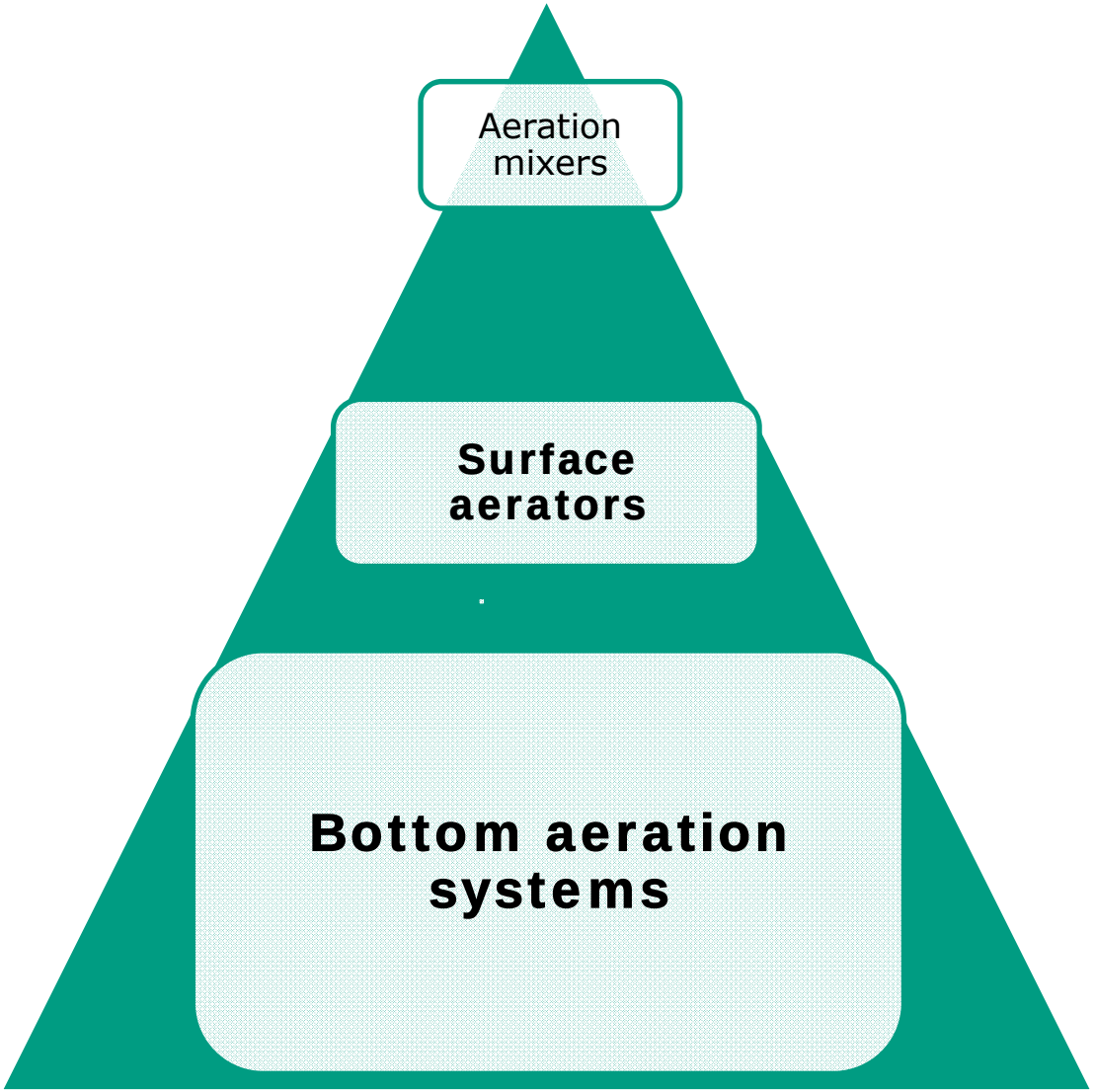




Areas of application



Aeration systems - types



Aeration mixers

Advantages:

- small tank volume
- chemically charged media
- easy to maintain
- low acquisition costs

Disadvantages:

- poor efficiency (oxygen entry)
- high operating costs

Not relevant for municipal wastewater treatment plants!

Surface aerators – gyroscopic (rotary)

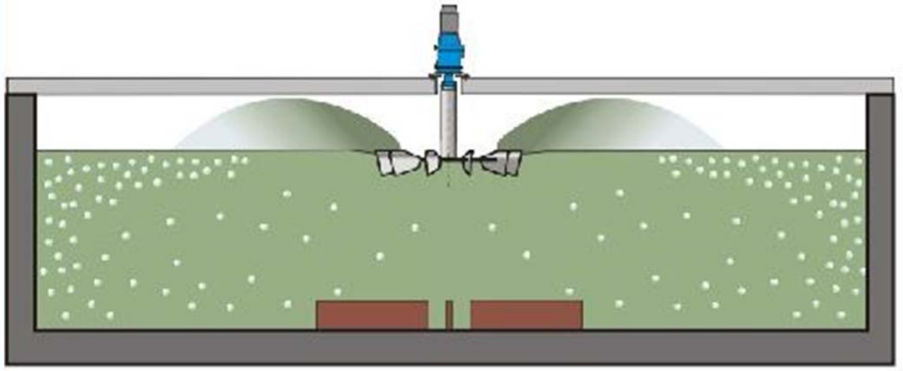
Function

aeration and "mixing"

Advantages:

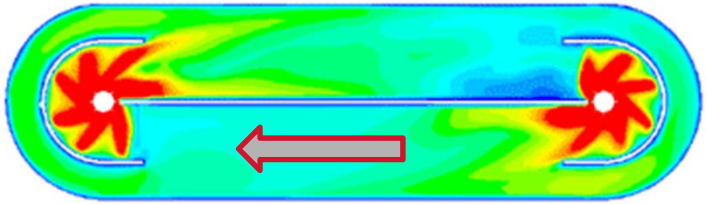
- medium-sized tank volumes
- easy to maintain
- low acquisition costs

  (building, compressor and air pipes not necessary!)

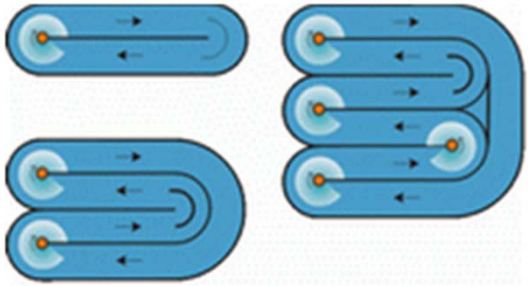


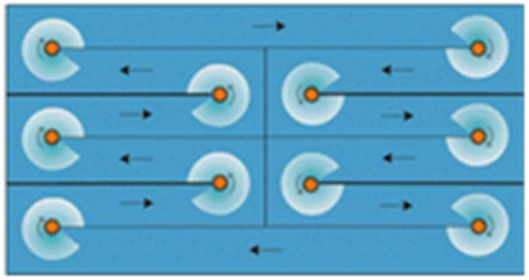
Disadvantages

- poor efficiency (oxygen entry)
- Operating bridge necessary
- Positioning practical only in the return area
- Effective depth max. 3-4 m
- high operating costs
- Emission



Surface aerator – arrangement

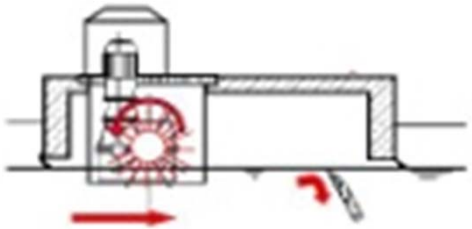




Surface aerator – cylinder (roller)

Function

aeration and generation of a flow velocity close to the surface



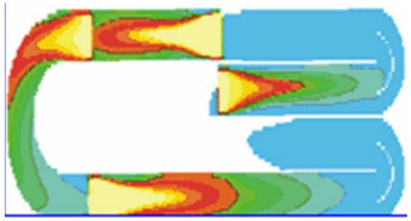
Advantages:

- medium and large-sized tank volumes
- easy to maintain
- low acquisition costs

  (building, compressor and air pipes not necessary!)

Disadvantages

- poor efficiency (oxygen entry)
- Operating bridge necessary
- Guide plates increases losses
- Positioning simultaneously operated TR
- Effective depth max. 3-4 m
- high operating costs
- Emission

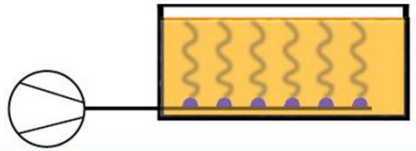


Bottom aerator – disc 9“ / 12“

Function

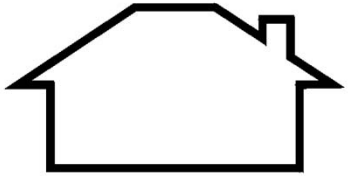
aeration

Aeration at depth using compressed air



Advantages:

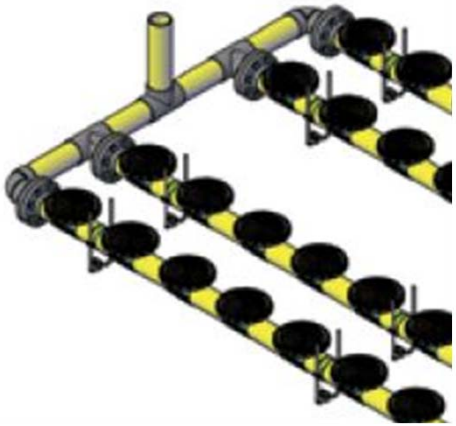
- medium and large-sized tank volumes
- Effective depth over the whole depth of the medium
- no operating bridge
- low emissions
- high efficiency (oxygen entry)
- low operating costs (system-dependent)



Disadvantages

- Positioning simultaneously operated TR
- Density of installation (number of aerators/m²)
- Working life of the chosen diaphragm material
- clogging of the diaphragm (incorrect design or incorrect operation)
- high acquisition costs

(building, compressor and air pipes not necessary!)

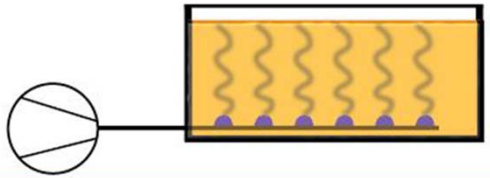


Bottom aerators – pipes, hoses, panels and plates

Function

aeration

Aeration at depth using compressed air



Advantages:

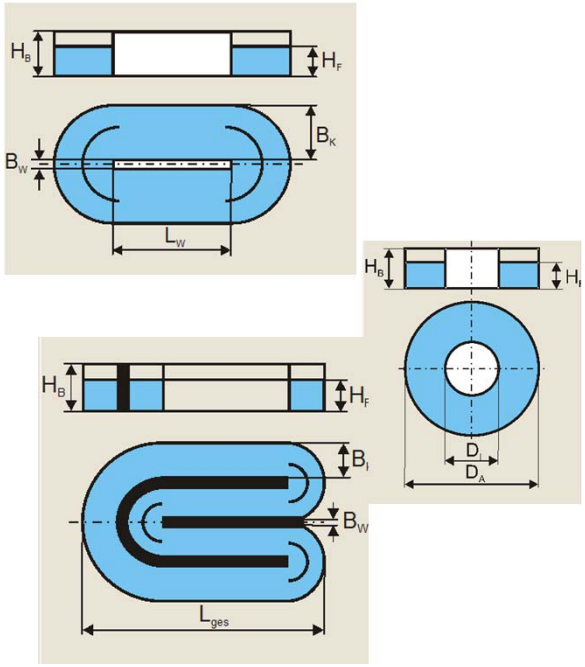
- as for 9" and 12" discs but
- good to very good efficiency (oxygen entry)

Disadvantages:

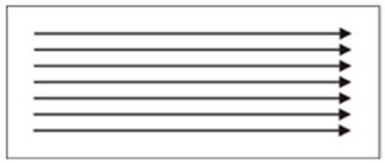
- as for 9" and 12" discs

Typical flow patterns - geometry and aeration

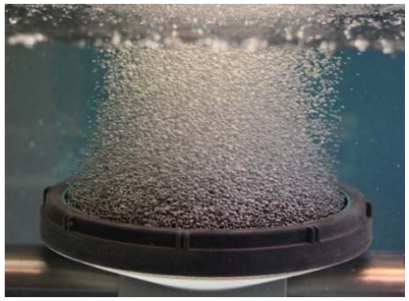
Tank geometries



Denitrification



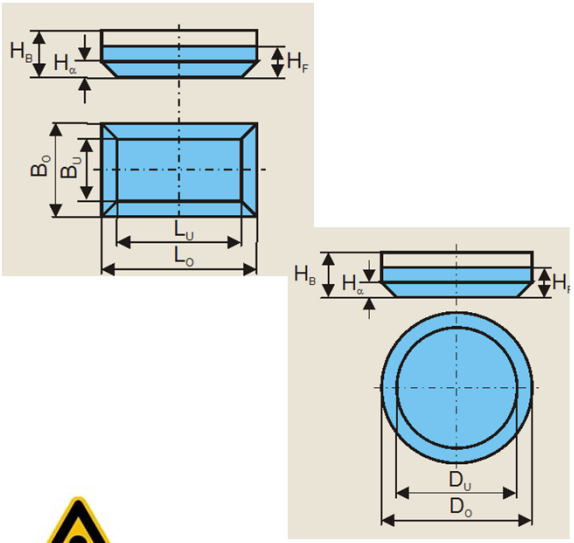
Nitrification



Dedending on the air intake volume and the occupancy rate of the aeration system !!

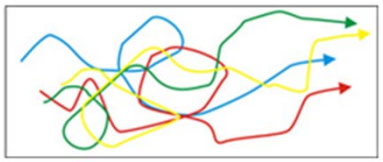
Typical flow patterns - geometry and aeration

Tank geometries

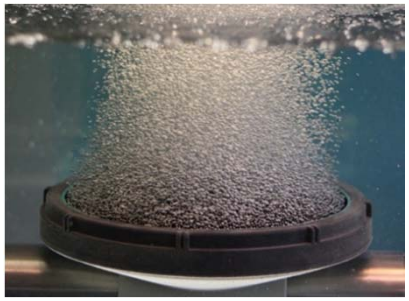


Plus all other tank shapes that **cannot** be classed as circulation tanks!

Denitrification



Nitrification



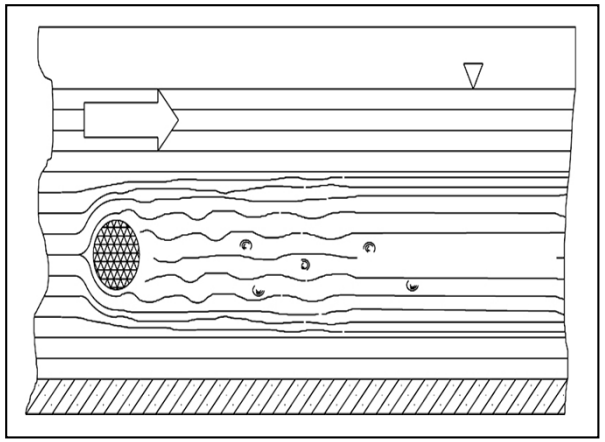
Flow losses

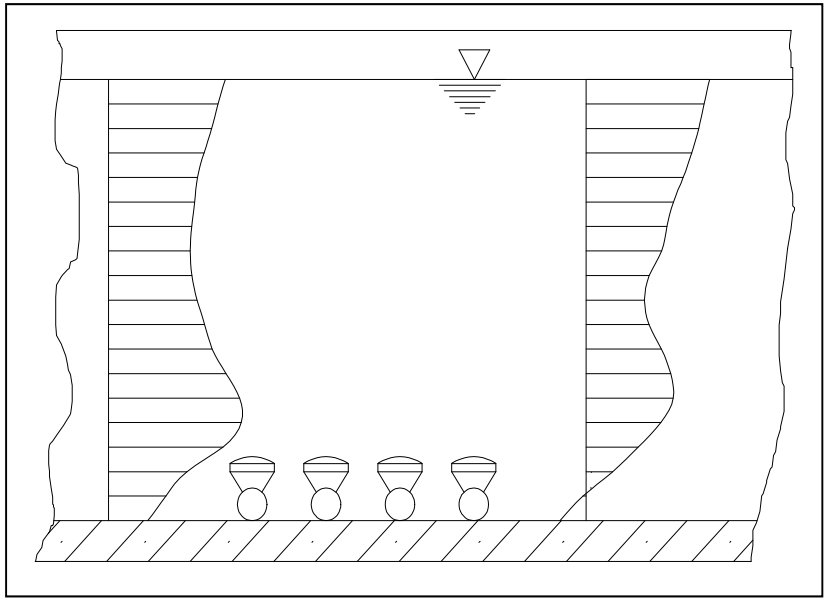
Flow losses are caused by:

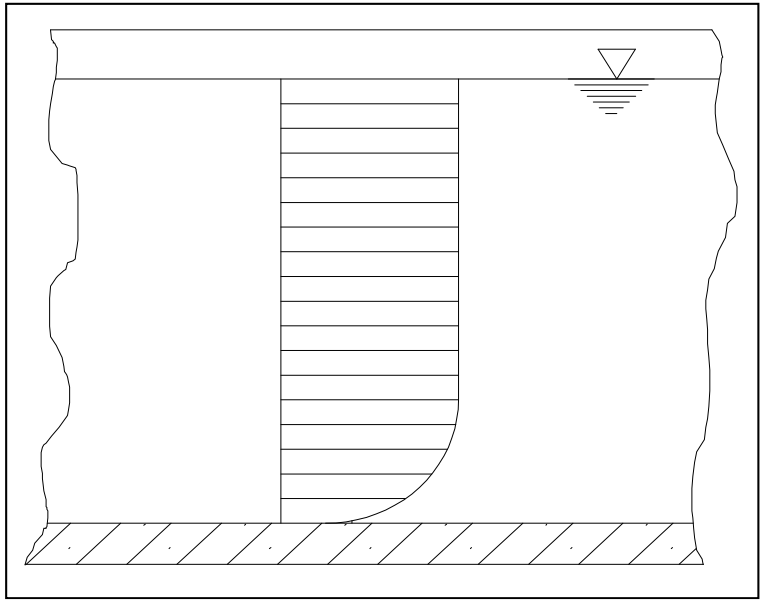
> Shape of the installation surrounded by the liquid

> Vortex behind the installation

> Transverse flows (outflows and inflows, aeration)

