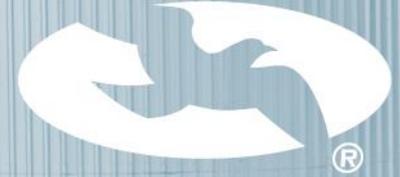


from **waste**
to **value**



Introduction to AD-Engineering - Plant components I

R. Waltenberger, R. Kirchmayr



BDI BioDiesel

BDI BioGas

BDI RetroFit

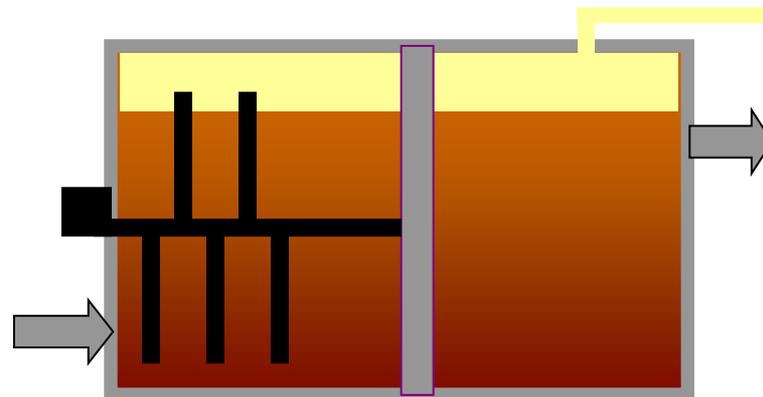
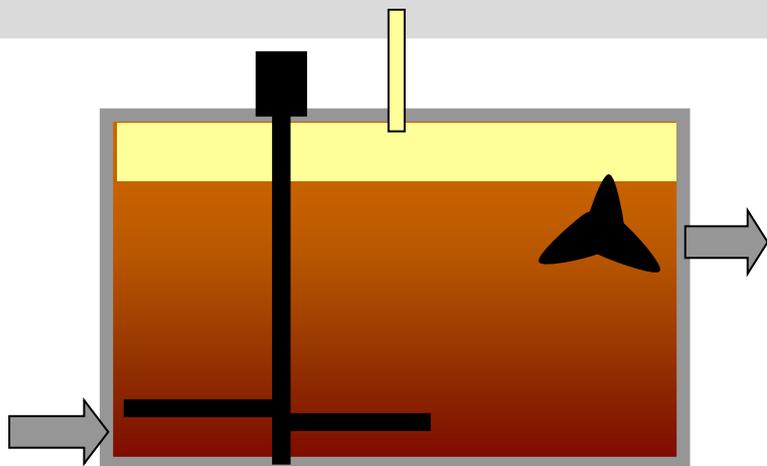
Reactor mixing



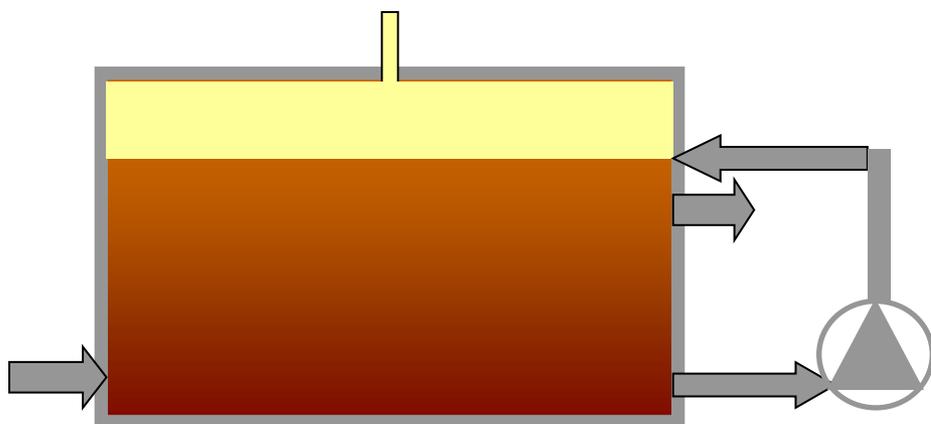
- Mixing of fresh substrate with digester sludge
- Even distribution of heat in the fermenter
- Distribution of nutrients
- Homogenisation; prevention of sedimentation and scum layer formation
- Good degassing of biogas from the fermentation sludge

All these purposes have to be fulfilled by a mixing technology with minimum energy demand !!!