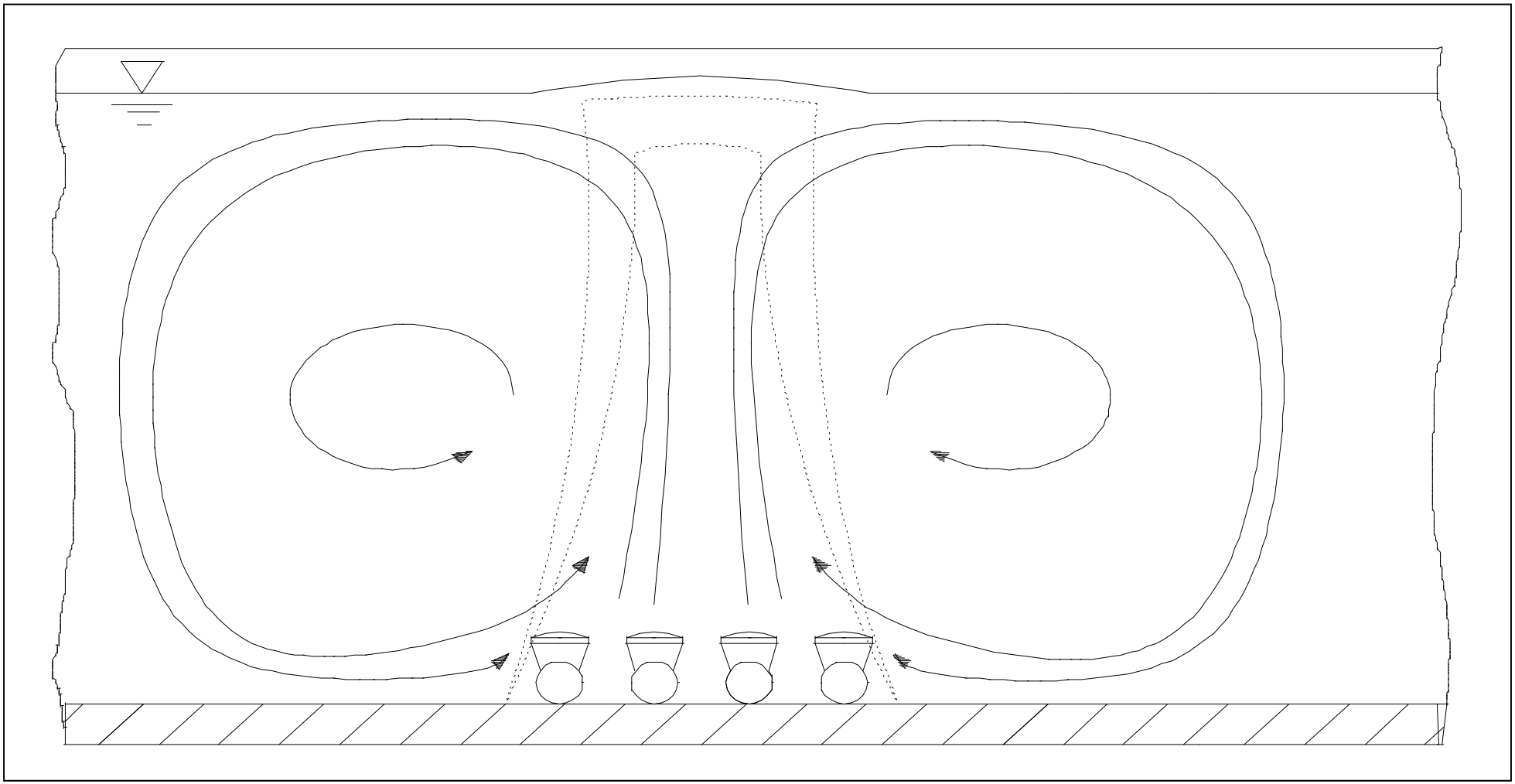






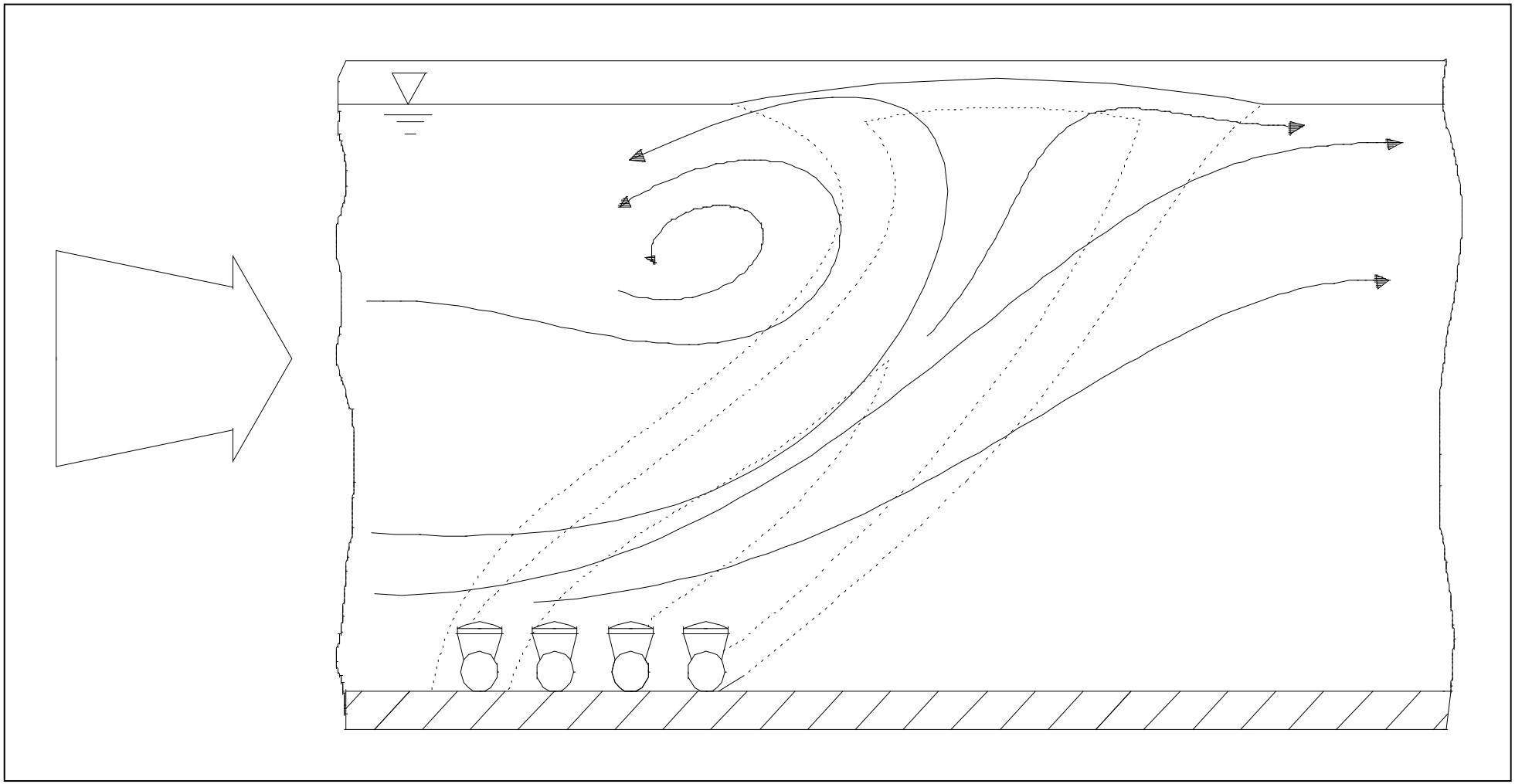
Aeration

Rotating movement **without** horizontal flow



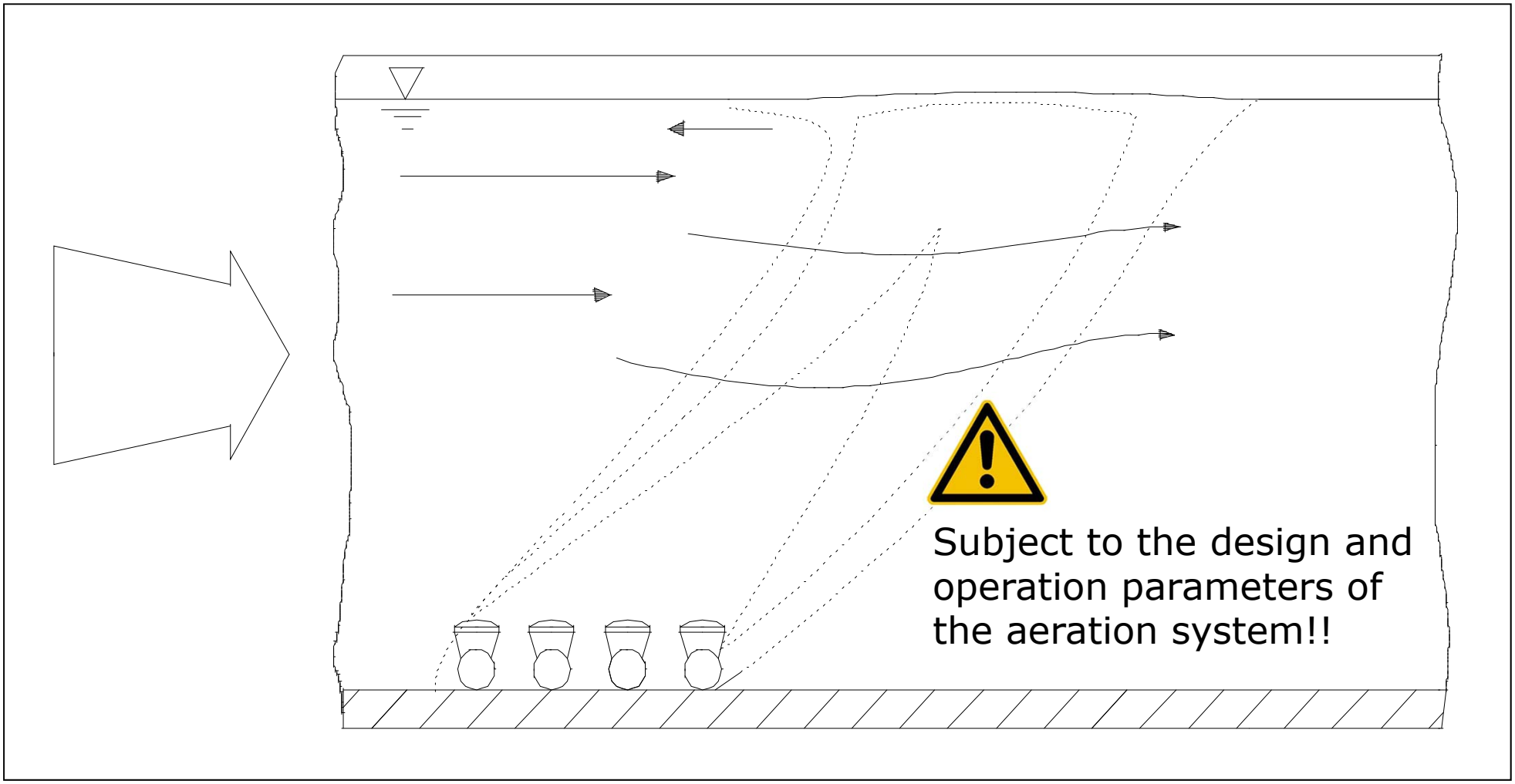
Aeration

Flow movement at **beginning horizontal flow**



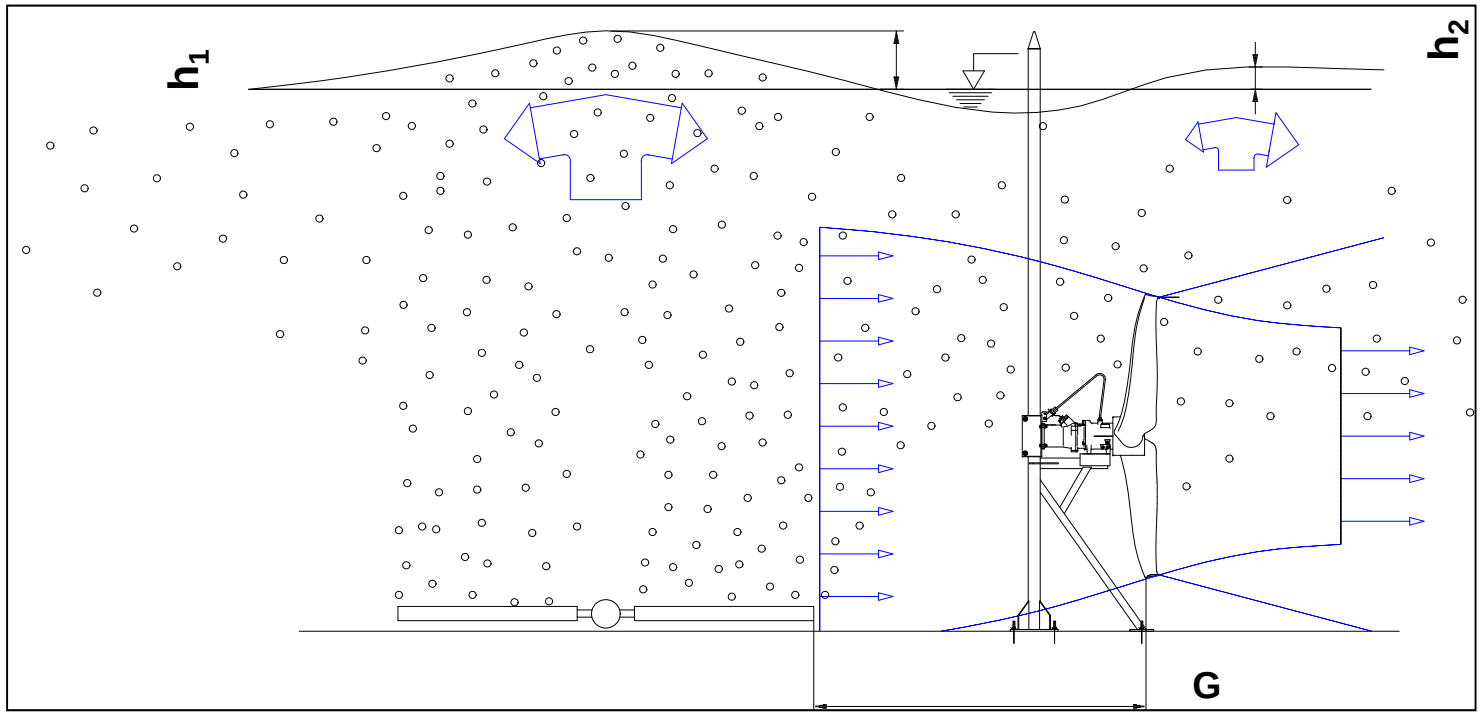
Aeration

Flow condition **after a longer period**



Aeration

Operating behaviour of a mixer in the aeration field



- primäry/secundäry
- Density
- Turbulences
- Unsymetrical flow
- Vibrations
- Life time
- Min. distances
- Backflow

h_1: Local increase of the volume by air bubbles leads to a raising of the water level in the area of the aeration fields

H_2: Raising of the water level by a rise in pressure of the propeller

Agenda

- General information
- Applications of submersible mixers
- ***Technical design of the submersible mixers***
- Classification of Wilo Submersible Mixers
- Accessories
- Wilo selection software

Product range with standard motors

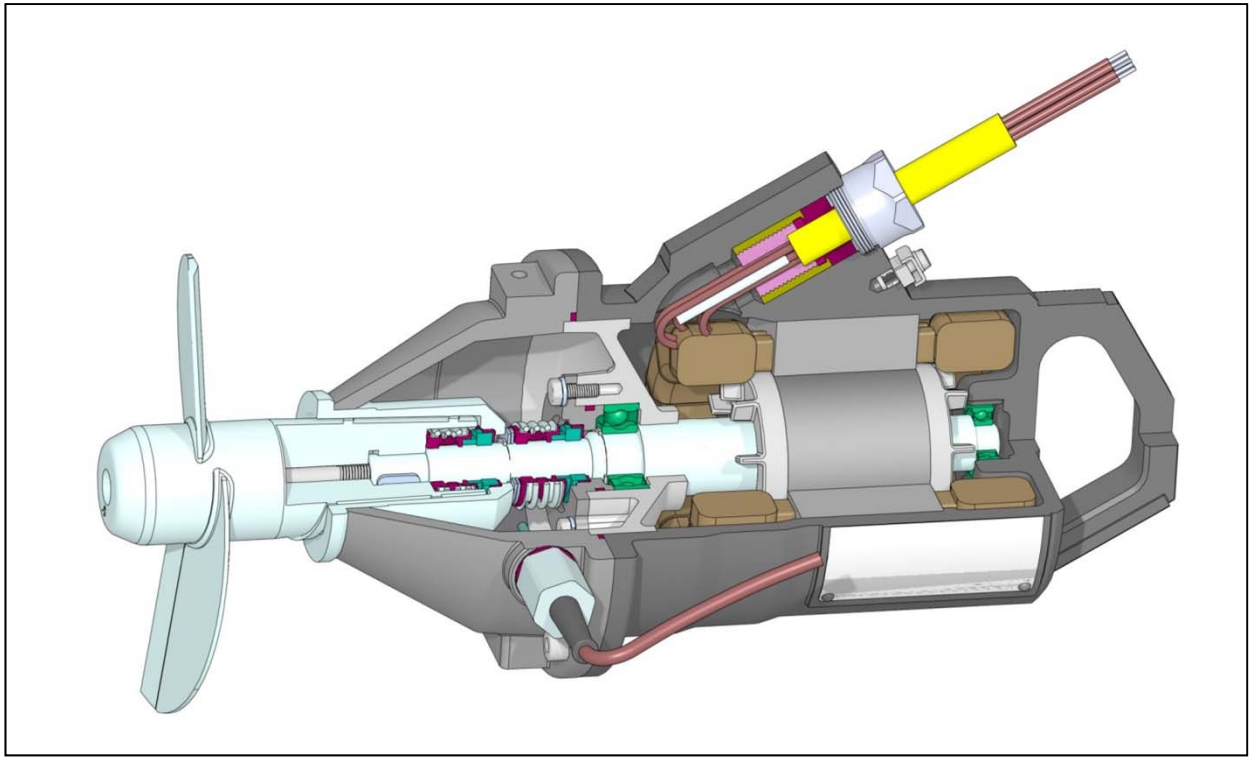
		50 Hz		60 Hz		
Range	**Mixer Type**	**P1.1 [kW]**	**Thrust [N]**	**P1.1 [kW]**	**Thrust [N]**	**Continous operation**
Miniprop	**TR 14 ... TR 16**	**0,26 – 0,3**	**45 – 65**	**0,33 – 0,42**	**60 – 90**	**conditionally suitable**
	TR 21/TR 21S	**0,34 – 1,2**	**75 – 240**	**0,53 – 1,34**	**105 – 245**	
	TR 28	**1,3**	**330**	**1,69**	**340**	
Uniprop direct	**TR 22**	**1,3 – 2,7**	**185 – 350**	**1,4 – 2,4**	**220 – 320**	**conditionally suitable**
	TR 36/TR 36S	**1,1 – 7,0**	**210 – 830**	**1,2 – 8,5**	**300 – 990**	
	TR 40/TR 40S	**2,25 – 5,2**	**505 – 1100**	**3,6 – 8,5**	**710– 1480**	
Uniprop gear	**TR 50-2/TR 50-2S**	**1,0 – 11,9**	**350 – 1920**	**0,4 – 12,2**	**110 – 2000**	**suitable**
	TR 60-2/TR 60-2S	**1,2 – 11,6**	**510 – 2370**	**1,5 – 12,0**	**500 – 2380**	
	TR 75-2	**3,0 – 10,8**	**1145 – 2850**	**2,95 – 14,0**	**1100 – 3320**	
	TR 90-2	**0,7 – 5,2**	**430 – 2120**	**0,9 – 4,1**	**580 – 1820**	
Uniprop gear	**TR 80-1/TR 80-1S**	**6,1 – 20,1**	**1670 – 3940**	**5,9 – 25,2**	**1650 – 4560**	**suitable**
Maxiprop	**TR 216**	**0,63 – 4,37**	**270 – 2460**	**0,7 – 4,45**	**460 – 2600**	**suitable**
	TR 221	**0,8 – 4,8**	**640 – 3350**	**0,8 – 5,5**	**650 – 3600**	
	TR 226	**0,68 – 4,9**	**800 – 4370**	**1,3 – 4,6**	**1550 – 4250**	
Megaprop	**TR 316**	**1,33 – 6,32**	**450 – 2450**	**1,3 – 6,2**	**1050 – 3400**	**suitable**
	TR 321	**0,8 – 4,9**	**720 – 3420**	**0,8 – 5,3**	**2700 – 3500**	
	TR 326	**1,1 – 6,41**	**1390 - 5270**	**2,3 – 4,9**	**2550 – 4400**	

Product range with high-efficient motor (IE3)

		50 Hz		
Range	Mixer Type	P1.1 [kW]	Thrust [N]	Continous operation
Uniprop gear	TRE 90-2	2,8 – 4,4	1500 - 2000	suitable
Maxiprop	TRE 221 / 321	1,0 – 3,8	1000 – 3120	suitable
Megaprop	TRE 226 / 326	1,55 – 4,4	1870 – 4240	Suitable

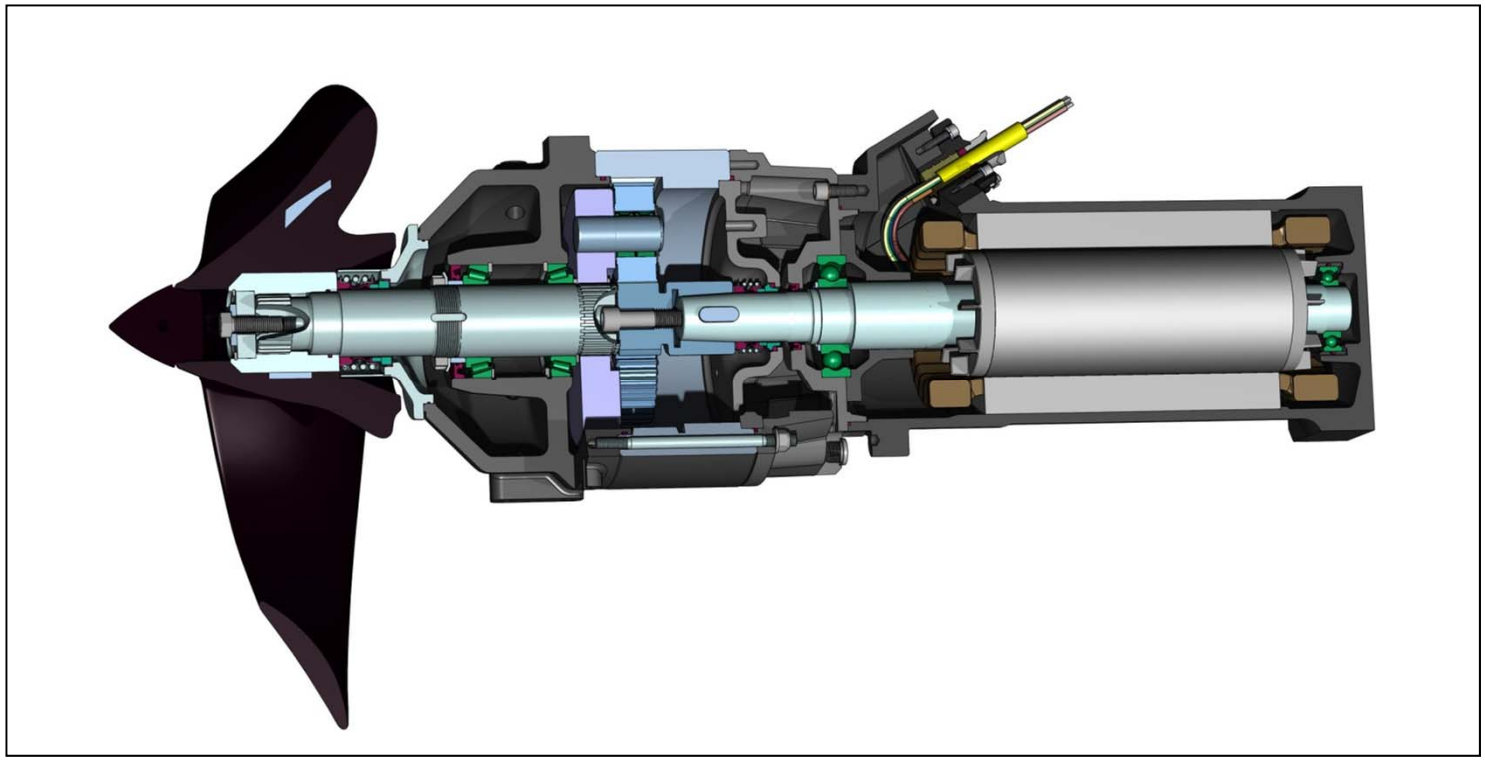
High Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
0,14 – 0,4	700- 1405	828 - 1680



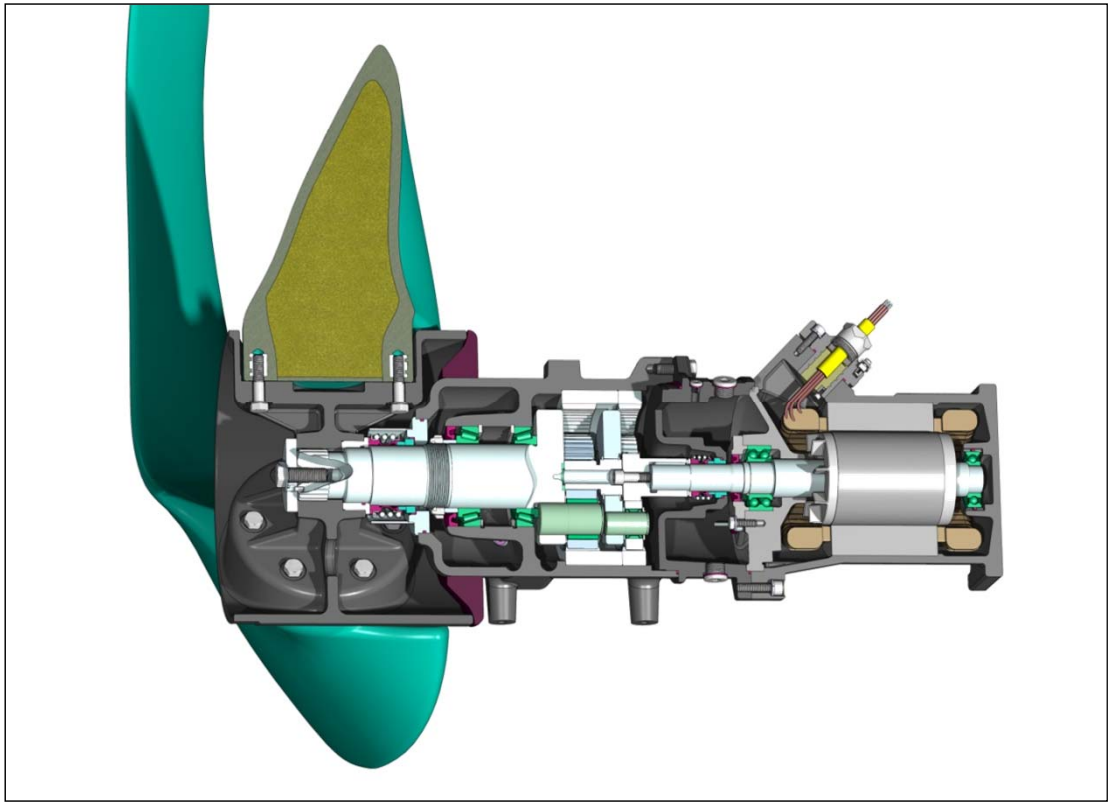
Medium Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
0,5 – 1,2	98 - 594	133 - 570

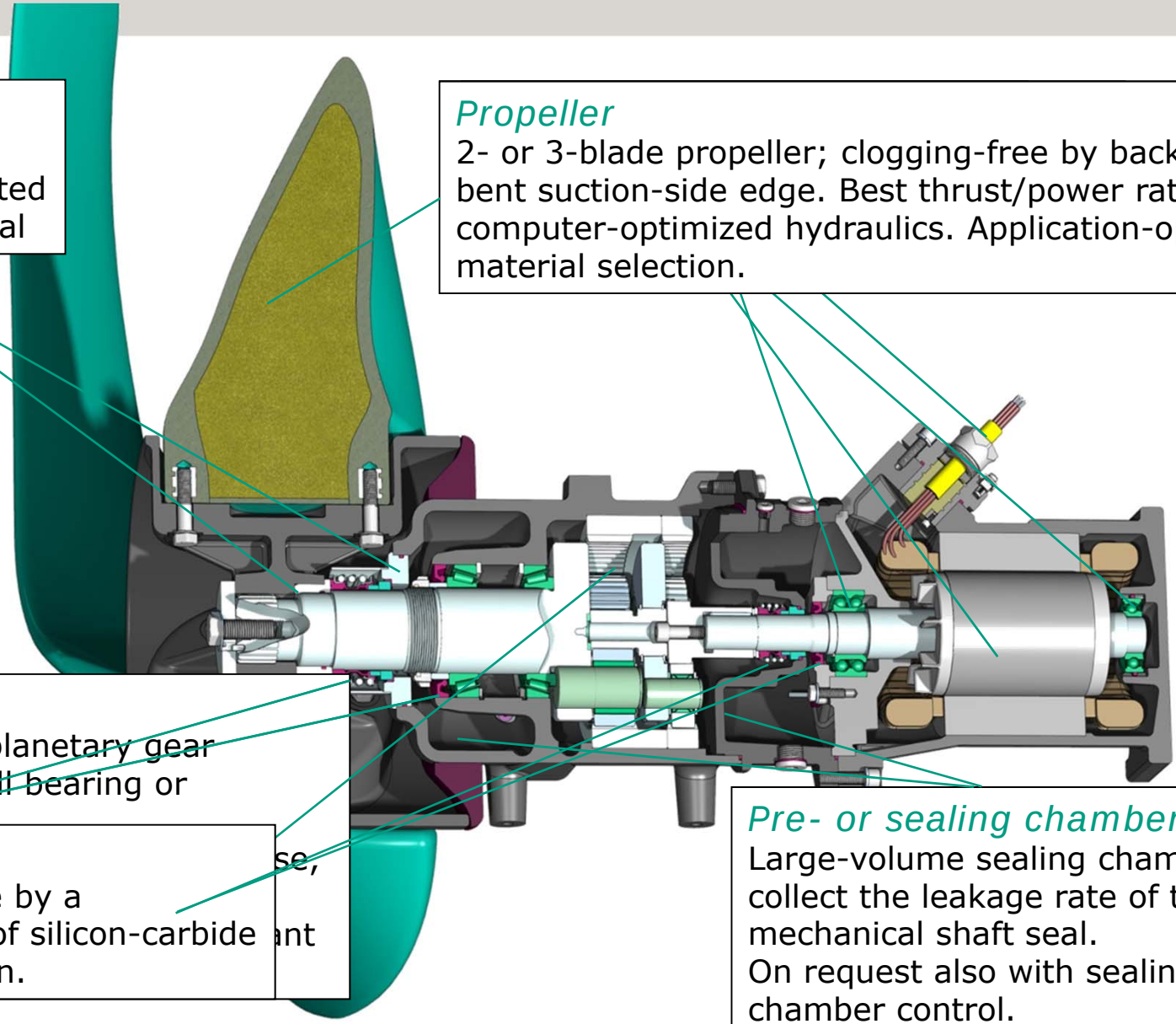


Slow Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
1,5 – 2,6	13 - 59	20 - 58



Matured Technology – The Components



Sealing sleeves
made of 1.4571 guarantee a long-lasting corrosion-protected fit of the mechanical shaft seal

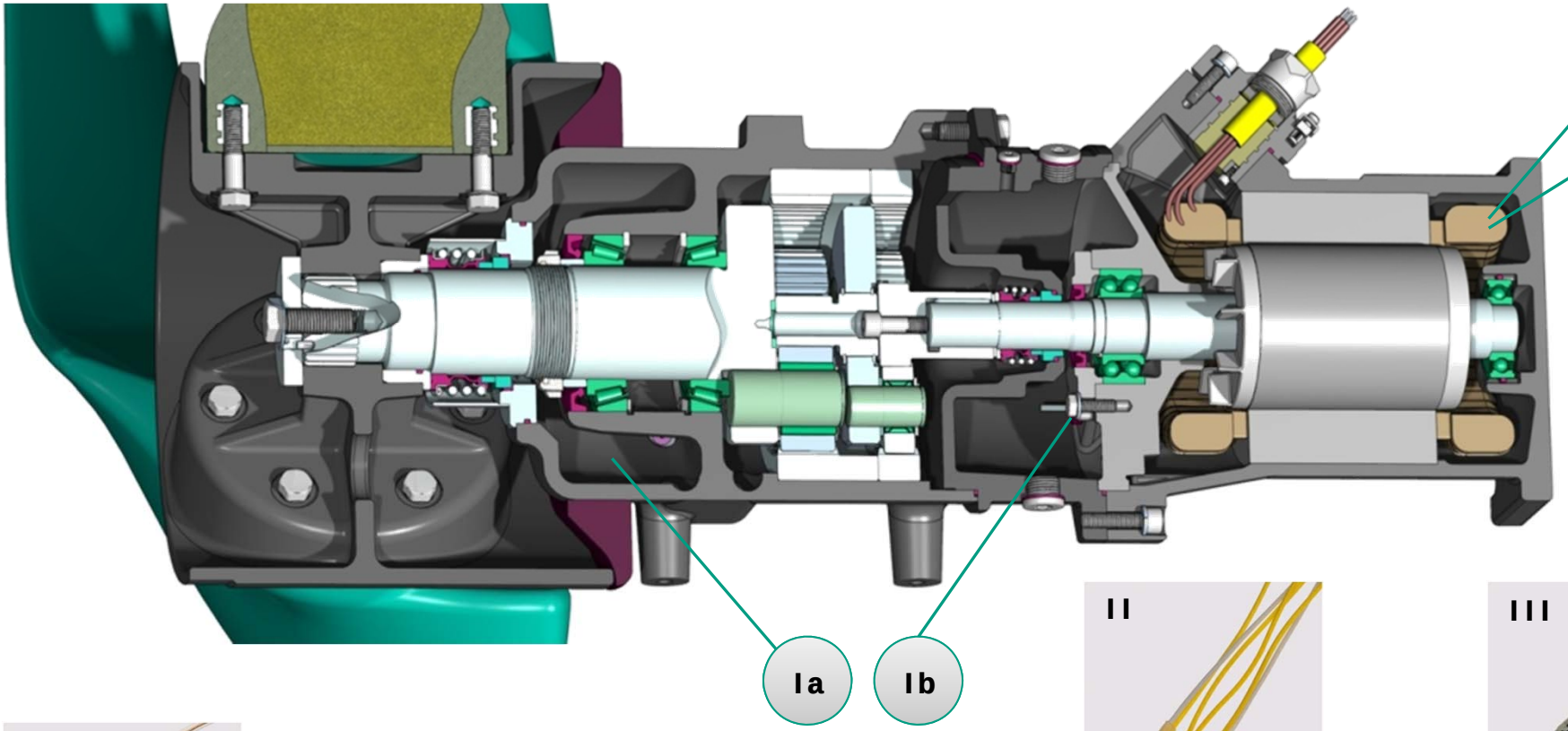
Propeller
2- or 3-blade propeller; clogging-free by backwards bent suction-side edge. Best thrust/power ratio by computer-optimized hydraulics. Application-optimized material selection.

Gearbox
Efficient 1-stage or 2-stage planetary gear with inclined and grooved ball bearing or taper roller bearing

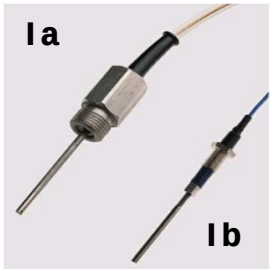
Sealing
on the liquid- and motor-side by a mechanical shaft seal made of silicon-carbide and radial seals made of viton.

Pre- or sealing chamber
Large-volume sealing chamber to collect the leakage rate of the mechanical shaft seal.
On request also with sealing chamber control.

Monitoring systems for motors



II= Optional
III= Standard



DI electrodes
Humidity checking
Ia= all types
Ib= T12 Standard
T17 Optional

PTC thermistor temperature sensor
Windings temperature sensor within the motor

Bimetal
Winding temperature monitoring within the motor

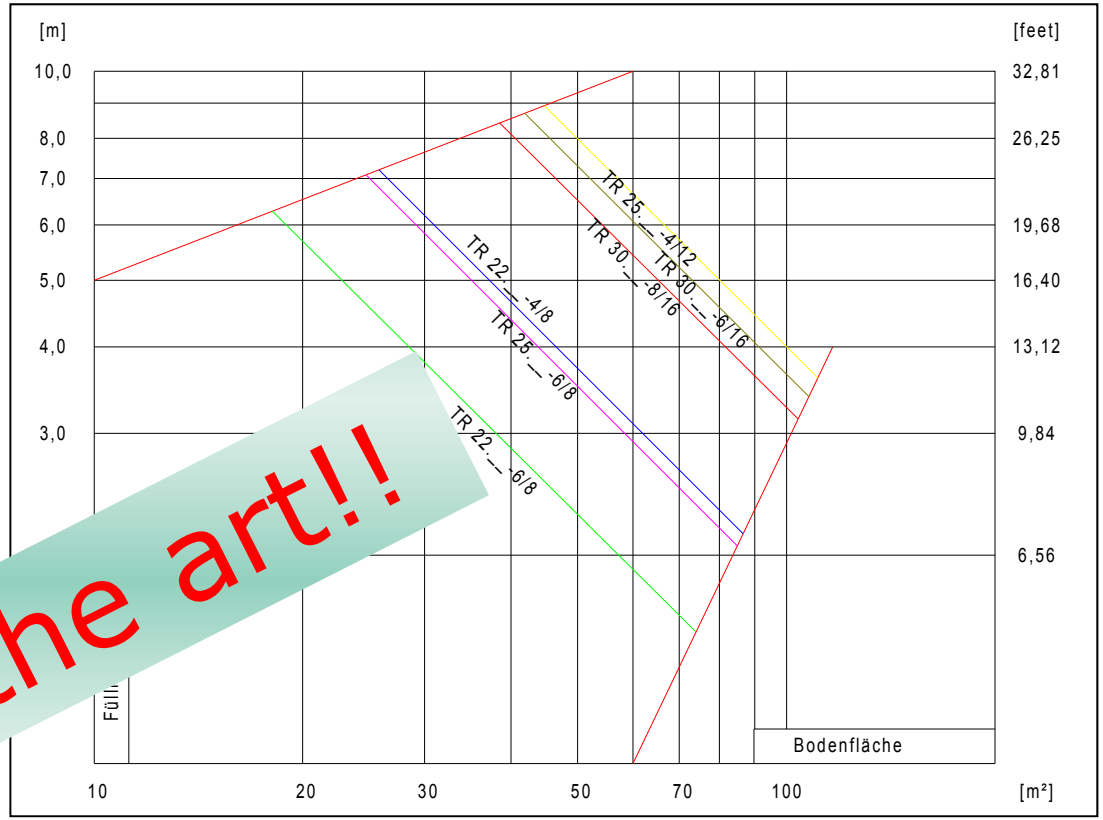
General Information - Curves

The curve is valid for round and rectangular tanks.

Primary sludge dry solids content < 1%

Without aeration

The tank length to tank width proportion must be less than 2,5.



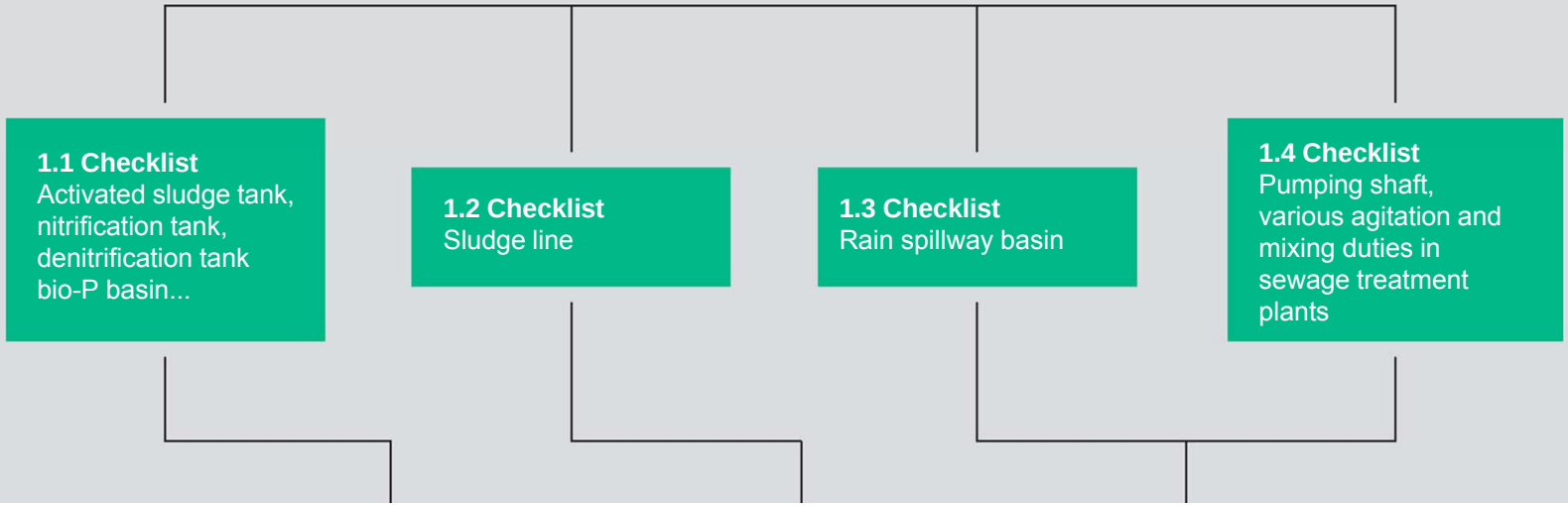
Not state of the art!!

In case of unfavourable tank geometries several submersible mixers must be installed

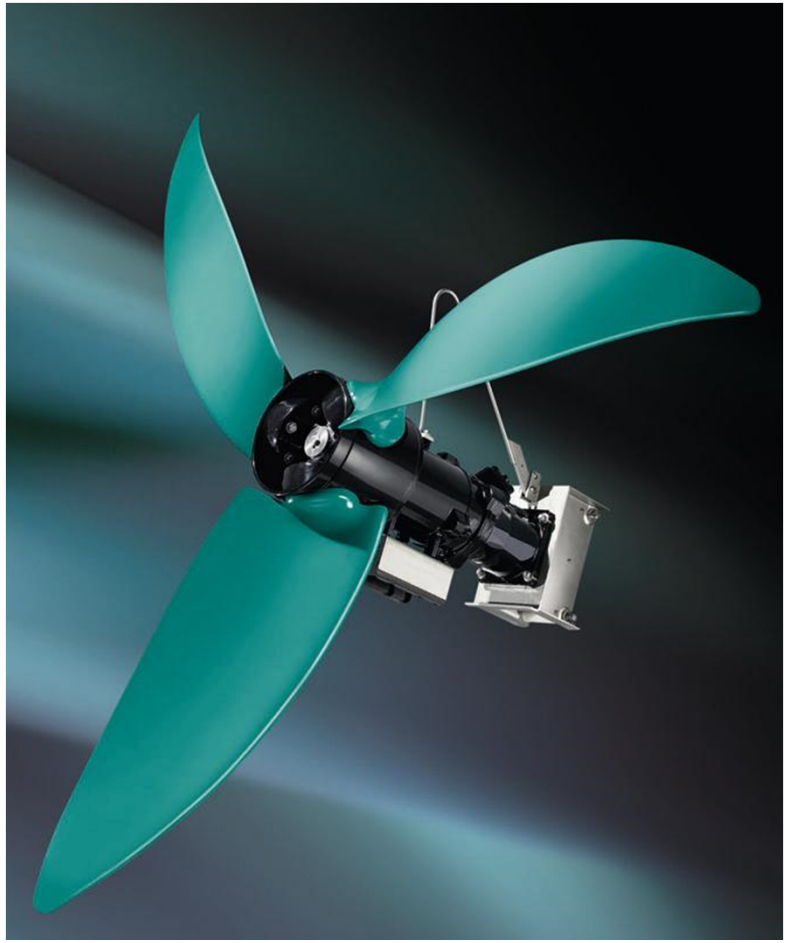
Checklist - enquiries

Overview

Checklists for submersible mixers.



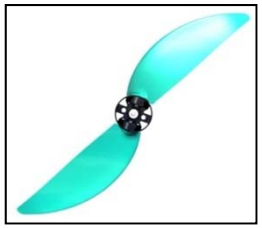
WILO Mixer - Unique Selling Proposition

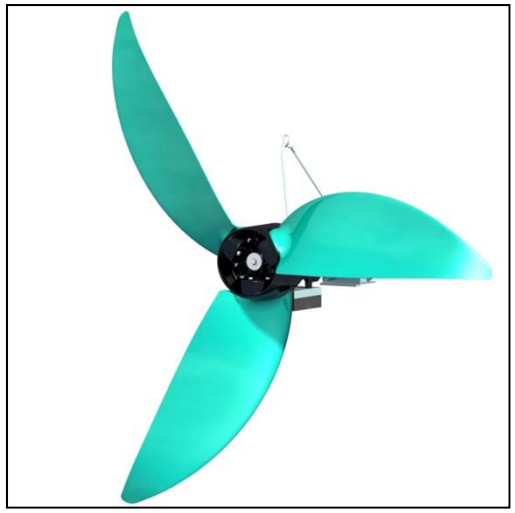


Comparison Submersible Mixers

WILO EMU
Maxiprop and Megaprop with motors in ex-proof design

Advantages:
-suitable for stations with ex-protection specified



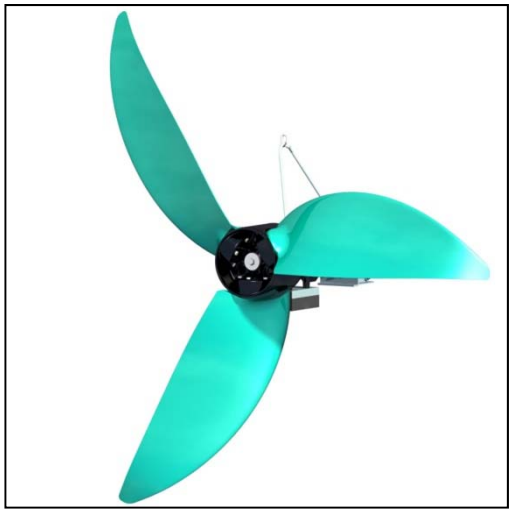


Competition
- partly without ex-proof design

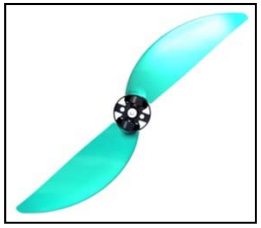
Comparison Submersible Mixers

WILO EMU
Megaprop
3-blade submersible mixer

Advantages:
- lower specific blade load
- better truth of rotation
- better energy transfer

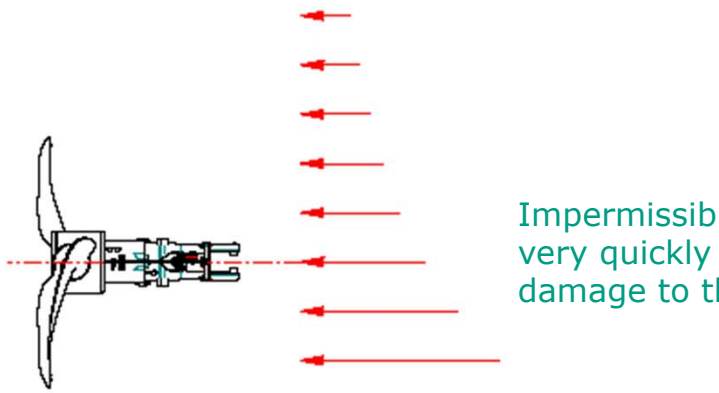


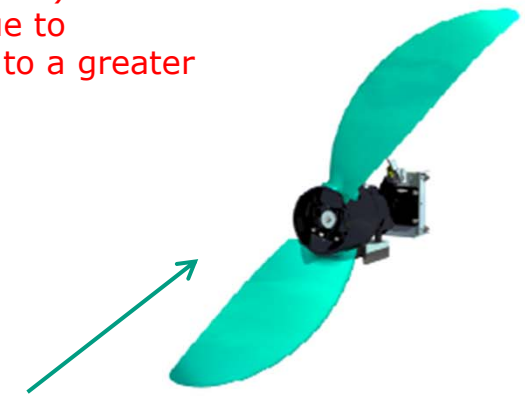
Competition
- less 3-blade submersible mixers with big blades



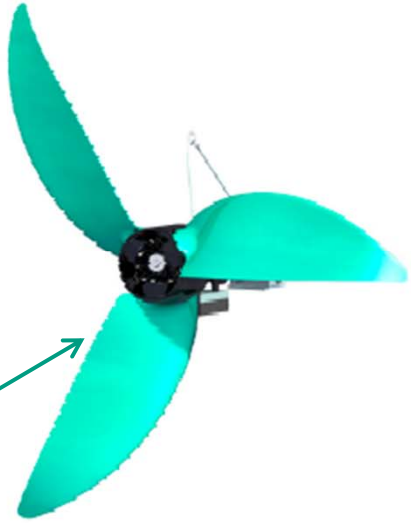
Advantages Megaprop?

Asymmetrical inflow (e.g. after flow diversion…) and variations in density of the medium (e.g. due to aeration…) always cause unbalanced forces to a greater or lesser extent.

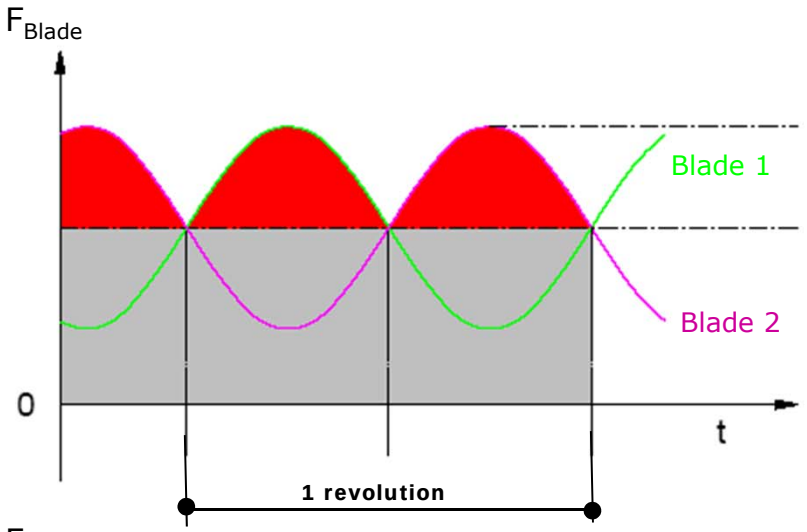


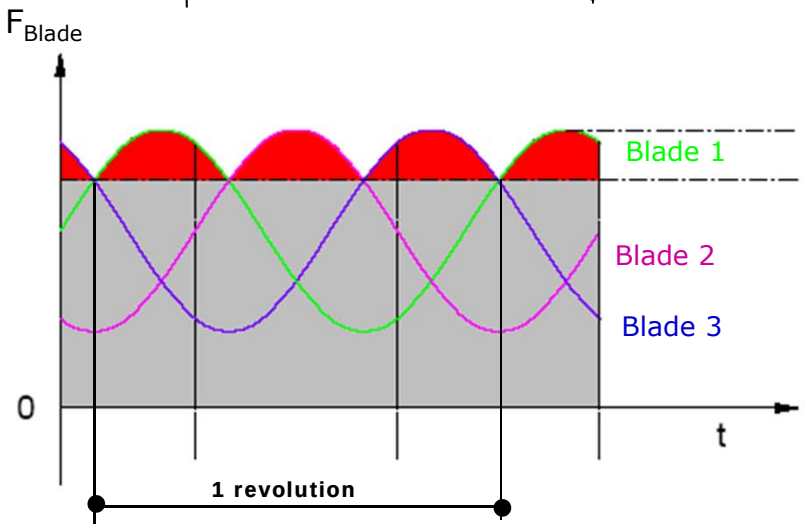


Impermissibly high unbalanced forces very quickly cause consequential damage to the unit and/or its fittings



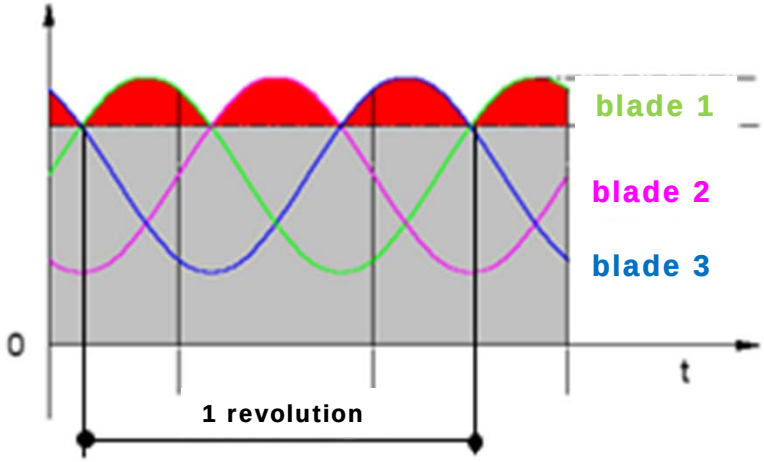
Introducing an additional blade reduces the incidence of unbalanced forces due to external influences

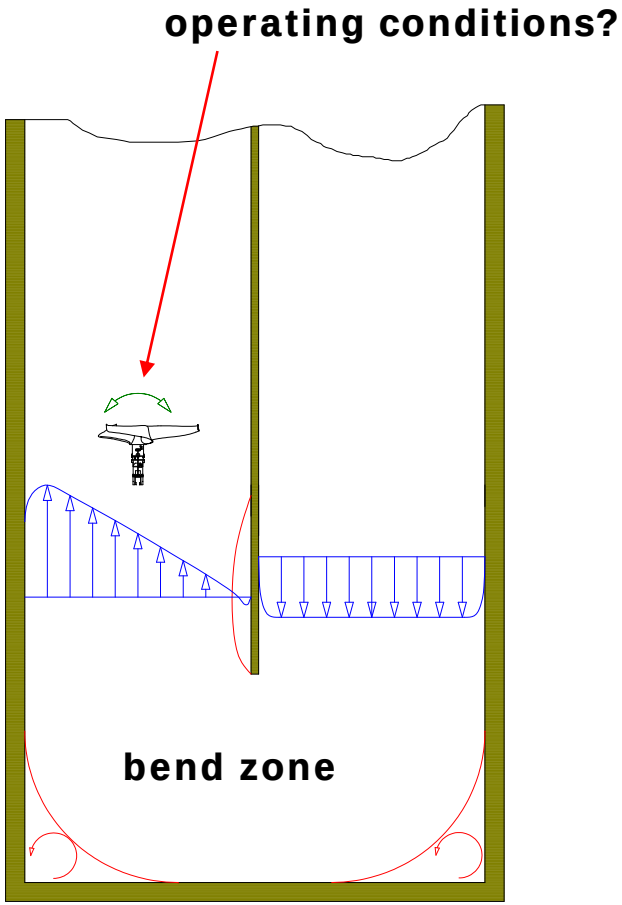




Advantages Megaprop?

Assymmetric inflow conditions of various causes.





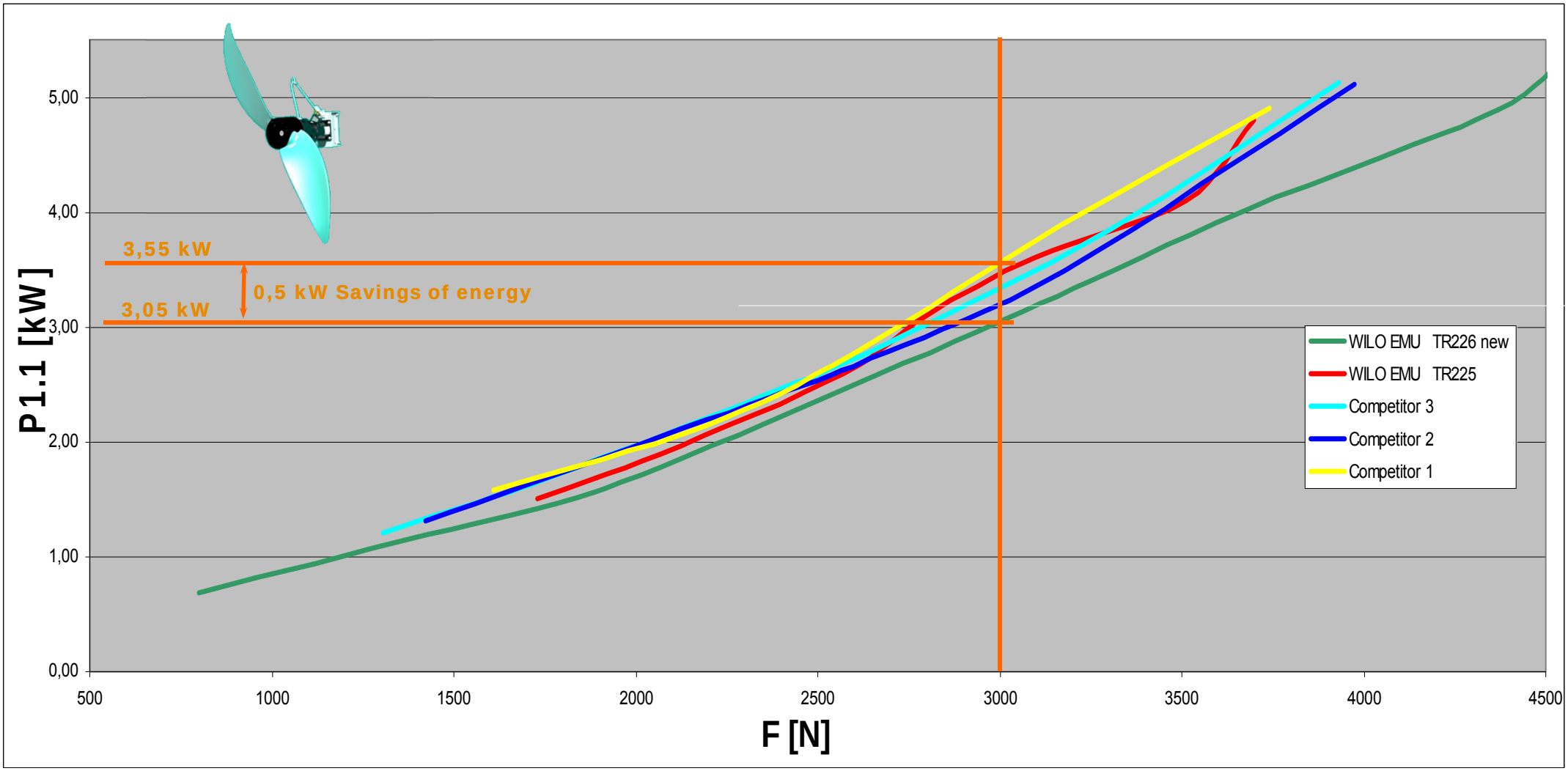
Advantages of Megaprop

- Can be used even under unfavourable external inflow conditions
- Low changes of torque on the machine and lowering device →low-vibration, longer service life
- Low load on each blade
- Lower speed for the identical thrust, yielding even gentler revolution and best possible minimisation of oxygen entry at the surface of the medium
- Because of the lower load on each individual blade in comparison to two-blade mixers, can be installed at significantly smaller distances from aeration, bends ....
- For the same thrust, a smaller three-blade propeller diameter can replace an equivalent two-blade mixer, offering the facility for optimum positioning when conditions are cramped.
- Smoother mechanical start-up
- Reduced eddies and vortices

Comparison Mixers New TR 226

Specific thrust = F / $P_{1.1}$ [N/kW]

$P_{1.1}$: Power input for each mixer at duty point
F : Mixer thrust



Comparison Submersible Mixers

WILO EMU
Patented WILO EMU-propeller with self-cleaning propeller hub (Cleaning-helix in casing of high-grade steel)

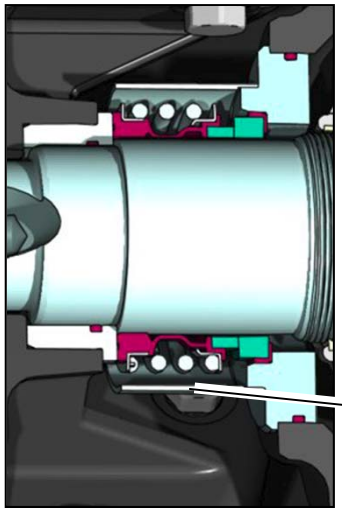
Competition
- Design without cleaning effect

Advantages:
-best suitable for the application in mixed liquids with clogging substances

Comparison Submersible Mixers

WILO EMU
Protection against clogging for mechanical shaft seal (protection sleeve for mech. shaft seal)

Advantages:
- Dirt particles are held off



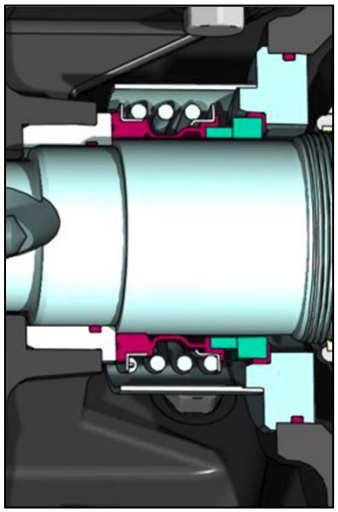
Protection sleeve for mechanical shaft seal

Competition
-Without protection sleeve for mechanical shaft seal

Comparison Submersible Mixers

WILO EMU

Mechanical shaft seal



Advantages:

-Silicon-carbide/silicon carbide
-Company Burgmann
-Easily available
-German product

Competitors:

-Tungsten carbide / tungsten carbide
-Worse operation features in case of damaged lubrication film
-Sealings from Sweden
-Not easily available

Comparison Submersible Mixers

WILO EMU

Propeller fixation:

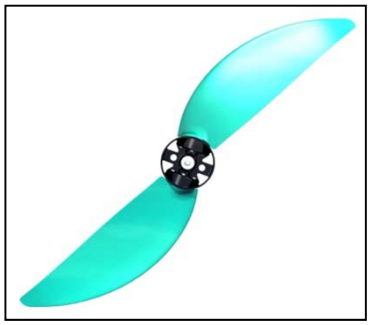
Extensive flange design

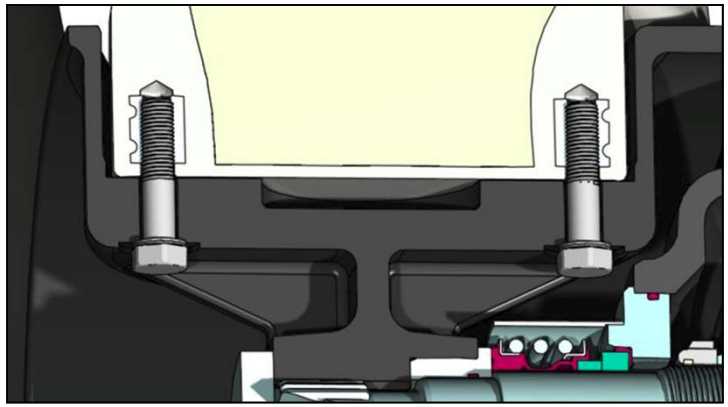
Advantages:

-Better transmission of force

-Easier assembly and disassembly

-No special tool necessary





Competition

- Shaft spline fixation
- Disassembly with special tool
- Very difficult disassembly, partly problems to remove the single blades from the hub

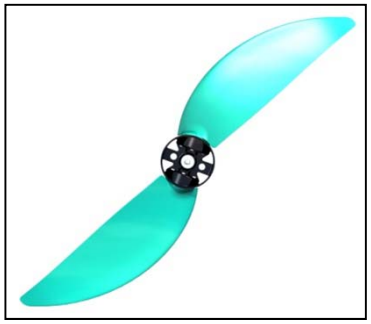
Comparison Submersible Mixers

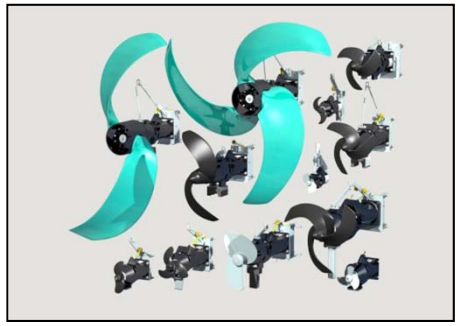
WILO EMU

Gradation of the speed by planetary gear (higher efficiencies than spur-gear system) and a multitude of propeller types designed for optimum flow efficiency.

Advantages:

-Optimum adjustment for each application





Competition

- Spur-gear system
- Diameter of propeller can be reduced to different sizes (only one standard propeller available)

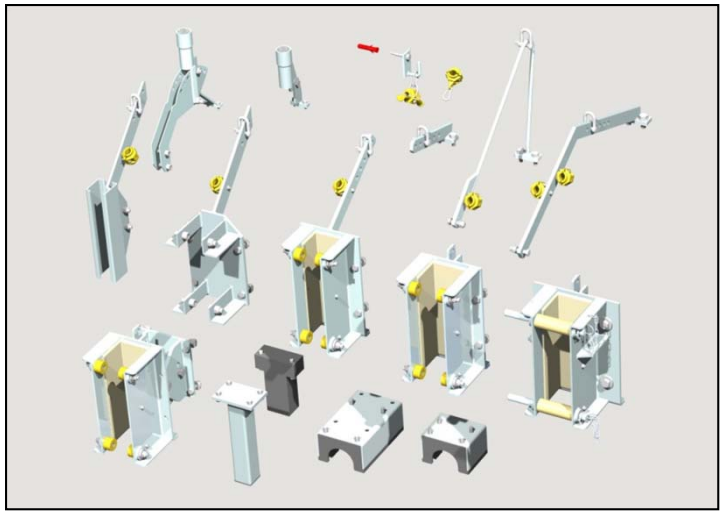
Comparison Submersible Mixers Modular System

- Submersible motor, gearbox and propeller form a compact, coaxial unit.
- This design allows an exact adjustment of the submersible mixers to the required performance data.
- Due to the modular system a large spectrum of submersible motors and curves is available.

Comparison Submersible Mixers

WILO EMU

Guide skid of high-grade steel
Lining with sliding coat and roller guiding



Competition:

> Partly without sliding coat and roller guiding

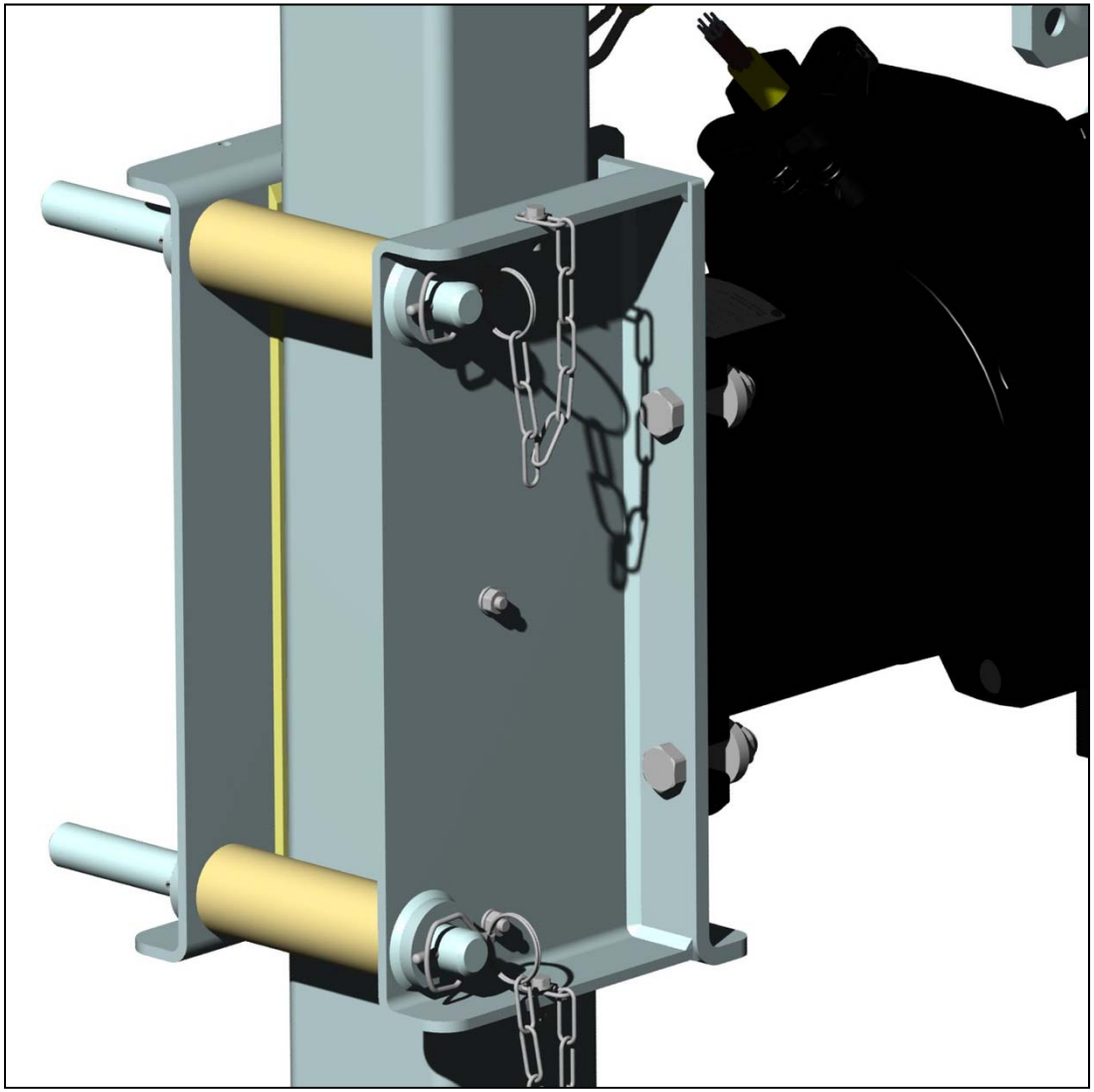
Advantages:

- Protection against corrosion
- Easy guidance
- Simple separation of the mixer from the guide pipe
- Due to the modular construction of the guide skid and the submersible mixer, it is possible to install the mixers at all lowering devices from 60-150 mm

Comparison Submersible Mixers

Frames

- Continuous rolls which can be removed without tools
- For application on different lowering devices of other manufacturers
- Increased stability



General Information – ISO 21630

Bases and consequences of the standard ISO 21630 in connection with the VDMA information sheet for today‘s submersible motor technology

Content:

- Selection criteria
- ISO 21630 in general
  - Power measurement
  - Thrust measurement
  - Power coefficient
  - Measuring tolerances
- VDMA (German Engineering Federation) working sheet in general
  - Liquid data
  - Performance parameters
  - Life cycle costs
- Test procedure in general
  - Power measurement
  - Dry solids concentration measurement
  - Flow velocity measurement
- Power comparison and amortization
- Consequences for WILO

Selection Criteria

The correct selection

It is not easy for the operating companies of sewage treatment plants to choose the most economical mixing system. The decisive factor should in no case be the cheapest investment cost, but an economic mixer comparison which considers all relevant influencing factors. This comparison is only useful, when all factors which are involved in the mixing process are considered.

These are:

- Investment costs
- Installation and start-up costs
- Energy and operation costs
- Maintenance and repair costs
- Breakdown costs
- Disposal costs

Only when the above mentioned influencing factors can be expressed in Euros, an objective mixer comparison is possible.

ISO 21630

ISO 21630
Acceptance and measuring standard for submersible mixers
Issued in 2004
Accepted as ISO standard in July 2007

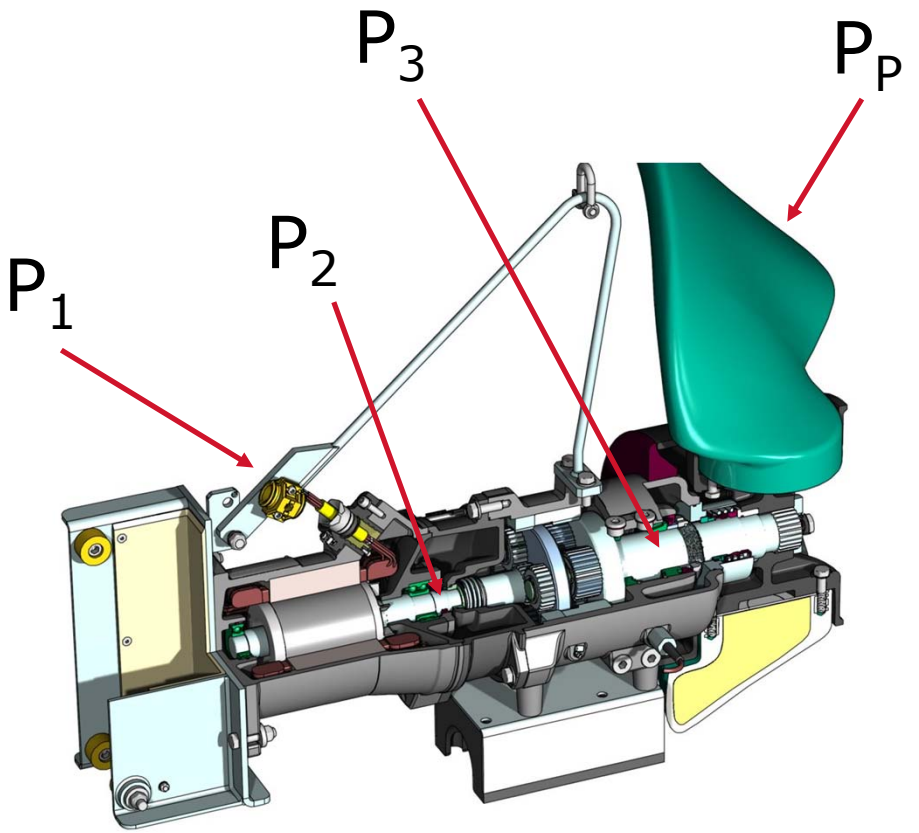
The main topics of the standard are:

- electrical power input in the duty point $P_{1.1}$
- thrust measurements
- measuring tolerances
- power coefficient

ISO 21630

Power definitions:

	with nominal operation	in the duty point
Power input motor	P_1	$P_{1.1}$
h		
Power output motor	P_2	$P_{2.1}$
h		
Power output gearbox	P_3	$P_{3.1}$
h		
Power output propeller	P_P	$P_{P.1}$



ISO 21630

The **power input in the duty point $P_{1.1}$** is the most important power parameter!

The customer has to pay for that power!

(Motor curve)

ISO 21630

Measuring tolerances:

	+ Tolerance	- Tolerance
Thrust value <300 N		12 %
Thrust value >300 N		8 %
$P_{1.1}$ <5000 W	10 %	
$P_{1.1}$ >5000 W	5 %	
Thrust Power ratio		

ISO 21630

Thrust measurement

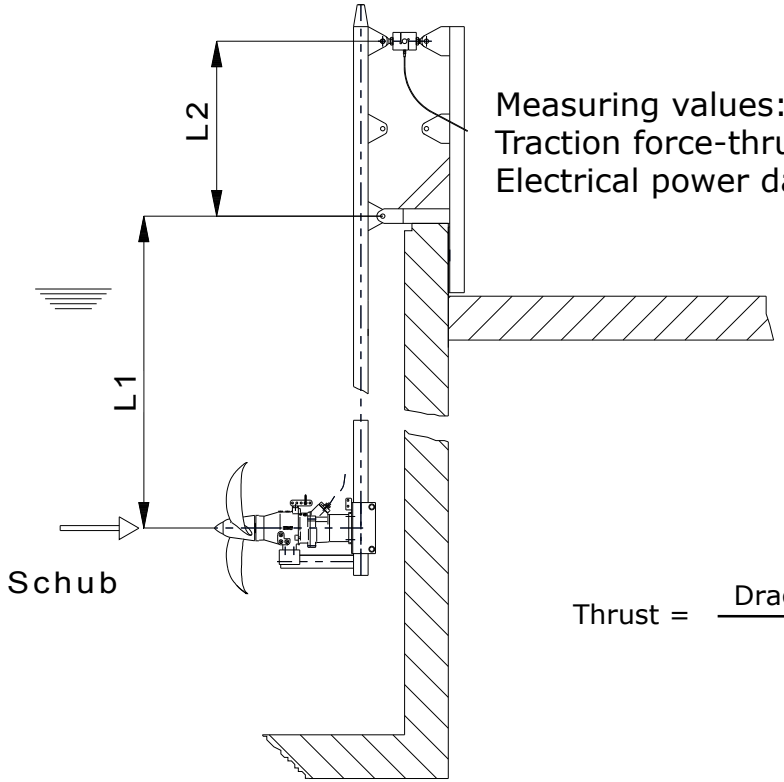
The mixer thrust depends on the velocity of the approaching flow.

Consequences:

Fast and middle fast running mixers can be measured in the test pit of WILO SE, Werk Hof.

Slow running mixers are measured on a measuring raft.

The biggest thrusts are measured with velocities of the approaching flow around 0 m/s.
The standard calls this „open sea" conditions.



Measuring values:
Traction force-thrust sensor
Electrical power data

$$\text{Thrust} = \frac{\text{Drag} \times L_2}{L_1}$$

(Measuring raft)

(Propeller and system curve)

VDMA Working Sheet

Notes for the comparison of mixers

A comparison of mixers is only possible, if all bidders have the same knowledge about the plant.

Performance parameters without mixing tank

(specification)

Energy density

Performance parameters with mixing tank

$$E_d = \frac{P_{1.1\ tot.}}{V_{Tank}}$$

Important:
- Number of mixers installed in the tank
- Total tank volume

$P_{1.1tot}$ = total power input of all mixers installed in the tank
V_{tank} = total tank volume

VDMA Working Sheet

Life cycle costs

For the selection of an economic mixing system among others the following factors must be considered:

- Investment costs
  - Mixer unit
  - Lowering device
  - Lifting device
  - Accessories such as operation platforms or operation bridges

- Installation and start up costs
  - Lifting devices
  - Installation works
  - Additional on site services

- Costs for acceptance test measurements

- Energy costs

- Disposal costs
  - Disassembly
  - Scrapping costs

- Maintenance costs
- Breakdown costs
  - Spare mixers (stand-by)
  - Rental mixers
  - Costs for tank emptying
  - Increased sewage disposal costs

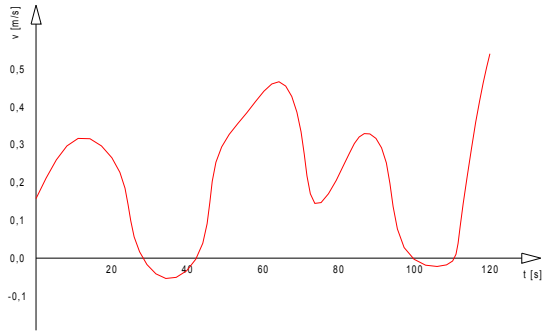
VDMA Working Sheet

Test procedure in general

Selection variants

- Mixing and circulating
- The generation of a flow velocity in the circulation tank

Flow velocity in the mixing tank



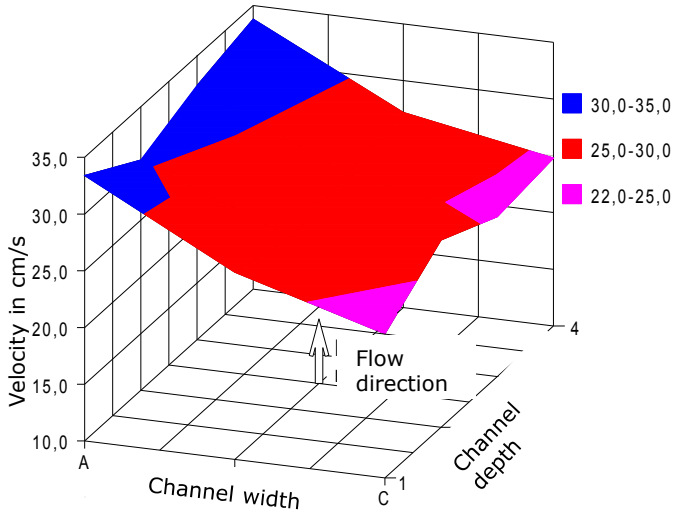
No directed flow field. In addidtion to the basic flow an unstable flow field which is dominated by different turbulence structures is generated

Selection by the sinking capacity

$P_{mix} > P_{sink}$

Proof by solids concentration measurement

Velocity distribution in the channel section



Average velocity components can be measured rather easily

Selection by the principle of linear momentum

$F_{thrust} > F_{system}$

Proof by flow velocity measurement

VDMA Working Sheet

Dry solids concentration measurement

Measuring devices:

- Gravimetric determination according to DIN 38414-2
- Solids sensors e.g. diffusion measurement

Per measuring point MP an average value will be determined from the total number *i* of the measurements taken at that point. From theses average values an average value of all *n* measuring points will be determined. Also the lowest and the highest value are determined. If these values do not differ from the average value by more than 15 %, the activated sludge tank will be mixed homogeneously.

(Example for concentration measurement)

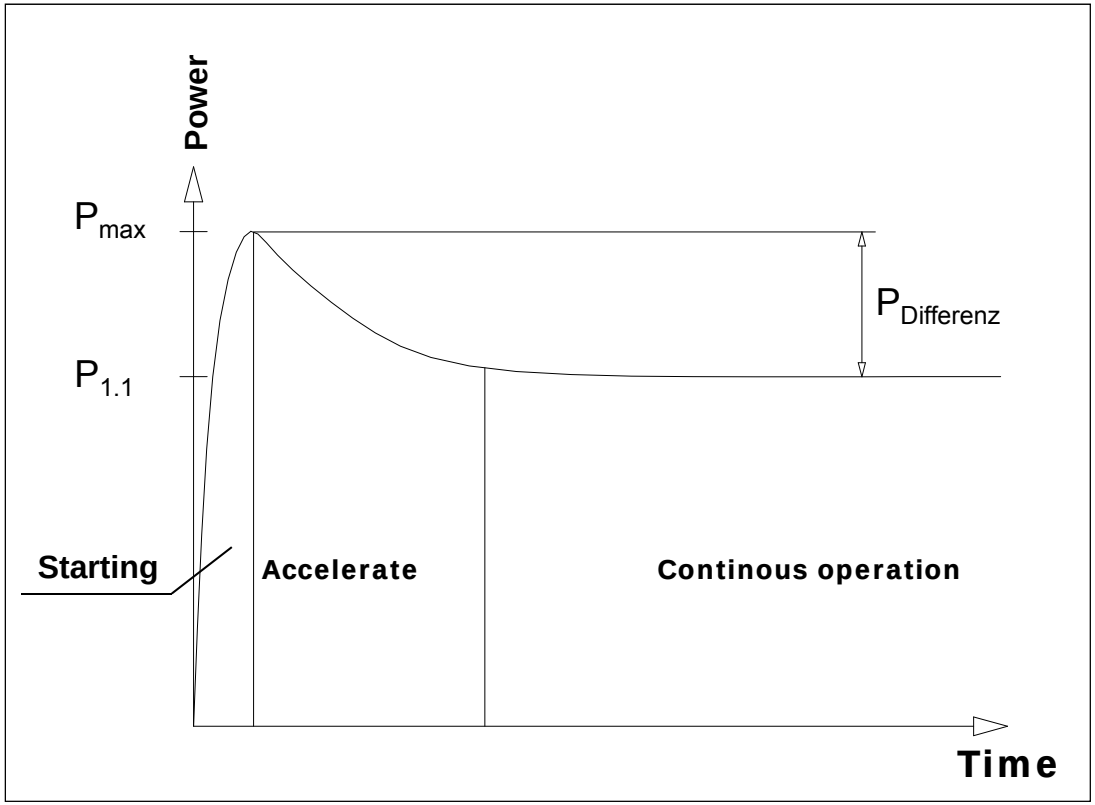
(Diffusion measuring device)

General Information

Operating behaviour of a mixer

$P_{Difference}$ is dependent on:

- Dry solids content
- Density
- Viscosity
- Liquid temperature



$P_{Difference}$
must be big enough to guarantee a continuous operation.

ISO 21630

Power coefficient R_{FP}

Relation of the thrust generated by the mixer to the to the needed electrical power

$$R_{FP} = \frac{\text{Thrust [N]}}{P_{1.1}\ \text{[KW]}}$$

Static thrust
Thrust measured with an inflow velocity of almost 0 m/s

$P_{1.1}$
Electrical power input at duty point during static thrust test

(Power coefficient – peripheral speed)

Thrust_ Power_Speed

Check list

Product range – Type disposition / Type variety

400 V 50 Hz	460 V / 60 Hz
0,14- 2,6 m	0,14 – 2,6 m
19 Typen	18 Typen
360 Varianten	180 Varianten

Product range – Modular design

Miniprop

Uniprop TR 36, 40

Motor	Sealing/ Pre-chamber	Gear type relating 1-stage 2-stage	Pre-chamber type relating

Propeller

Uniprop (all typ beside TR 36, TR 40)

Maxi-/Megaprop (all type)

Product range – Standard materials

Housings
Motor/Gear

- Cast iron

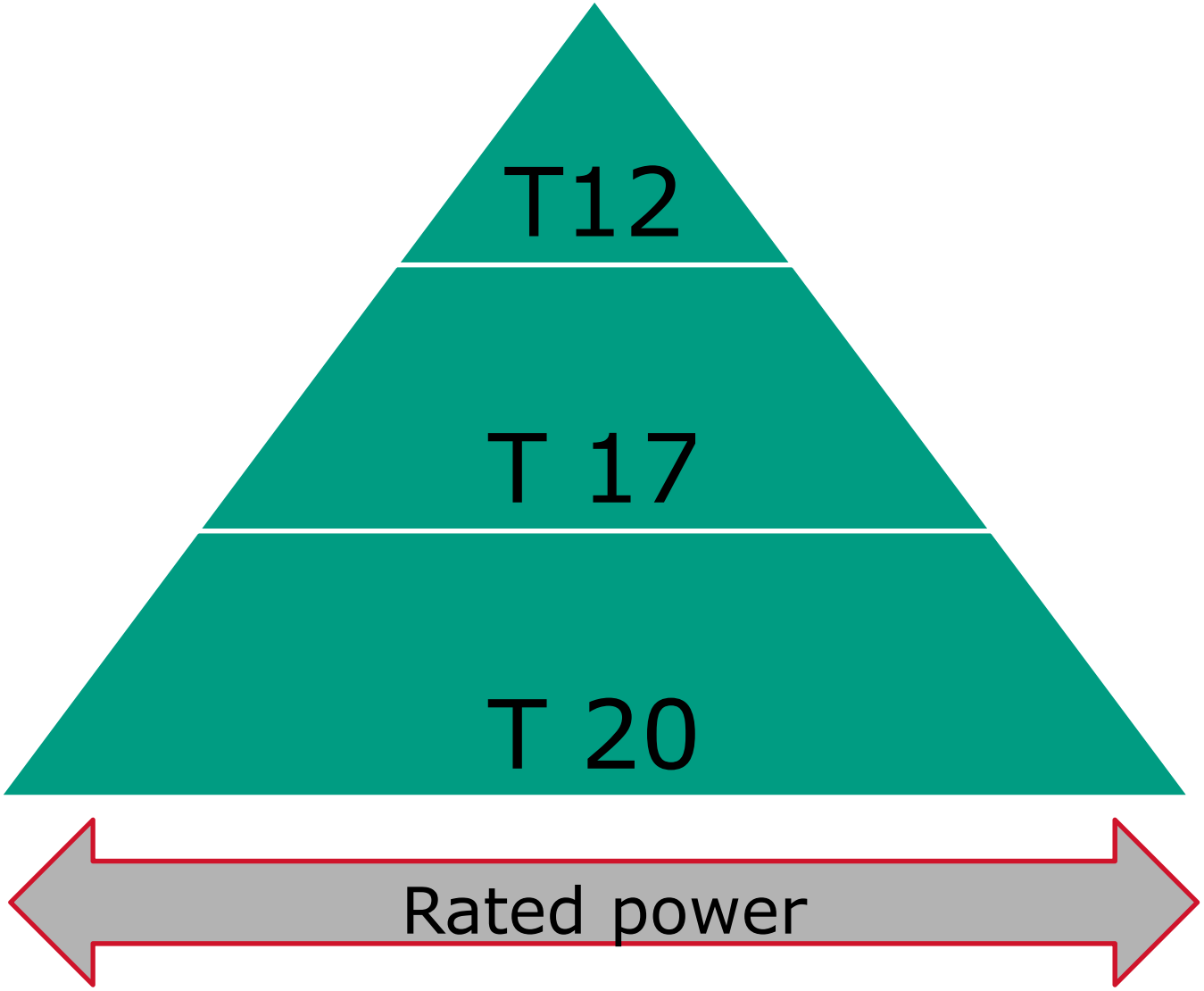
Motor shaft

- 1.4021
- 1.4462 (Duplex)

Propeller

- Cast Iron
- Stainless steel
- PUR
- GRP

Product range – Motor variants



Product range – Power cable

Technical Data for the WILO EMU Submersible Mixer TR 316 50Hz

Technical changes reserved!	TR 316.43-6/8	TR 316.46-6/8
Propeller-ø (mm)	1600	1600
Propeller speed (rpm)	43	46
Quantity of propeller blates	3	3
Circulation capacity (m³/s)	1,48	1,57
Thrust (N)	1090	1230
Motor speed (rpm)	915	915
$P_{\text{Rated power output}}$ (kW)	1,75	1,75
$P_{\text{Max. power input}}$ (kW)	2,50	2,50
$P_{1.1}$ (kW)*	1,33	1,58
$I_{\text{Rated current}}$ at 400V (A)	4,45	4,45
$I_{1.1}$ at 400V (A)**	2,90	3,20
I_{starting} (A)	17,00	17,00
Transmission $_{\text{Planetary stage}}$ i =	*3,600*	*3,364*
Transmission $_{\text{Total}}$ i = (6,2)	22,320	20,857
Efficiency (%)	70	70
cos φ	0,82	0,82
max. Weight (kg)	205	205
Cable/Type:		
Direct:	7x1,5	7x1,5
Star-Delta:	10G1,5	10G1,5
Direct Ex:	7x1,5	7x1,5
Star-Delta Ex:	10G1,5	10G1,5
Ex-protection		
Test number		

- H07RN-F
- NSSHöu-J
- NSSHöu-O

Cable/Type:		
Direct:	7x1,5	7x1,5
Star-Delta:	10G1,5	10G1,5
Direct Ex:	7x1,5	7x1,5
Star-Delta Ex:	10G1,5	10G1,5
Ex-protection		
Test number		

General type classification

high-speed mixer
(without transmission gearing)

Medium-speed mixers
(1-stage planetary gearing)

Low-speed mixers
(2-stage planetary gearing)

Product range - mixer technology

WILO designation

Miniprop = high-speed mixer, without transmission gearing
- Prop = 140-280 mm

Uniprop = high-speed mixer, without transmission gearing
- Prop = 360-400 mm

medium-speed mixer, with 1-stage planetary gearing
- Prop = 500-900 mm

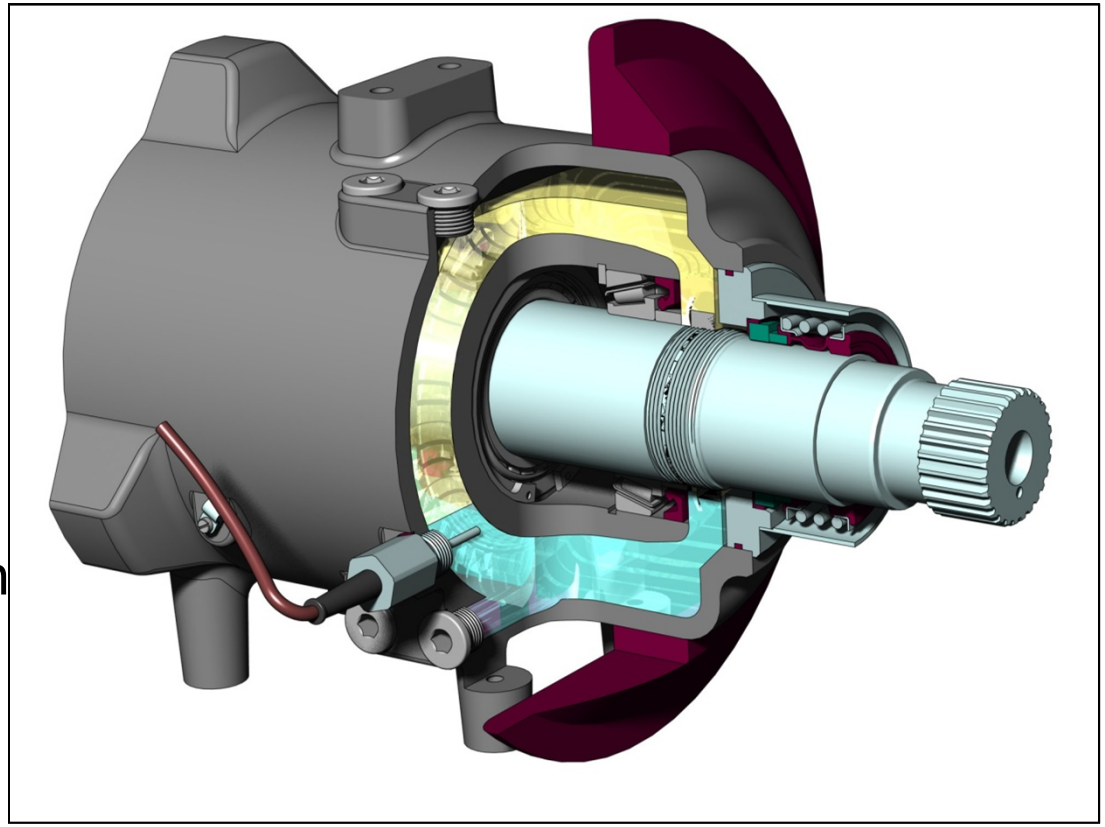
Maxiprop = low-speed mixer, with 2-stage planetary gearing
- Prop = 1600-2600 mm (2-blade)

Megaprop = low-speed mixer, with 2-stage planetary gearing
- Prop = 1600-2600 mm (3-blade)

Matured Technology

Sealing on the liquid-side

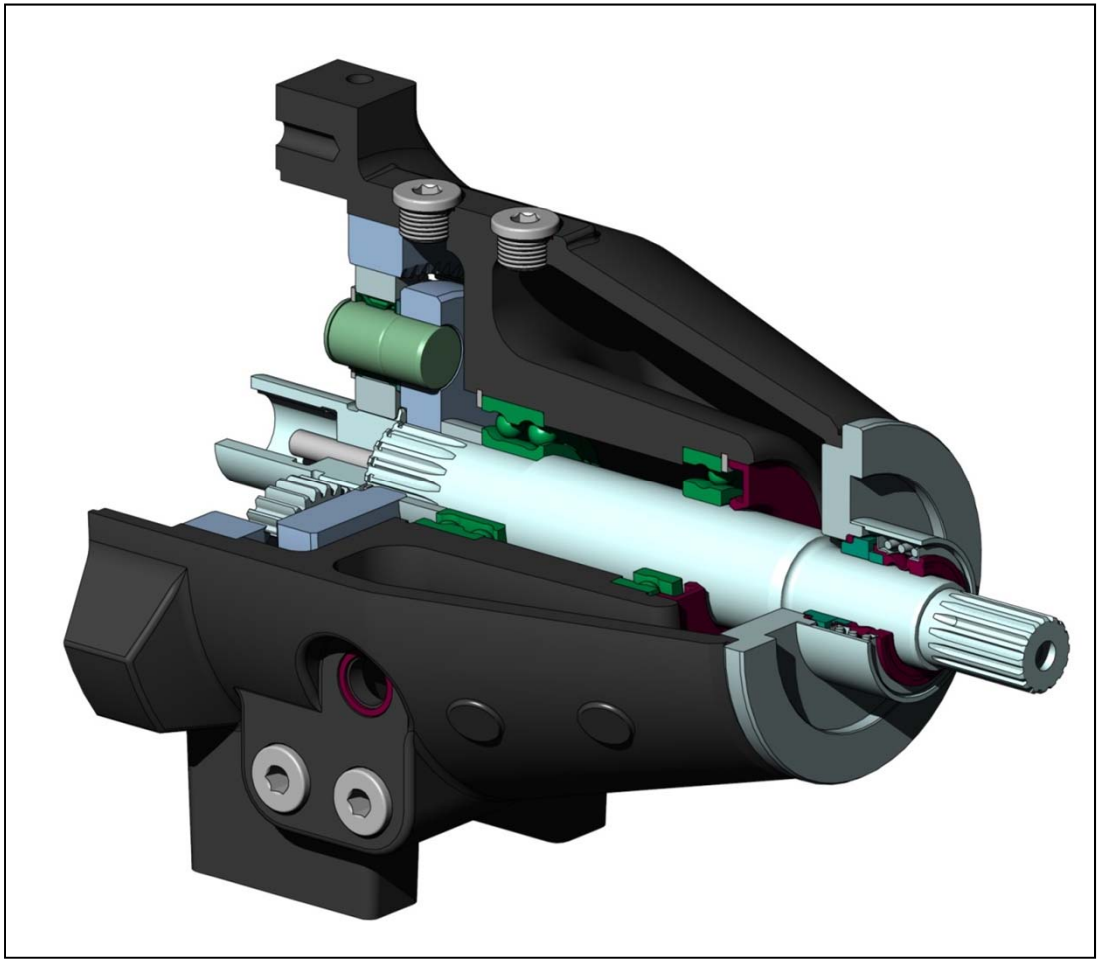
- Highly wear-resistant mechanical shaft seal SiC/SiC
- External sealing
- Protection against clogging for the mechanical shaft seal
- Sealing fit of the counter ring in a special seal washer made of 1.4571
- Gearbox shaft made of 1.4462



Matured Technology

Gearbox

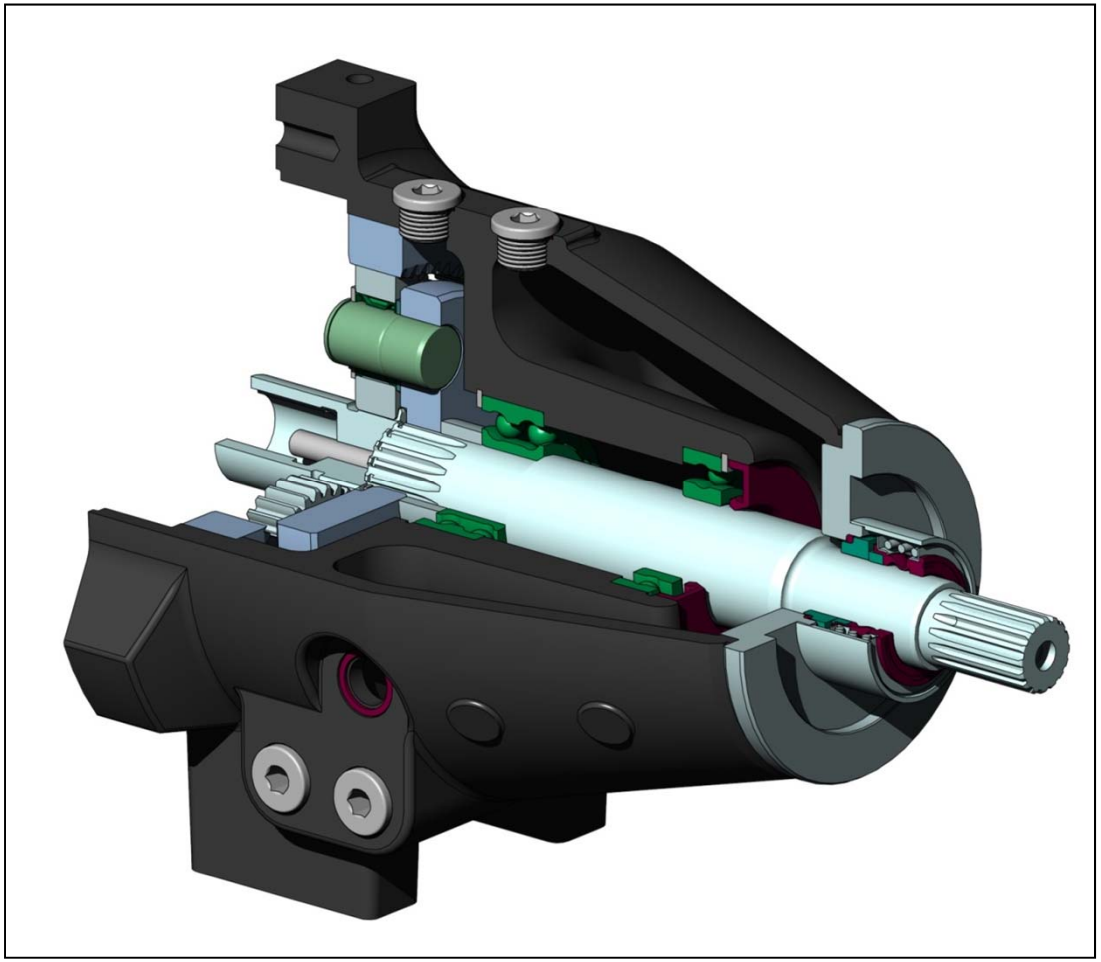
- Big distance between bearings
- Short distance between bearing and propeller
- Separate big-volume pre-chamber
- Possibility to screw in moisture probe
- Gears are hardened and grinded
- Design for max. flow efficiency



Matured Technology

Gearbox

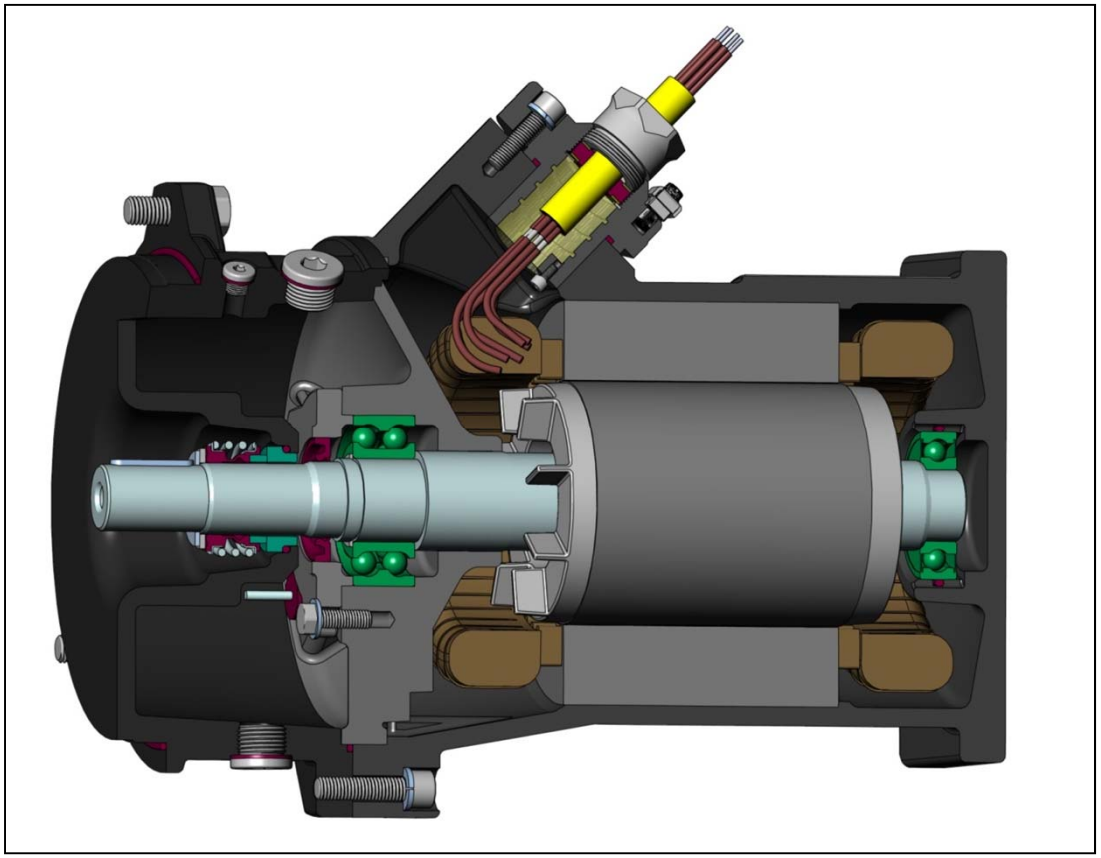
- Calculated bearing life
  - 100.000 hours
- Many gearbox transmissions easily exchangeable
- Easily accessible oil drain plugs
- Maintenance works once a year
- Gearbox shaft made of 1.4462



Matured Technology

Motor

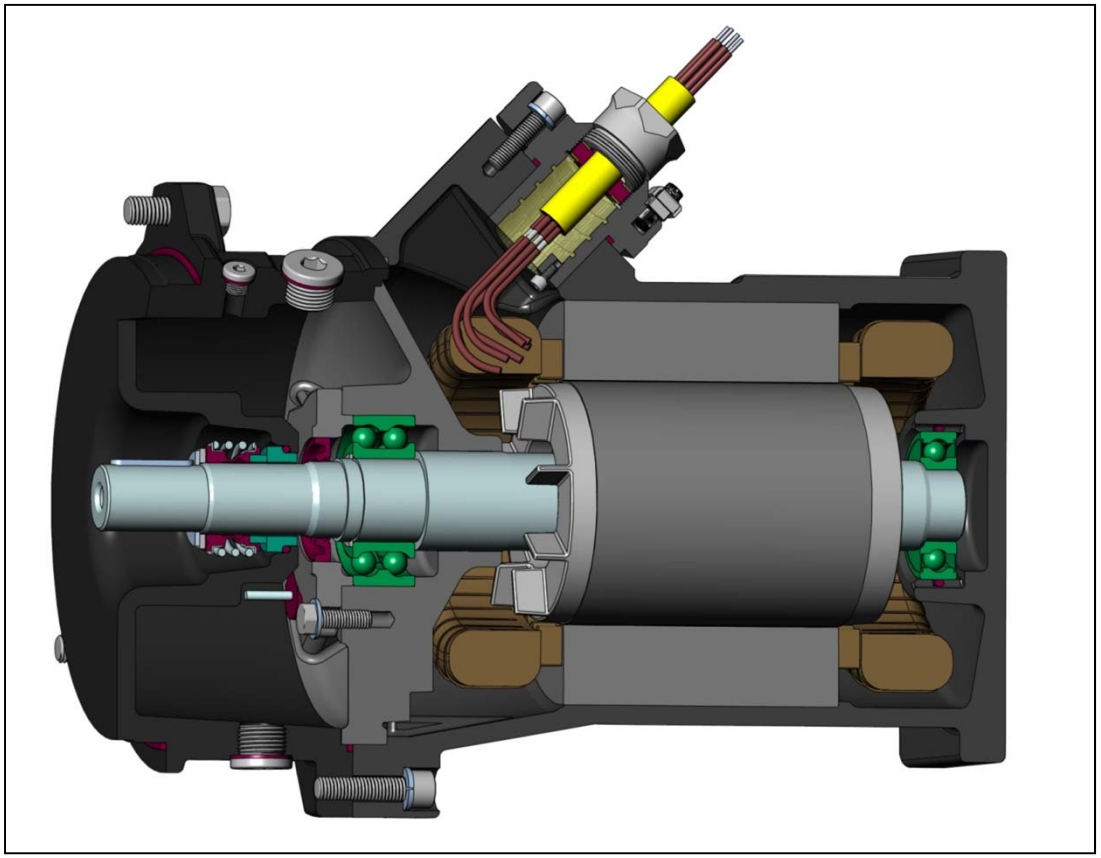
- Additional sealing chamber
- Sealing by mechanical shaft seal
- Permanently grease-lubricated, maintenance-free ball bearings
- Insulation class F
  (in special design H/F)
- Protection type IP 68
- Ex-proof possible



Matured Technology

Motor

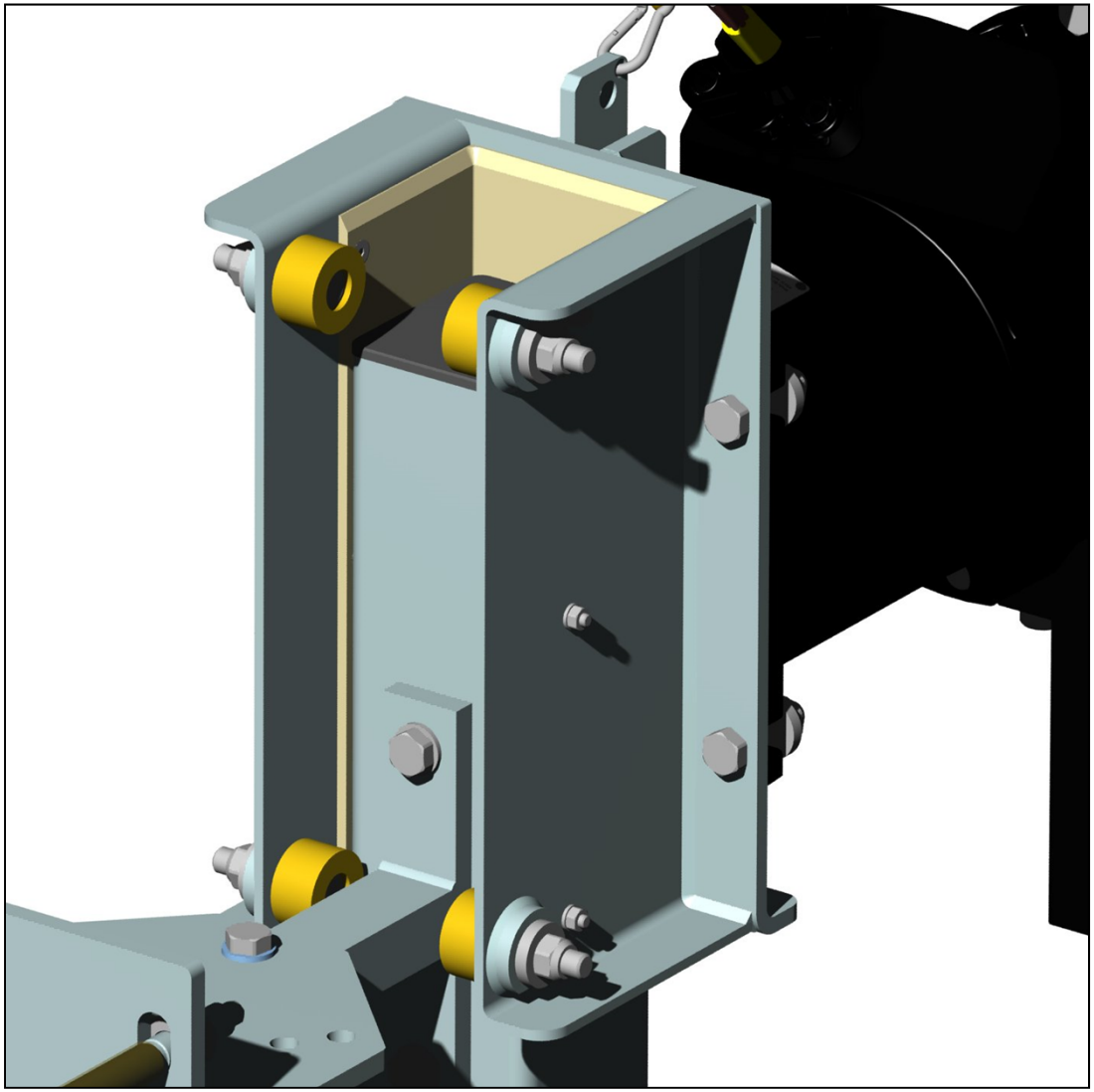
- Winding protection, bimetallic temperature switches or PTC-thermistors.
- Longitudinally water-tight, cast cable trumpet
- Leakage sensor in motor chamber optional
- Possibility for direct mounting of different frames



Matured Technology

Frames

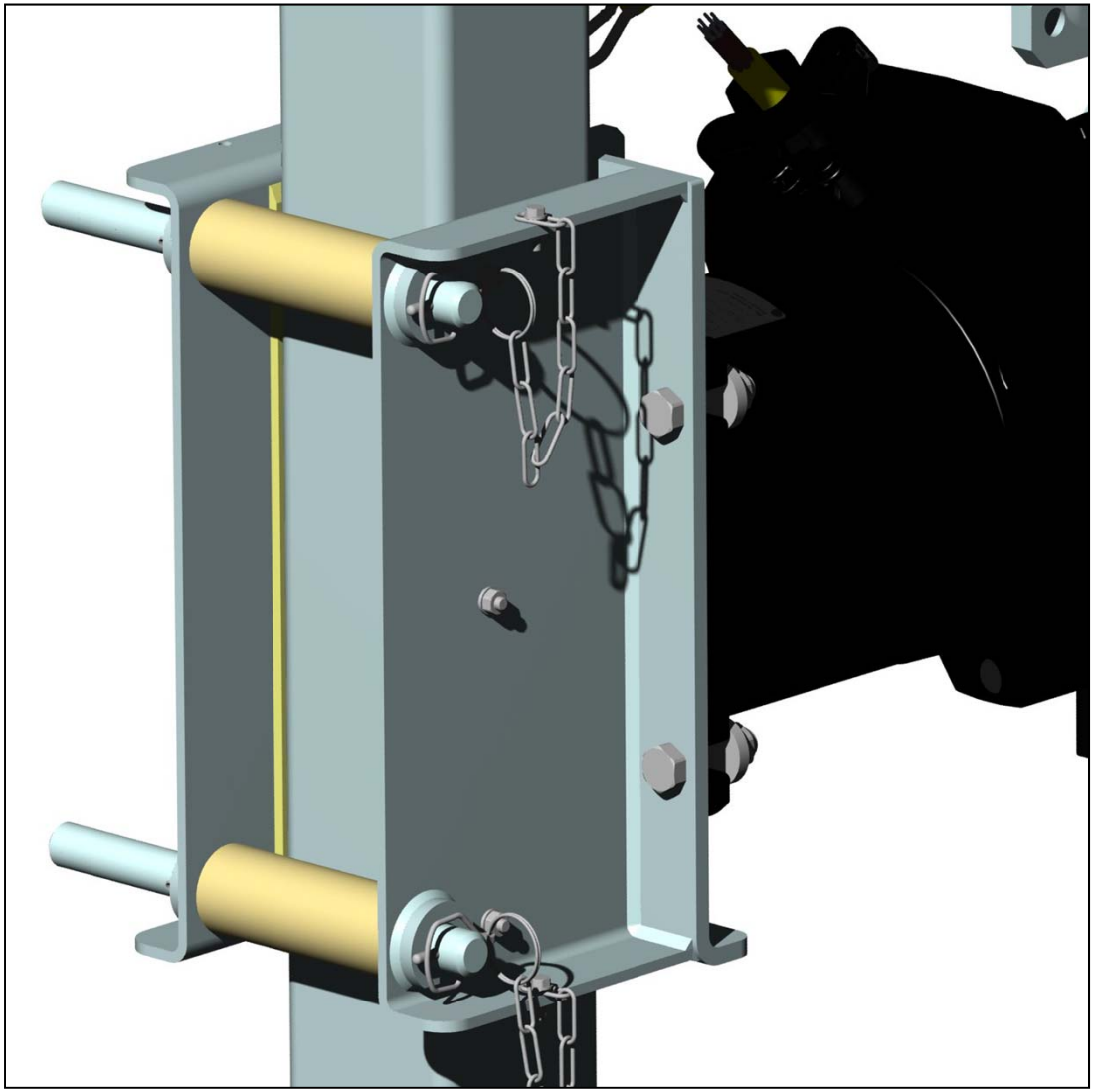
- Material 1.4571
- Simple separation of the submersible mixer from the guide pipe; free drawing without manual interferences
- Lined with a sliding coat of PA
- Roller guiding optional: continuous rolls



Matured Technology

Frames

- Continuous rolls which can be removed without tools
- For application on different lowering devices of other manufacturers
- Increased stability



Agenda

- General information
- Applications of submersible mixers
- Technical design of the submersible mixers
- ***Classification of Wilo Submersible Mixers***
- Accessories
- Wilo selection software

Sizes and Powers of Wilo Submersible Mixers (IE1)

		50 Hz		60 Hz		
Range	**Mixer Type**	**P1.1 [kW]**	**Thrust [N]**	**P1.1 [kW]**	**Thrust [N]**	**Continous operation**
Miniprop	**TR 14 ... TR 16**	**0,26 – 0,3**	**45 – 65**	**0,33 – 0,42**	**60 – 90**	**conditionally suitable**
	TR 21/TR 21S	**0,34 – 1,2**	**75 – 240**	**0,53 – 1,34**	**105 – 245**	
	TR 28	**1,3**	**330**	**1,69**	**340**	
Uniprop direct	**TR 22**	**1,3 – 2,7**	**185 – 350**	**1,4 – 2,4**	**220 – 320**	**not suitable**
	TR 36/TR 36S	**1,1 – 7,0**	**210 – 830**	**1,2 – 8,5**	**300 – 990**	
	TR 40/TR 40S	**2,25 – 5,2**	**505 – 1100**	**3,6 – 8,5**	**710– 1480**	
Uniprop gear	**TR 50-2/TR 50-2S**	**1,0 – 11,9**	**350 – 1920**	**0,4 – 12,2**	**110 – 2000**	**suitable**
	TR 60-2/TR 60-2S	**1,2 – 11,6**	**510 – 2370**	**1,5 – 12,0**	**500 – 2380**	
	TR 75-2	**3,0 – 10,8**	**1145 – 2850**	**2,95 – 14,0**	**1100 – 3320**	
	TR 90-2	**0,7 – 5,2**	**430 – 2120**	**0,9 – 4,1**	**580 – 1820**	
Uniprop gear	**TR 80-1/TR 80-1S**	**6,1 – 20,1**	**1670 – 3940**	**5,9 – 25,2**	**1650 – 4560**	**cond. suitable**
Maxiprop	**TR 216**	**0,63 – 4,37**	**270 – 2460**	**0,7 – 4,45**	**460 – 2600**	**suitable**
	TR 221	**0,8 – 4,8**	**640 – 3350**	**0,8 – 5,5**	**650 – 3600**	
	TR 226	**0,68 – 4,9**	**800 – 4370**	**1,3 – 4,6**	**1550 – 4250**	
Megaprop	**TR 316**	**1,33 – 6,32**	**450 – 2450**	**1,3 – 6,2**	**1050 – 3400**	**suitable**
	TR 321	**0,8 – 4,9**	**720 – 3420**	**0,8 – 5,3**	**2700 – 3500**	
	TR 326	**1,1 – 6,41**	**1390 - 5270**	**2,3 – 4,9**	**2550 – 4400**	

Sizes and Powers of Wilo Submersible Mixers with IE3 Motors

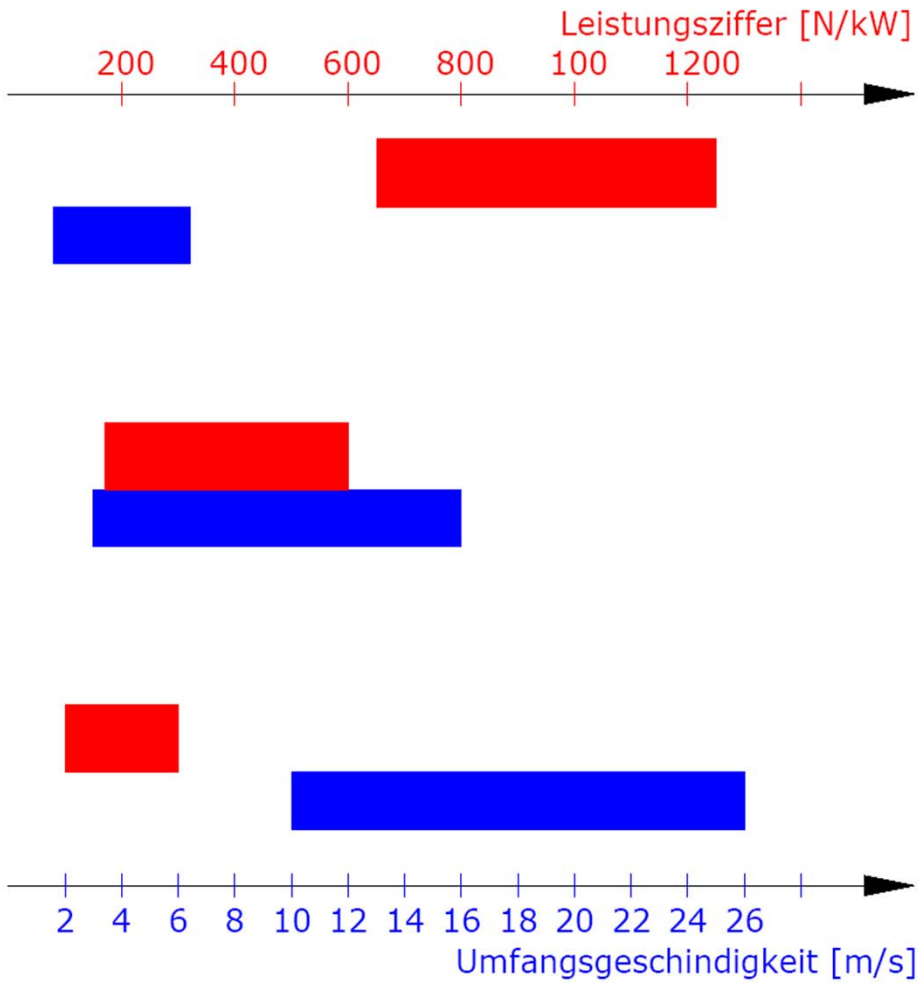
		50 Hz		
Range	Mixer Type	P1.1 [kW]	Thrust [N]	Continous operation
Uniprop gear	TRE 90	2,8 – 4,4	1500 - 2000	suitable
Maxiprop	TRE 221	1,8 – 3,8	1650 – 2880	suitable
Megaprop	TRE 321	1,8 – 4,4	1600 – 3400	suitable

Classification of the Submersible Mixers

Slow speed
submersible mixers
< 100 min^{-1}

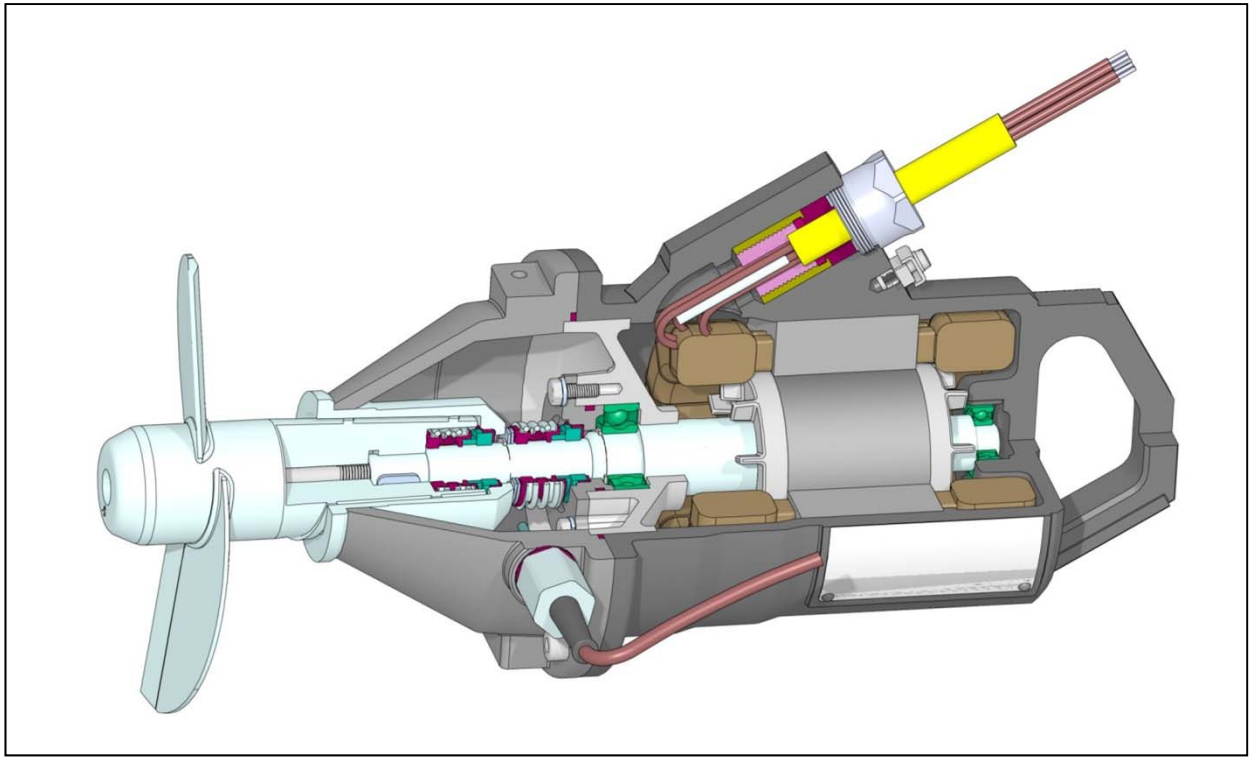
Medium speed
submersible mixers
100 – 600 min^{-1}

High speed
submersible mixers
> 700 min^{-1}



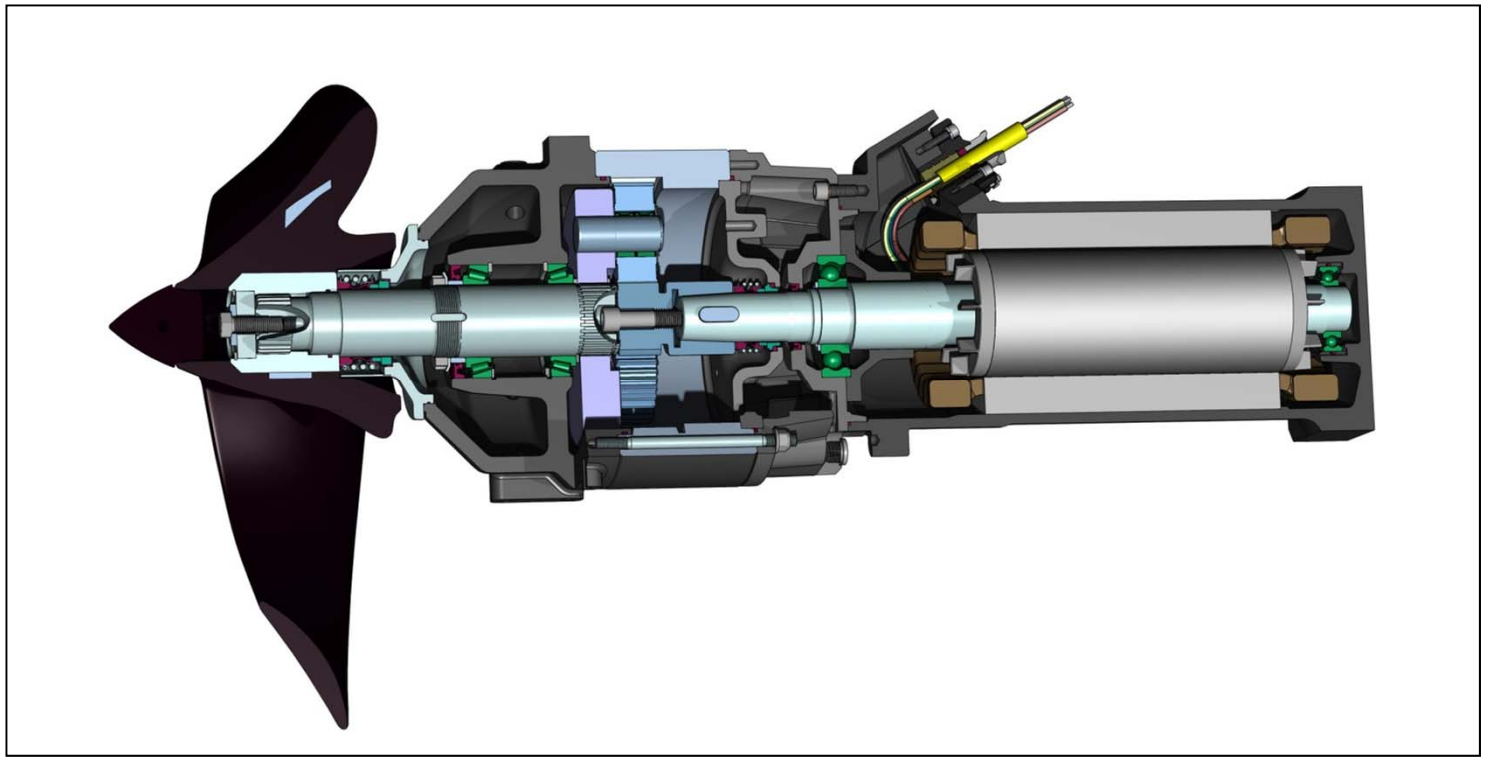
High Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
0,14 – 0,4	700- 1405	828 - 1680



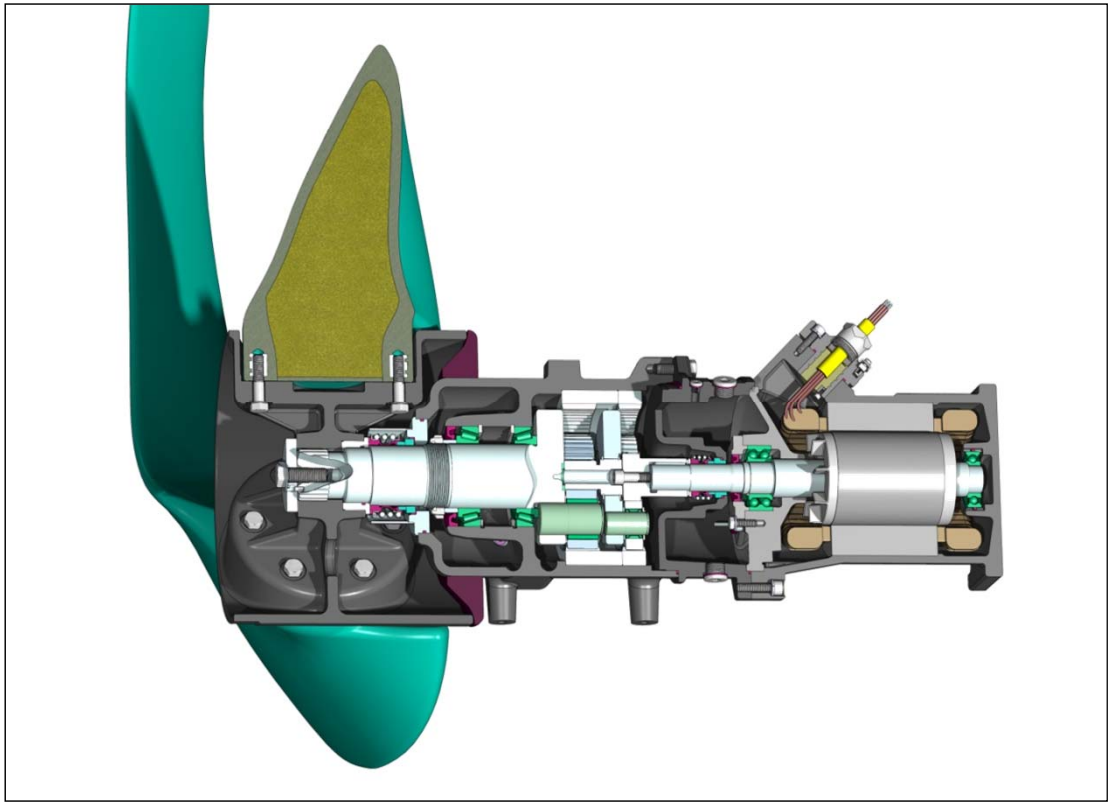
Medium Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
0,5 – 0,9	98 - 594	133 - 570



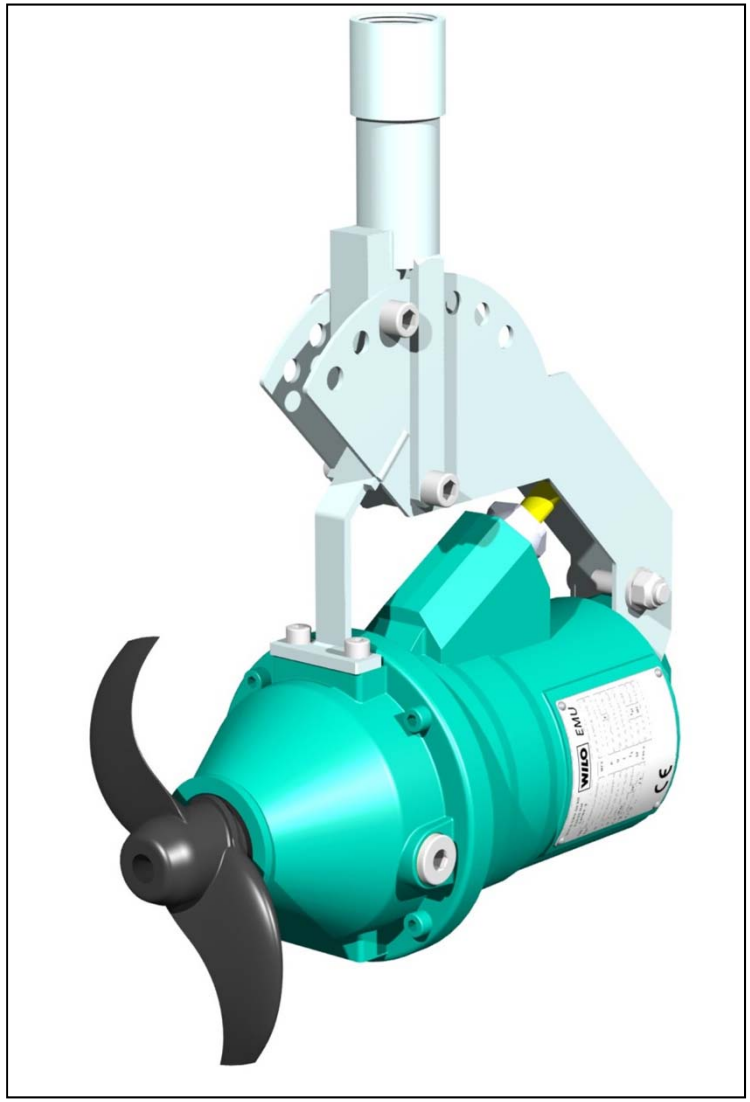
Slow Speed Mixers

Propeller diameter [m]	Propeller speed [min^{-1}] 50 Hz	Propeller speed [min^{-1}] 60 Hz
1,5 – 2,6	13 - 59	20 - 58

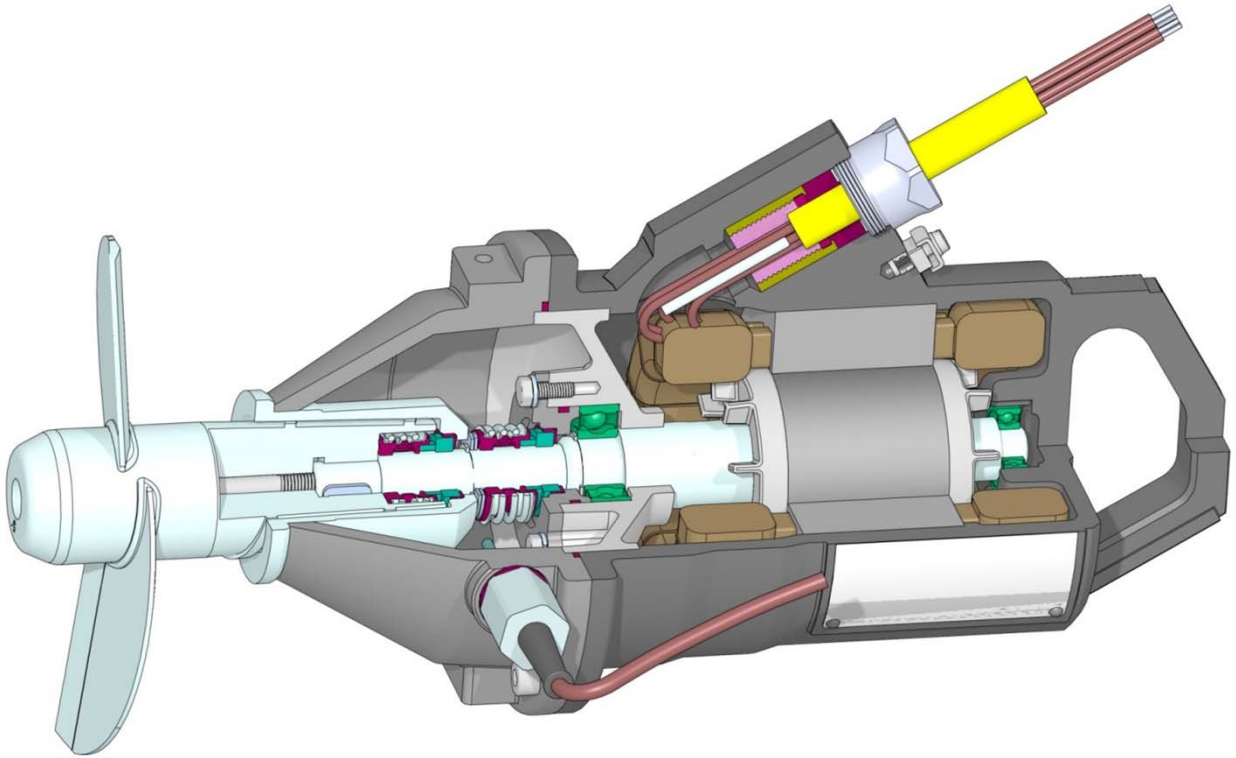


Wilo-EMU Miniprop
High Speed Submersible Mixers

- Miniprop submersible mixers are mainly suitable to clean storm water retaining basins, to whirl up deposits in pumping stations, to destroy floating sludge layers and to homogenize the tank content in sewage treatment plants and in small reaction tanks.
- Due to the optimum blade profile of the resistant PUR-propeller (optional: stainless steel propeller) the mixer guarantees a high efficiency during application.



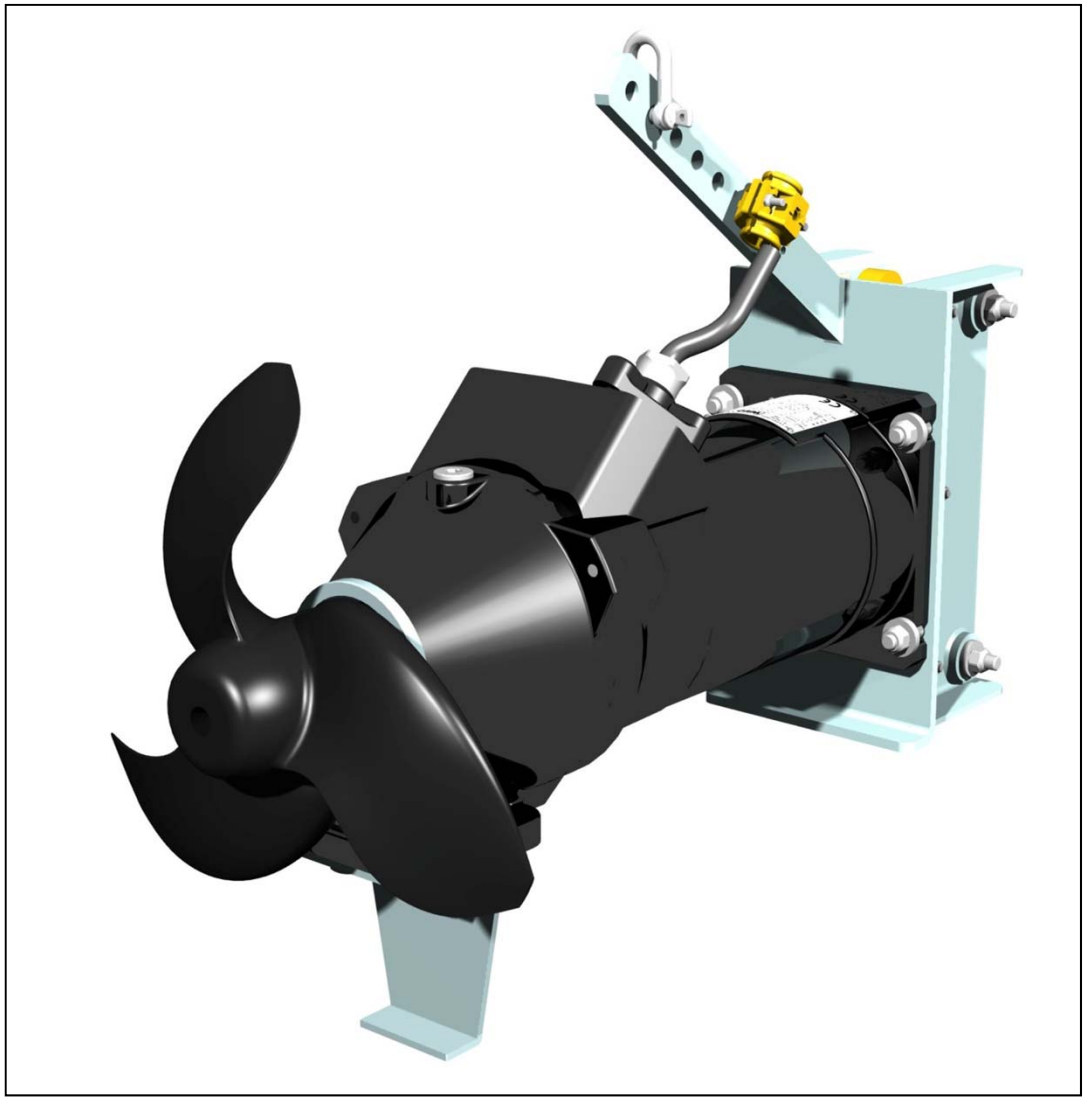
Wilo-EMU Miniprop Submersible Mixers (High Speed)



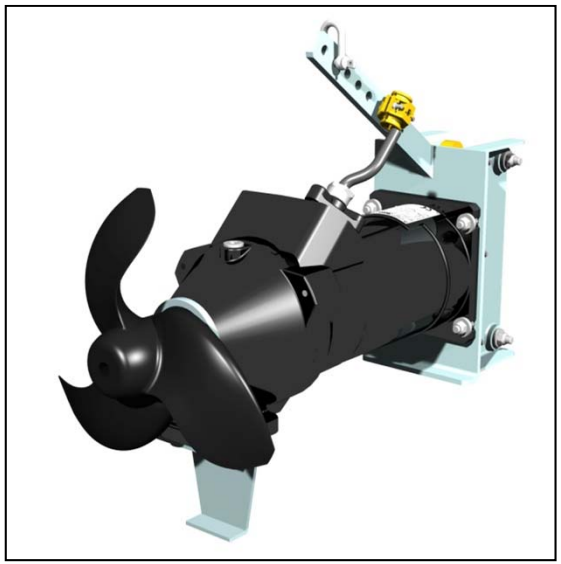
Wilo-EMU Uniprop Submersible Mixers (direct-driven) (High Speed)

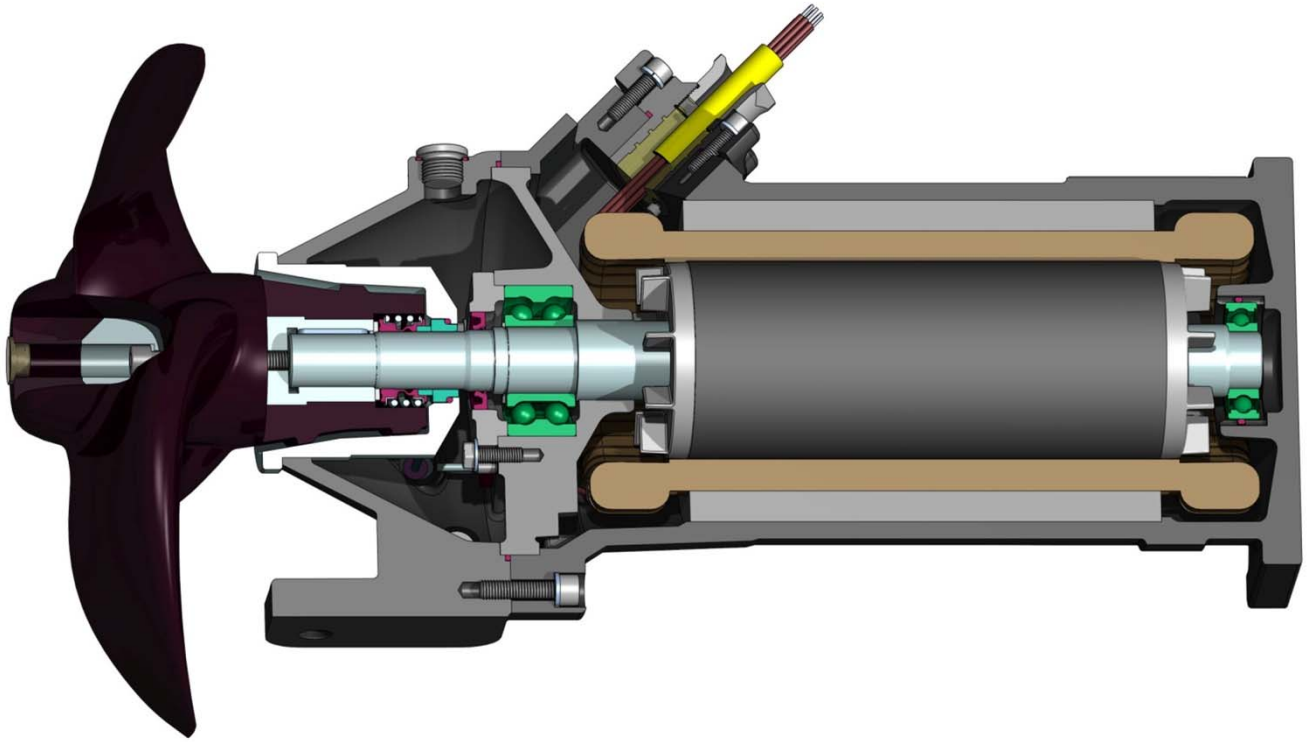
With this new design a series of modern, direct-driven mixers with optimized power has been created for the use in sludge tanks, storm water retention tanks and liquid manure tanks.

Propellers with high efficiency, very good resistance against abrasion and high operational safety due to insensibility against clogging are used.



Wilo-EMU Uniprop Submersible Mixers (direct-driven) (TR 22, 36, 40)

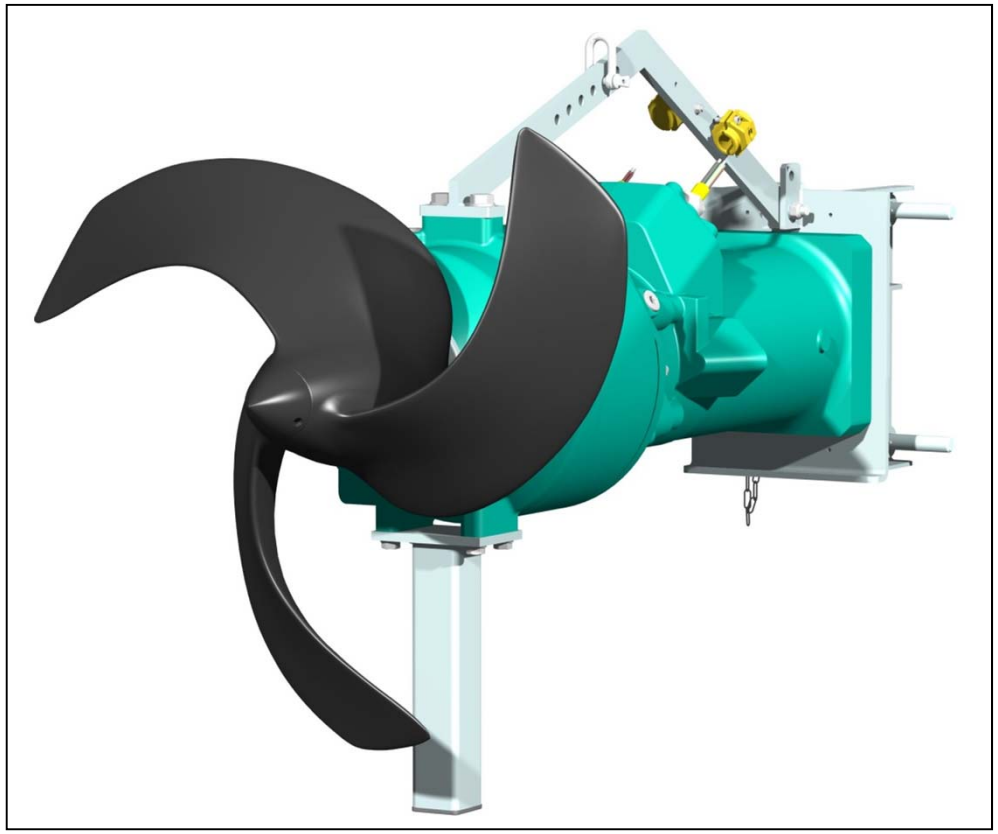




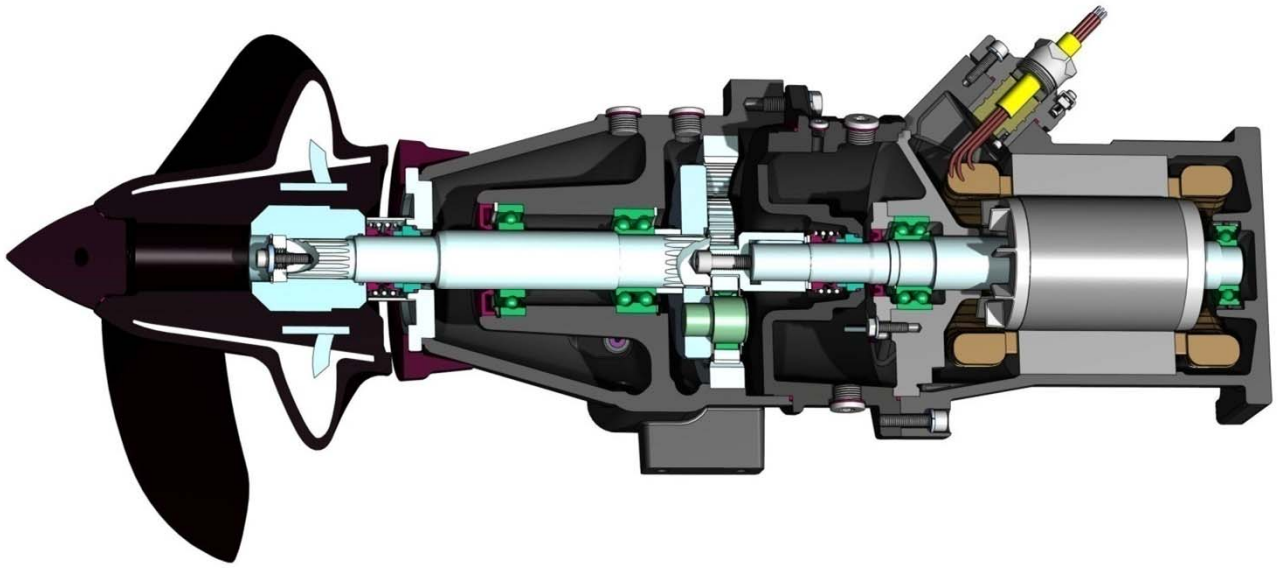
Wilo-EMU Uniprop Submersible Mixers (1-stage planetary gear) Medium Speed

- With this new design a series of modern mixers with optimized power and 1-stage planetary gear has been created for the use in sludge tanks, storm water retention tanks and liquid manure tanks.

- Propellers with high efficiency, very good resistance against abrasion and high operational safety due to insensibility against clogging are used.



Wilo-EMU Uniprop Submersible Mixers
1-stage planetary gear (TR 50-2, 60-2, 75-2, 80-1, 90-2)



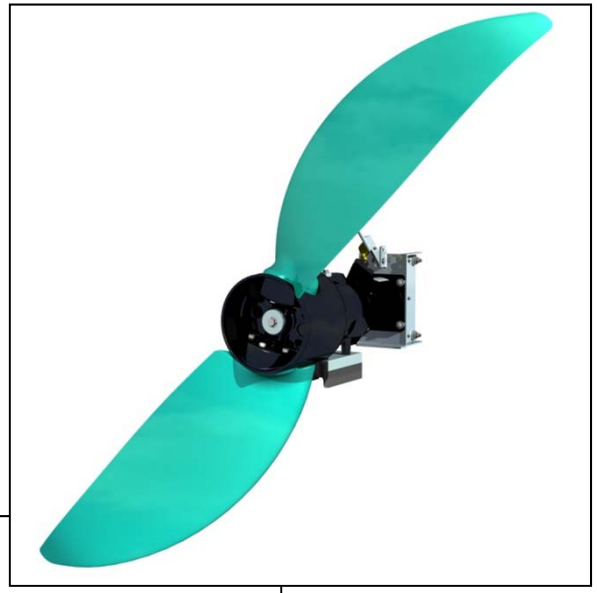
Wilo-EMU Maxiprop and Megaprop
High-efficiency slow speed mixers

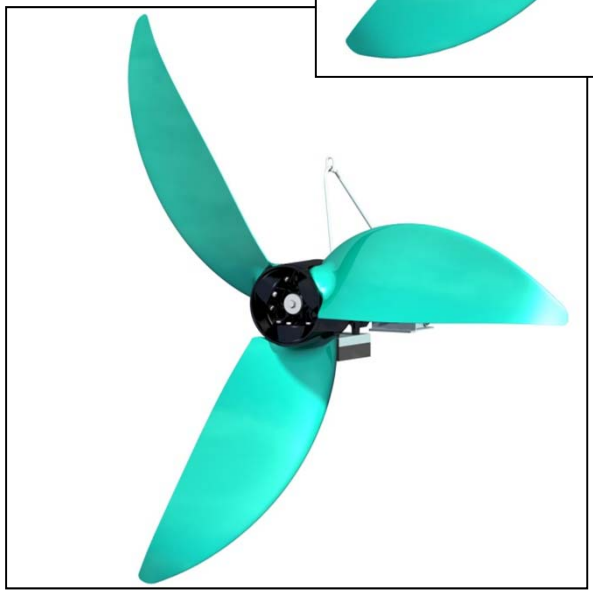
Wilo offers two different slow speed mixers:

- Maxiprop with 2-blade propeller
- Megaprop with 3-blade propeller

„Slow speed mixers“ are designed to guarantee a homogenous suspension of the activated sludge in sewage treatment plants with an energy input as small as possible.

In case of the 3-blade propeller there are less torque changes with same thrust. This assures a smooth operation even in case of unfavourable inflow conditions.



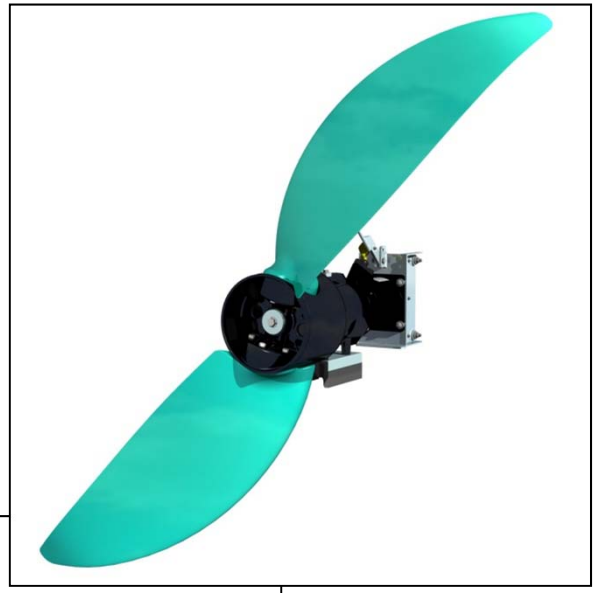


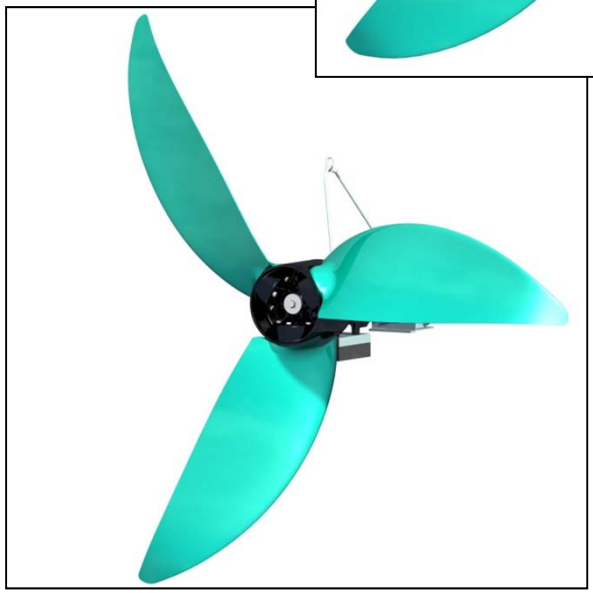
Wilo-EMU Maxiprop and Megaprop
High-efficiency slow speed mixers

- Energy-optimized design for continuous operation
- Best thrust-power factor as per ISO 21630
- Low wear even after continuous operation of many years

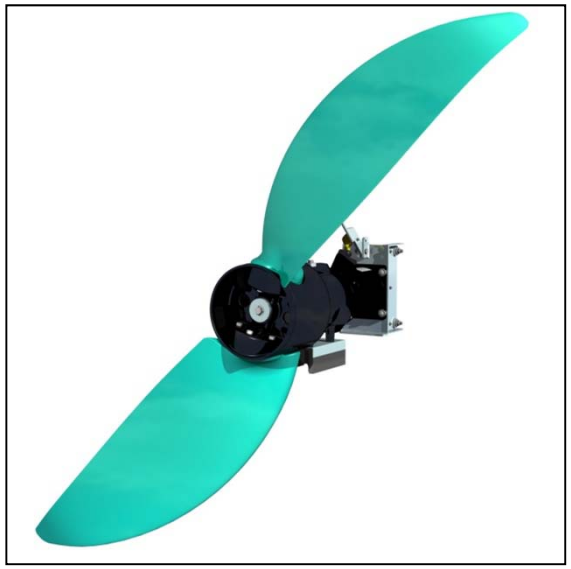
⇒ Low LCC

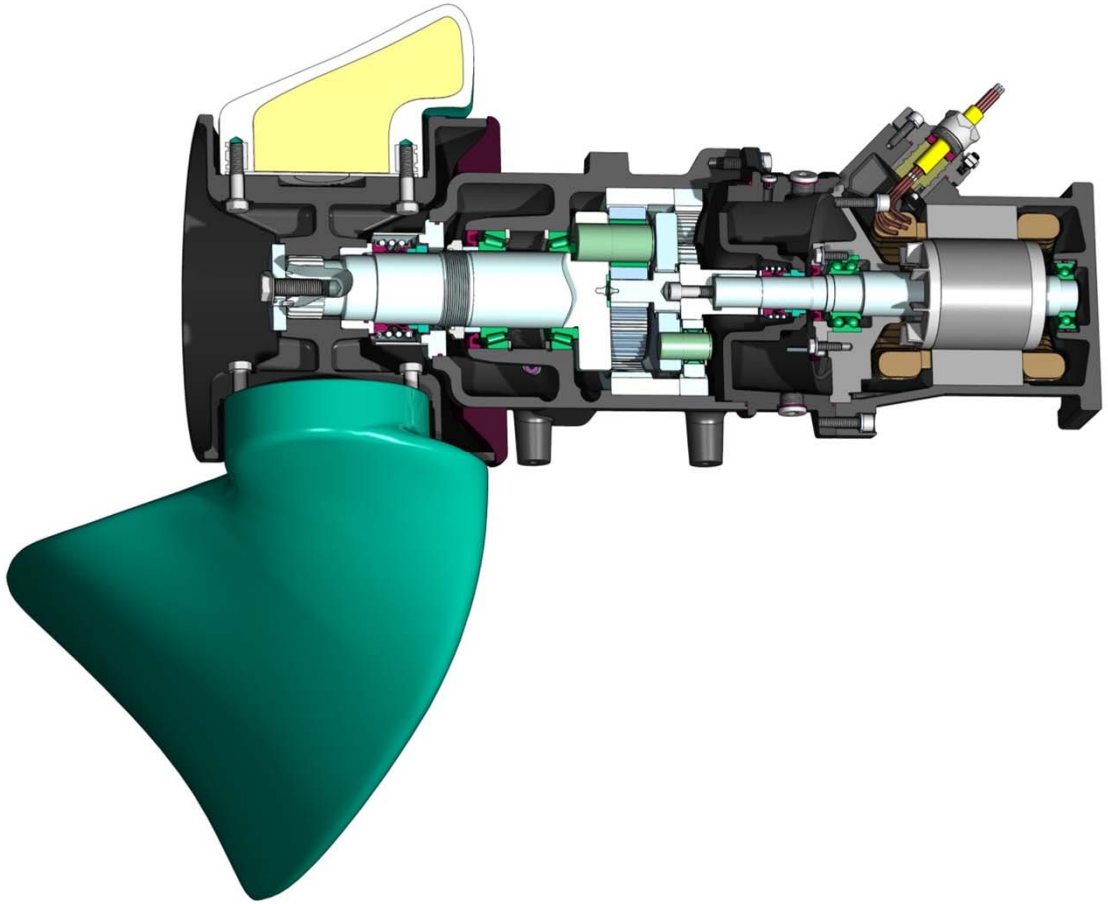
⇒ Short amortisation period



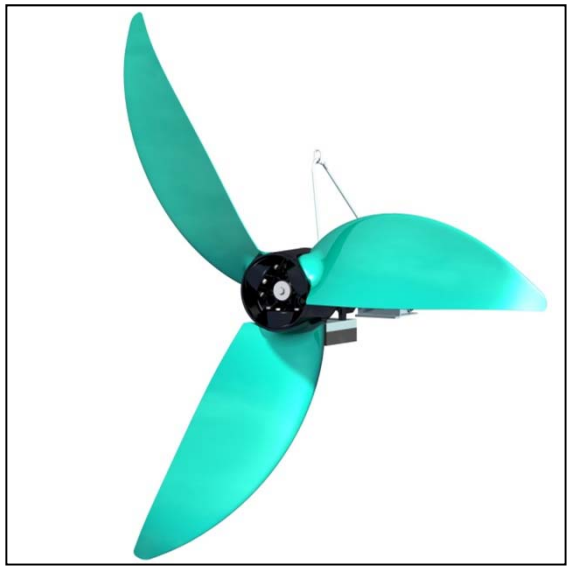


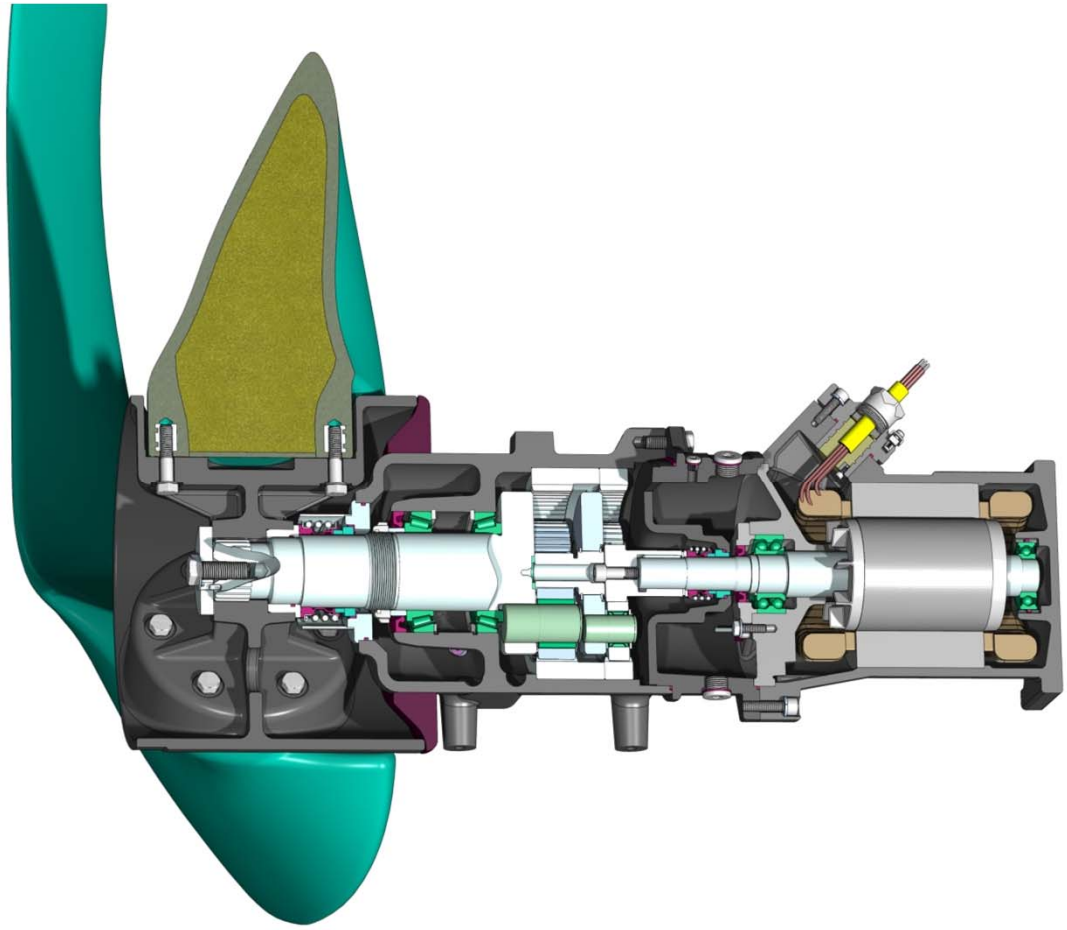
Wilo-EMU Maxiprop Submersible Mixers (up to 2.6 m propeller diameter) 2-blade





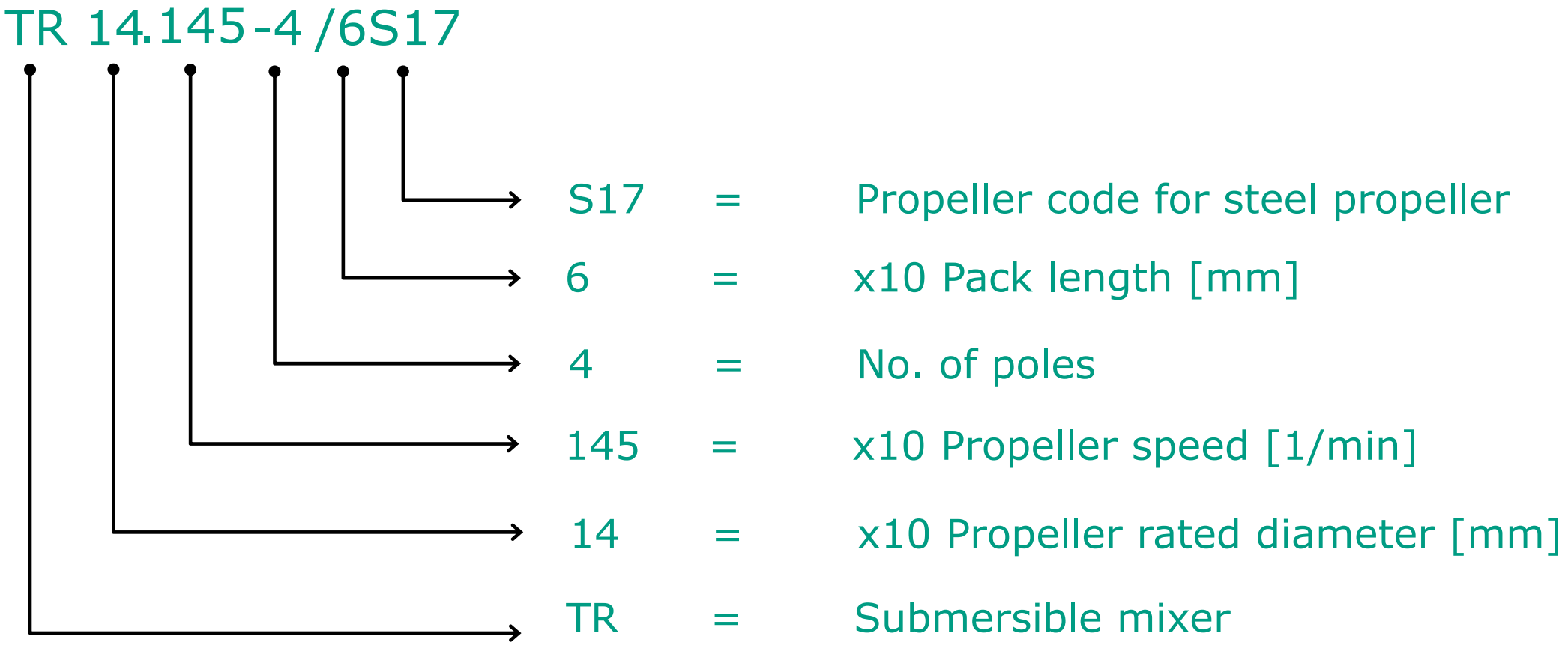
Wilo-EMU Megaprop Submersible Mixers (up to 2.6 m propeller diameter) 3-blade





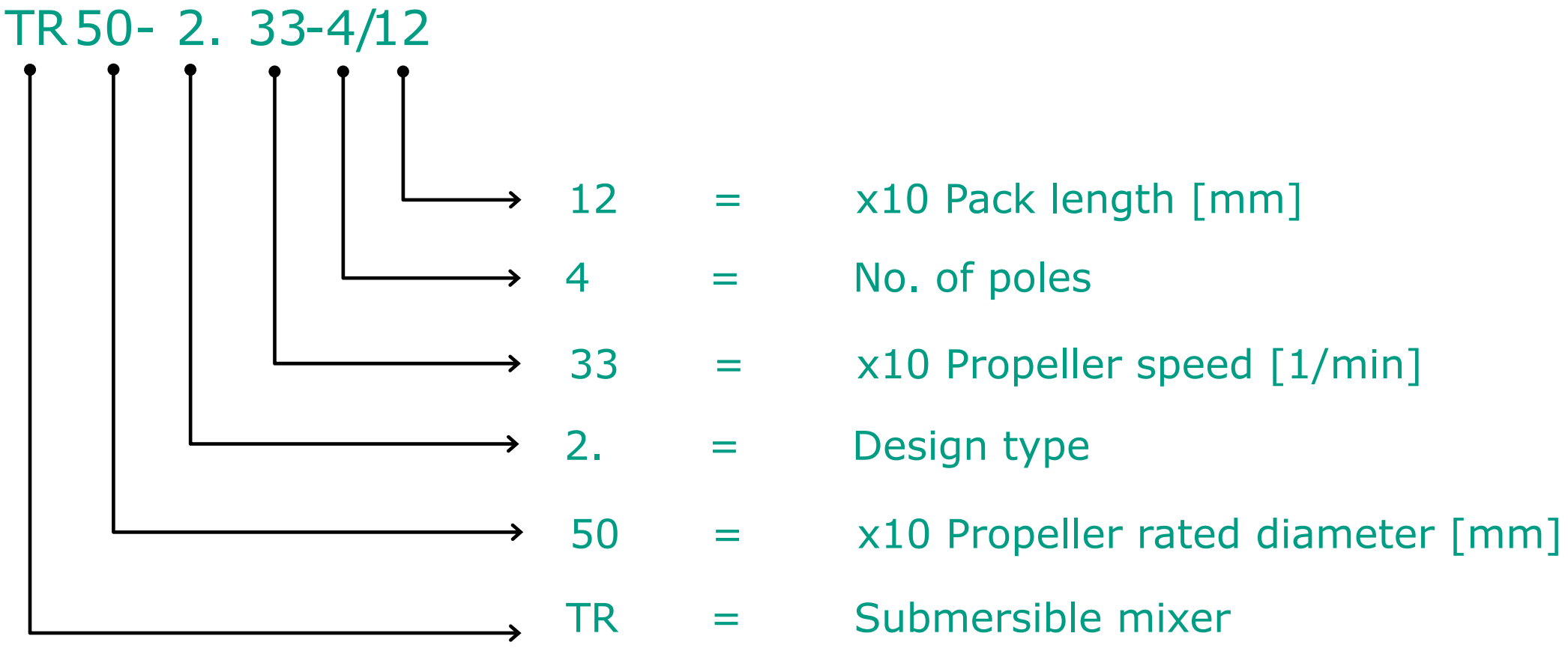
Presentation of the Submersible Mixer Nomenclature

Submersible Mixer TR 14.145-4/6 S17



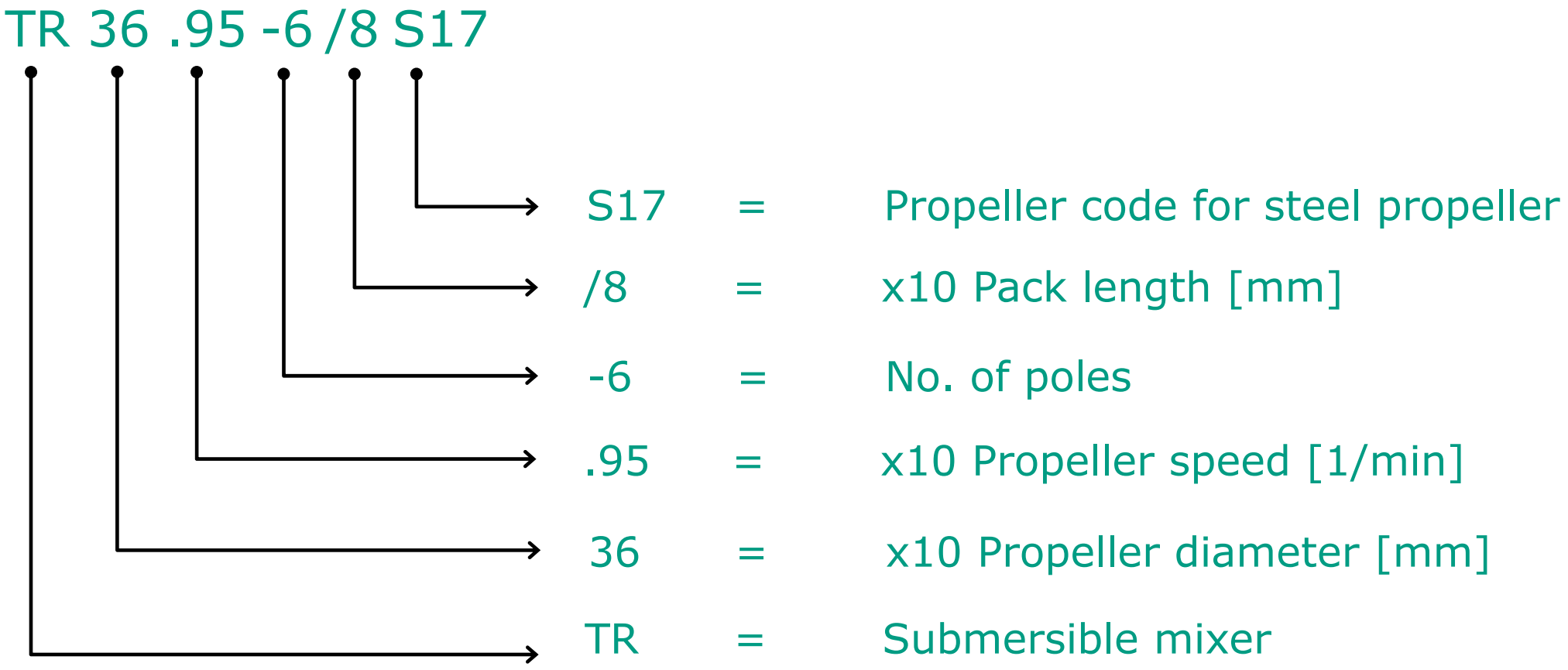
Presentation of the Submersible Mixer Nomenclature

Submersible Mixer TR 50-2.33-4/12



Presentation of the Submersible Mixer Nomenclature

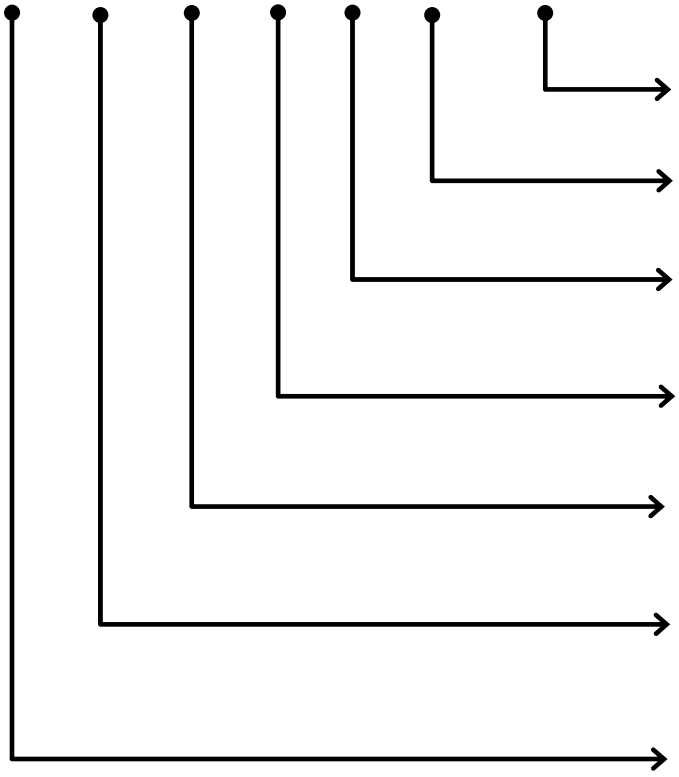
Submersible Mixer TR 36.95-6/8 S17



Presentation of the Submersible Mixer Nomenclature

Submersible mixer TR 80-1.30-4/30 S20

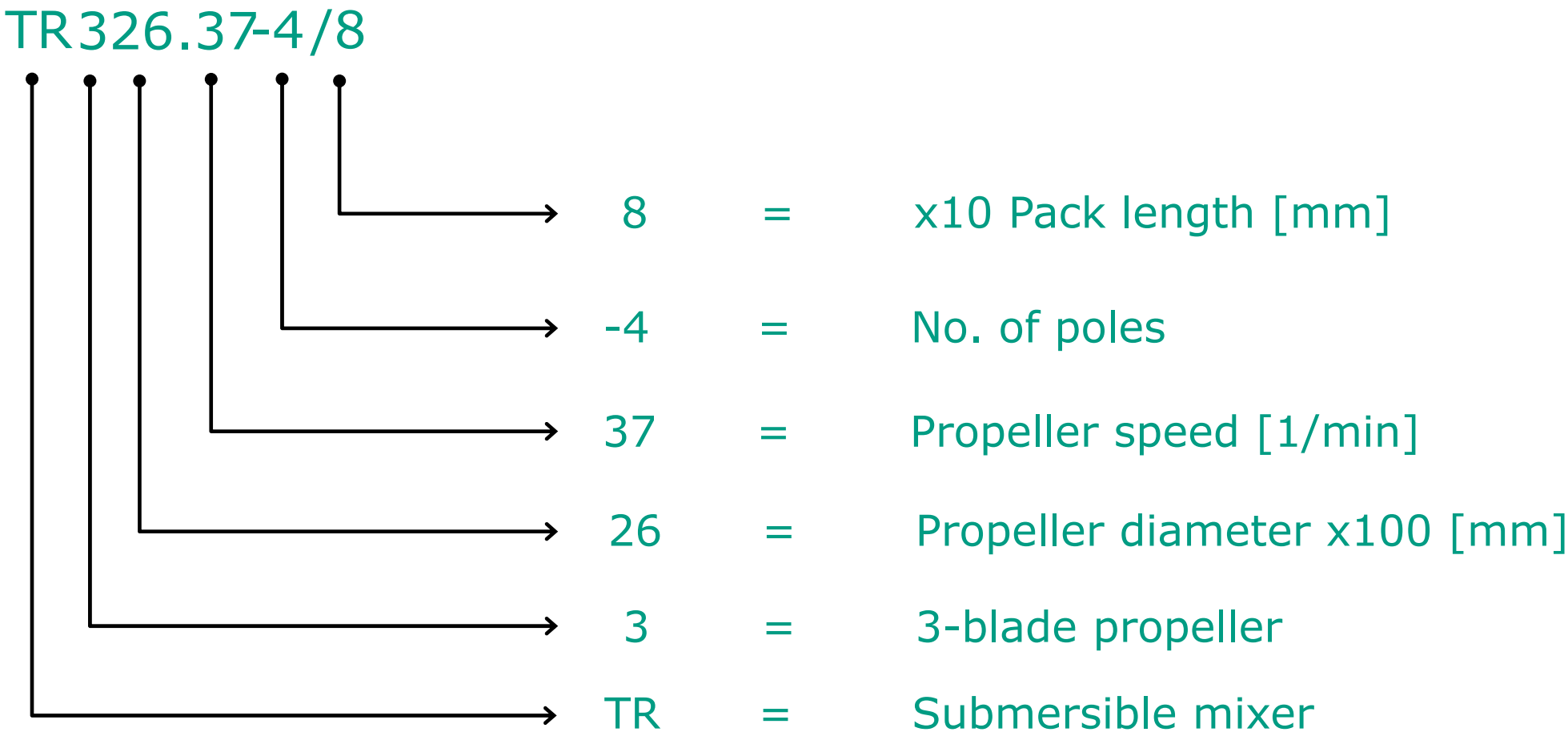
TR 80-1.30-4/30 S20



S20	=	Propeller code for steel propeller
30	=	x10 Pack length [mm]
-4	=	No. of poles
.30	=	x10 Propeller speed [1/min]
-1	=	Design type
80	=	x10 Propeller diameter [mm]
TR	=	Submersible mixer

Presentation of the Submersible Mixer Nomenclature

Submersible mixer TR 326.37-4/8



Proper Names

Submersible mixers:

Miniprop = Small high speed submersible mixer

Uniprop = High speed /medium speed submersible mixer
1 planetary gear

Maxiprop = Slow speed submersible mixer, 2-blades

Megaprop= Slow speed submersible mixer, 3-blades

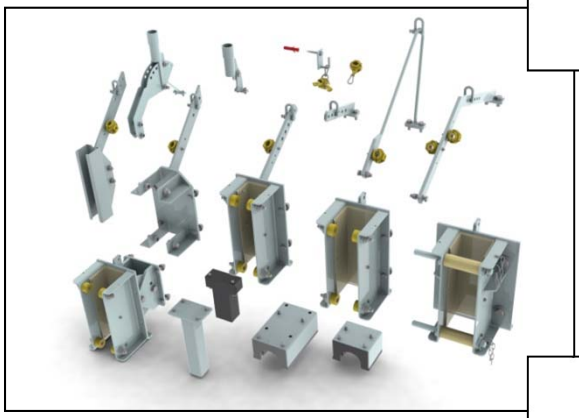
Agenda

- General information
- Applications of submersible mixers
- Technical design of the submersible mixers
- Classification of Wilo Submersible Mixers
- ***Accessories***
- Wilo selection software

Wilo Accessories

A wide range of suitable accessories belongs to the Wilo Submersible Mixers.

- Lowering devices
- Auxiliary lifting devices
- More installation material



Survey

Example

Selection aids are also available as dxf- and dwg-files!

Accessory Components Submersible Mixers

Lowering devices

Whether swivelling or stationary support, available in the qualities V2A (AISI 304), V4A (AISI 316)

The Wilo product range includes lowering devices for each application.

Due to our flexible in-house production at the location Hof we are able to meet also special customer requests.

Accessory Components Submersible Mixers

Auxiliary lifting devices

Different reaches in the qualities steel galvanized, V2A (AISI 304),V4A (AISI 316)

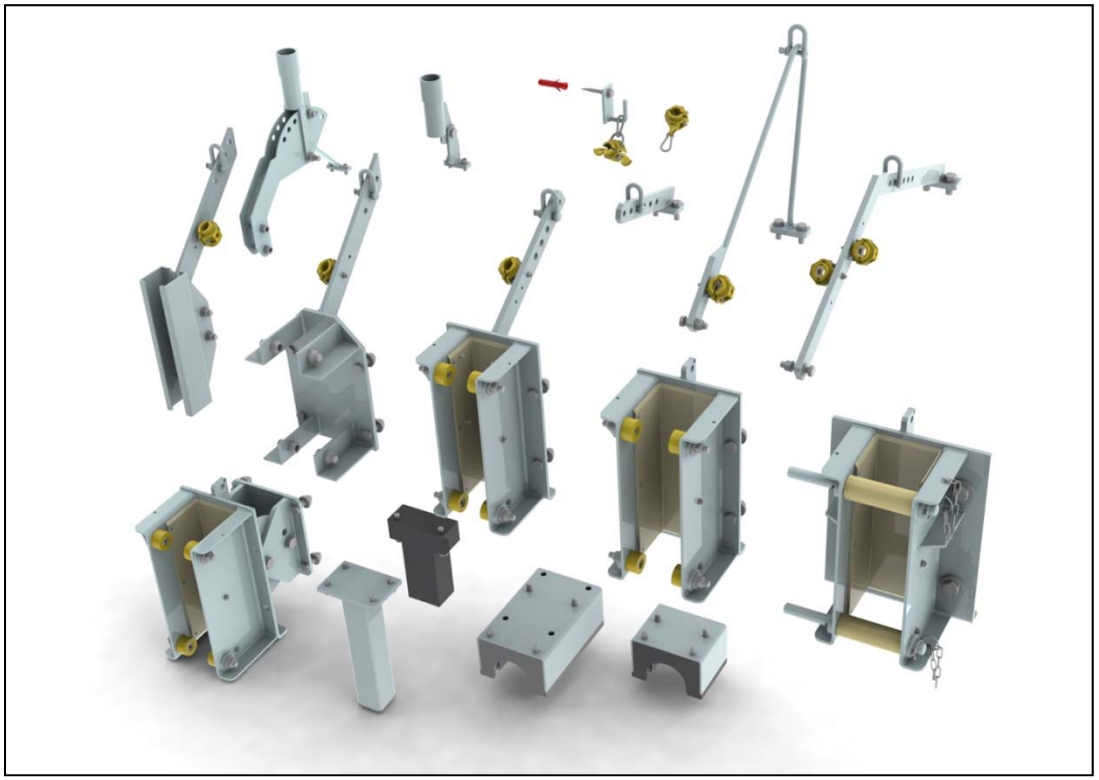
LGA-certified, exactly adapted to the Wilo submersible mixers regarding reach and load capacity.

Accessory Components Submersible Mixers

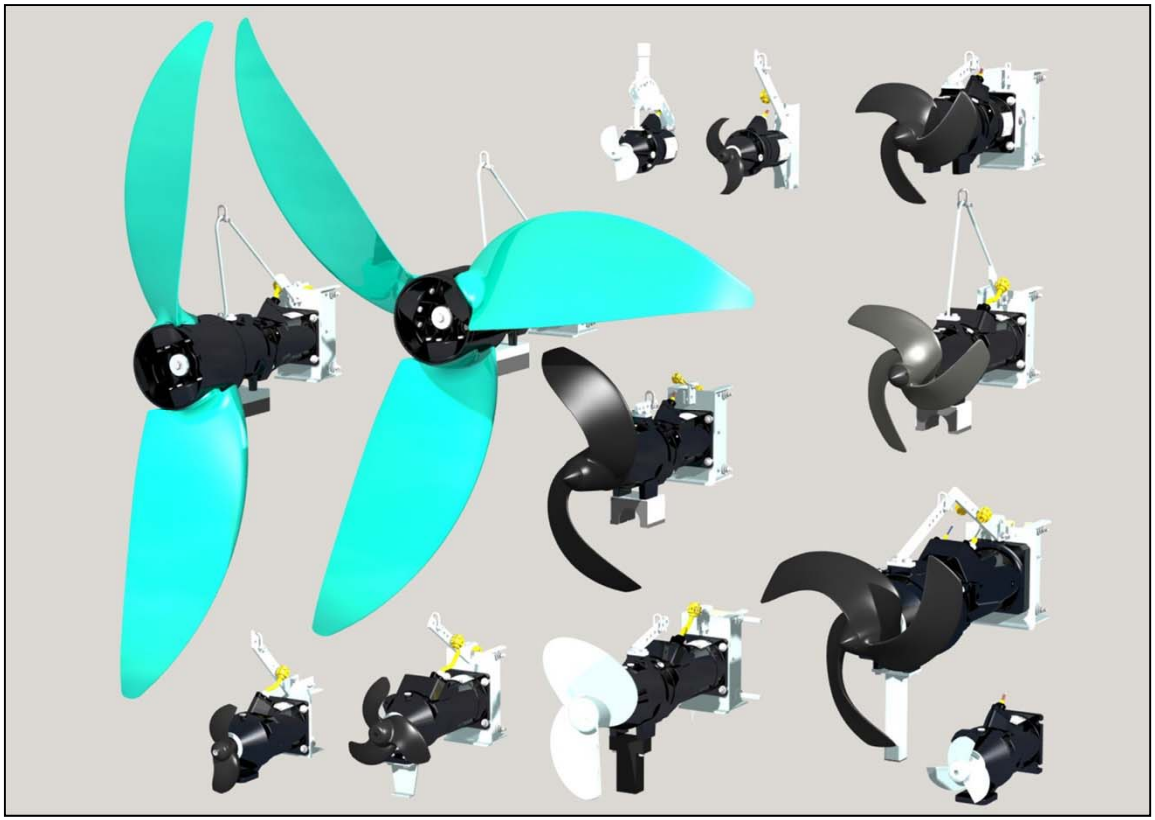
More accessories

From guide pipe over frame up to rubber buffers and supports – adaptation to the different applications without any problems.

Welded parts made of A4 (AISI 316) in standard design.



WWTP Heilbronn - profitability analysis



Data

- 8 activated sludge basins
  66m · 13,5m · 7,5m water level = 8400m³
- 4 mixers each = 32 mixers
- yearly running period of the mixers: 365 days
- energy price: 0,12 €/kWh

Activated sludge basin

Installation of WILO EMU mixers

- Currently there are
  - > **24** WILO EMU mixers and
  - > **8** Competitor mixers in use

Profitability

- electric work **per** mixer
  - > Competitor mixer (2 wings): 3,21 kWh
  - > WILO EMU mixer (3 wings): 2,50 kWh

Δ 22,1%

- electric work of **24** mixers
  - >24 Competitor mixers / year:

    24 · 3,21 kWh · 24 · 365 = <u>674.870,40 kWh</u>
  - >24 WILO EMU mixers / year:

    24 · 2,50 kWh · 24 · 365 = <u>525.600 kWh</u>

Δ 149.270,40 kWh

Profitability

- Economization in € per year

  > 24 WILO EMU mixers instead of 24 competitor mixers

  (Δ) 149.270,40 kWh/a · 0,12 €/kWh = 17.912,45 €/a

>Complete equipment with WILO EMU mixers

WILO EMU: 32 TRW · 2,50 kWh · 24 · 365 = 700.800,00 kWh/a

ABS: 32 TRW · 3,21 kWh · 24 · 365 = 899.827,20 kWh/a

Δ 199.027,20 kWh/a

Energy economization with 32 WILO EMU mixers =23.883,27 €/a

Specific power density

Formula:

$$P_{1.1\ ges.} / V_{basin}$$

WILO EMU in one basin
4 · 2500 W / 8400m³ = 1,19 W/m³

Competritor in one basin
4 · 3215 W / 8400m³ = 1,53 W/m³

Δ 22,2%

= Economization of 0,34 W/m³

Agenda

- General information
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- Technical design of the submersible mixers
- Classification of Wilo Submersible Mixers
- Accessories
- ***Wilo selection software***

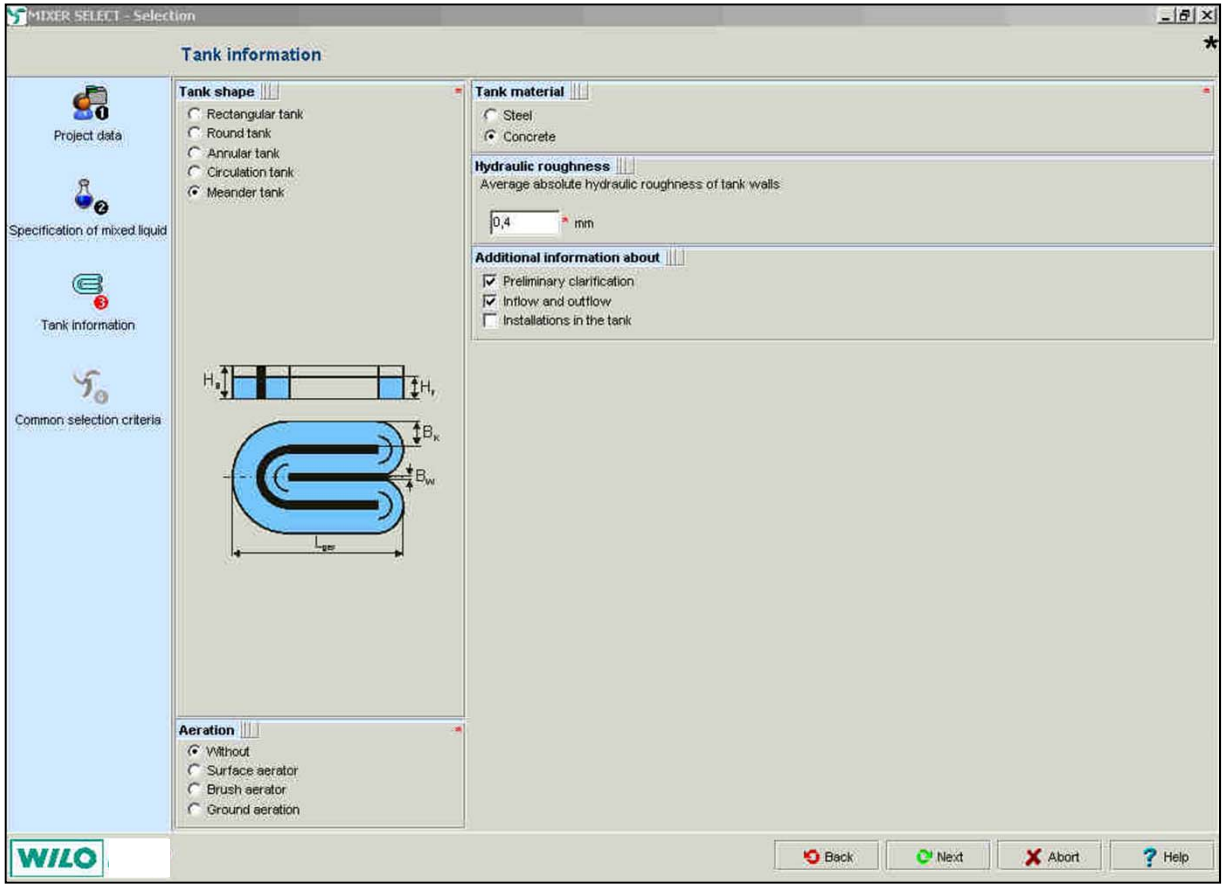
Possibilities to Save Cost by the Selection Software for Submersible Mixers

By means of a selection program based on the latest aspects of flow-technology it is possible for us to find the optimum mixer for the various tank shapes.

The optimum Submersible Mixer shows the minimum energy consumption for the required mixing duty – complete mixing or homogeneous suspension of flow velocity.

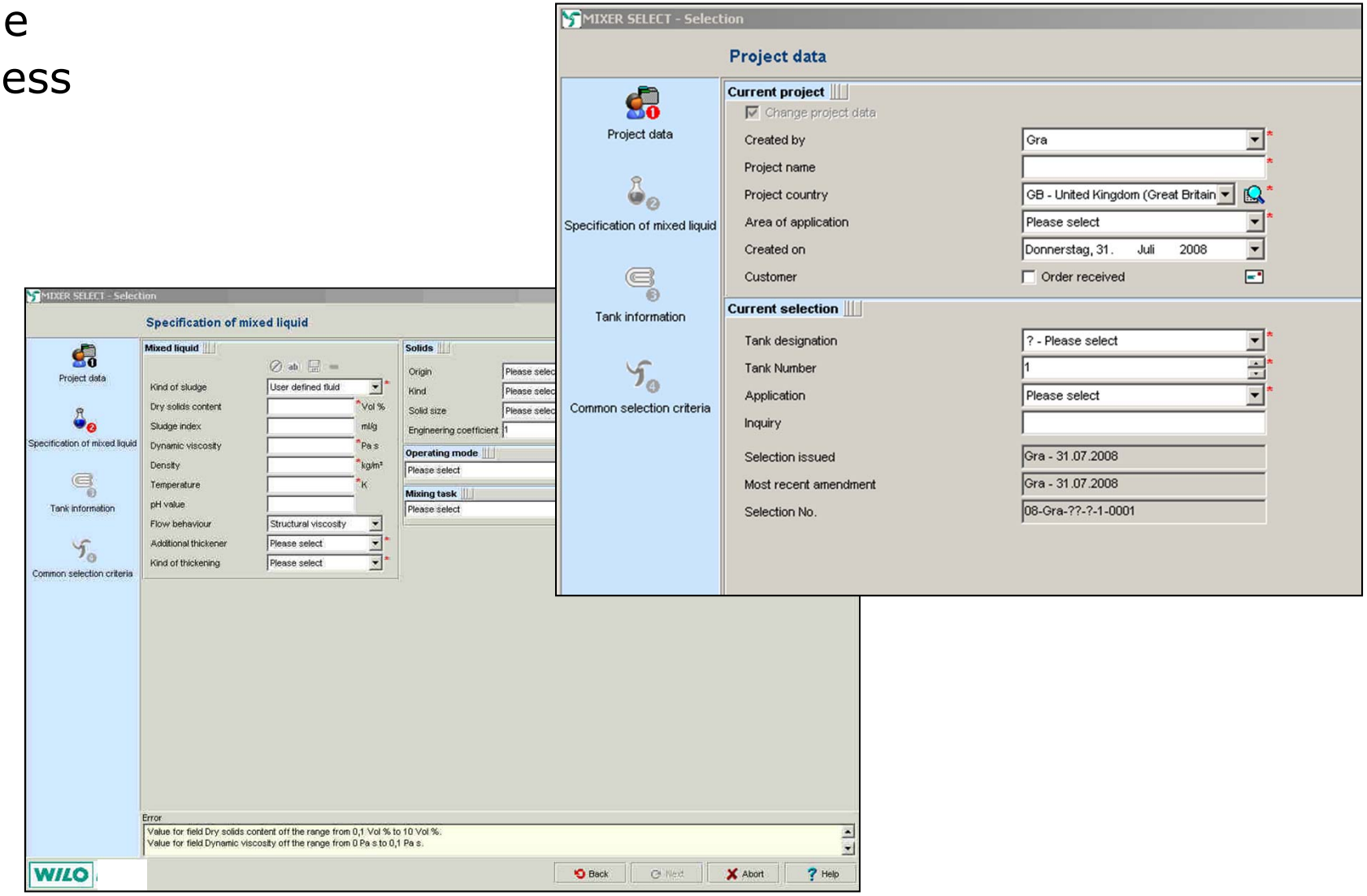
Mixer Selection Software

Example of the selection process

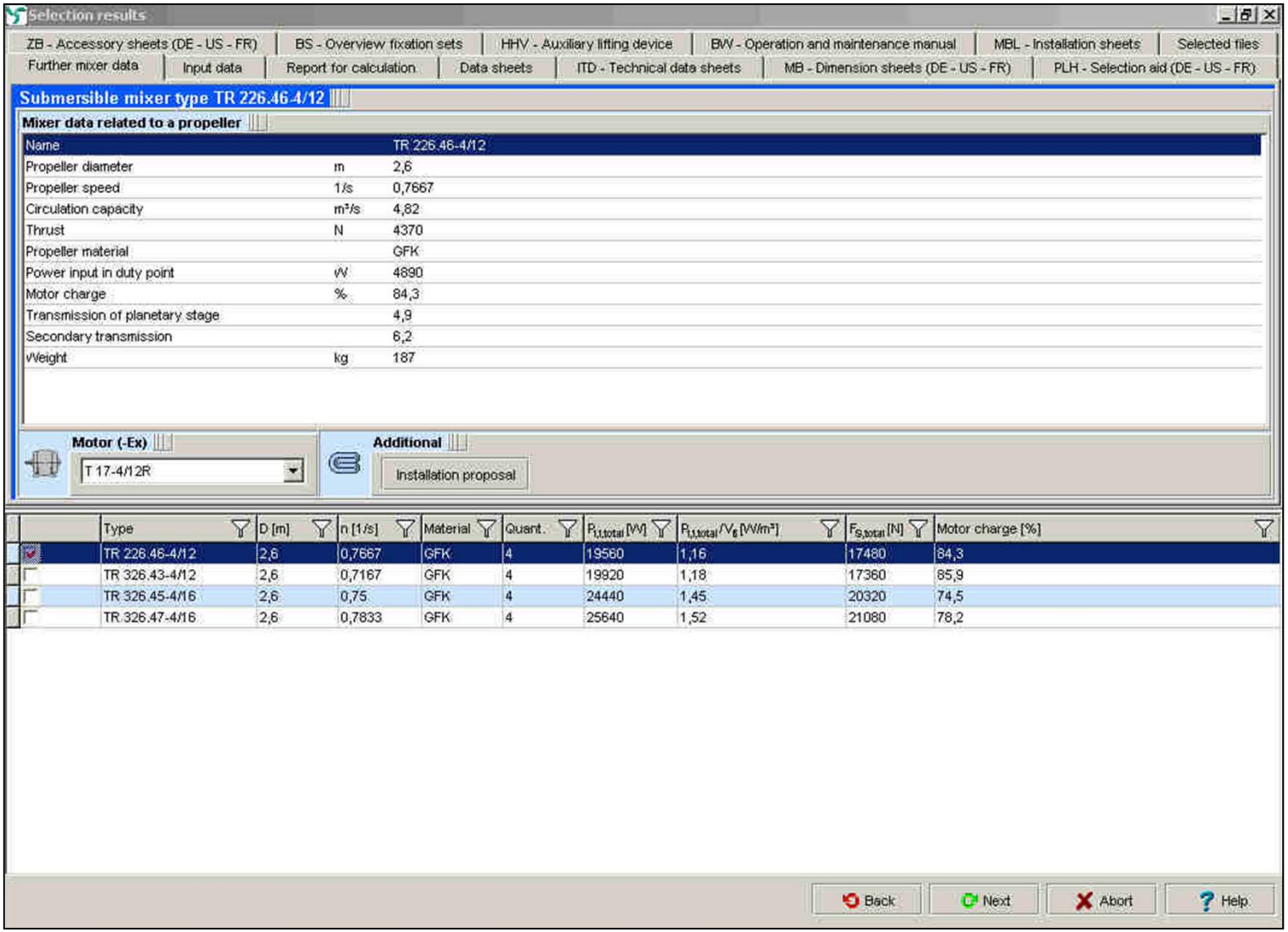


Mixer Selection Software

Example of the selection process



Mixer Selection Software



Mixer Selection Software

Einbauvorschlag

ID	08-Gra-DE-BB-1-0001
Projektland	Deutschland
Projektname	Rührwerksvortrag
Position	1 Belebungsbecken
Datum	30.09.2008
Rührwerk	TR 226.20-8/8
Anfrage	

WILO
Pumpen Intelligenz

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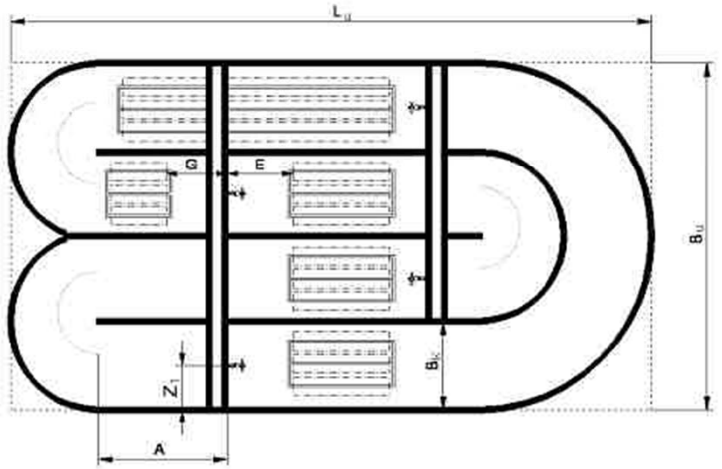


n *	4	
Lu	60	m
BK	5	m
G *	7	m
NI *	4	

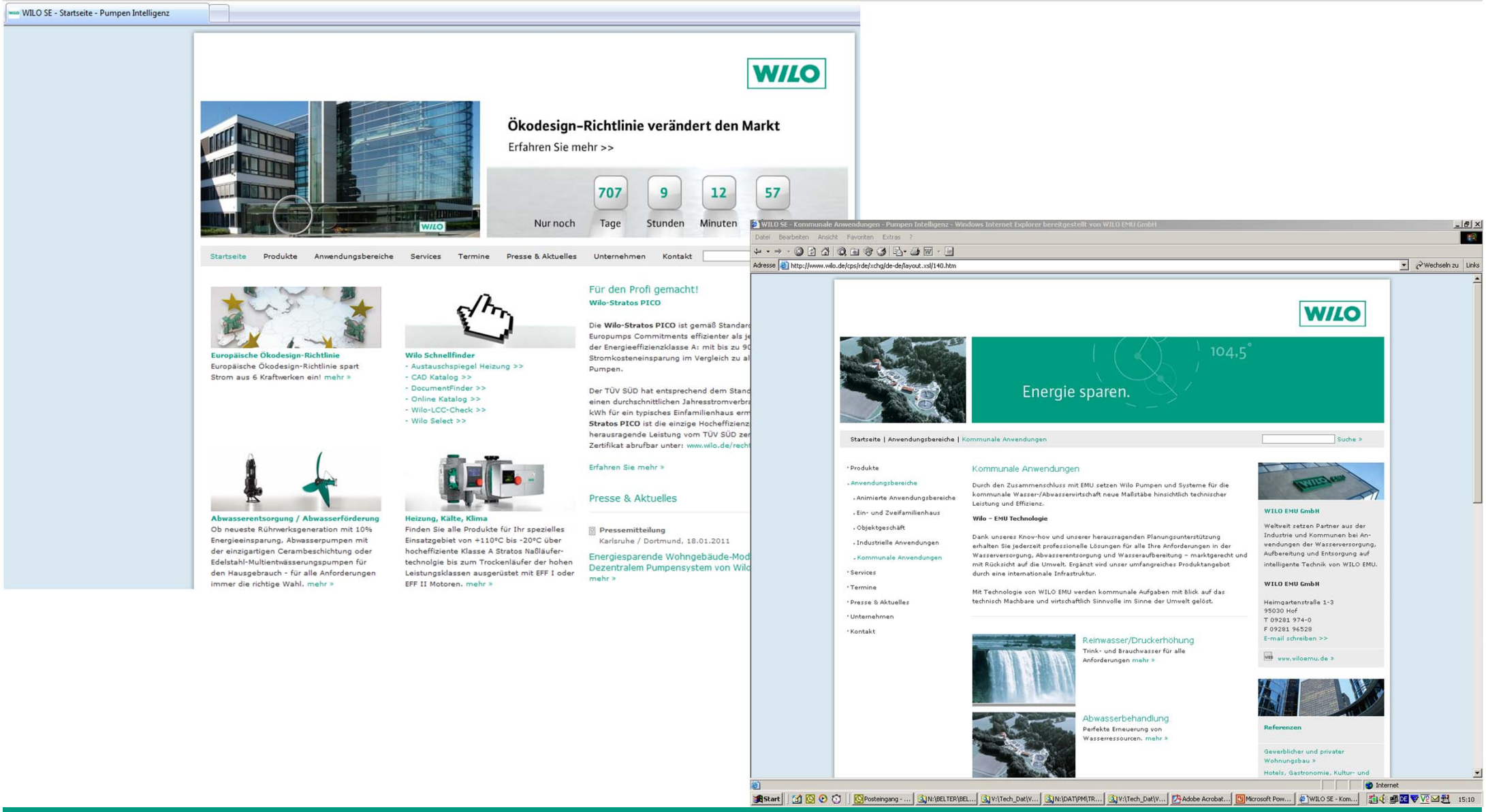
A	8	m
Bu	20,9	m
E *	8	m
Z1	2,5	m

Bei Umlauf- und Mäanderbecken entspricht der hydraulische Querschnitt in der Umlenkung dem Kanalquerschnitt.

Mixer Selection Software

- Selection of the mixers
- Compilation of the installation suggestions
- Comparison of energy costs
- Creation of the mixer data sheet
- Subsequent evaluations are possible in the project data base

Visit us on our new Website www.wilo.com



Discussion

I thank you very much

for your attention.

If you have further questions,

please do not hesitate

to contact me!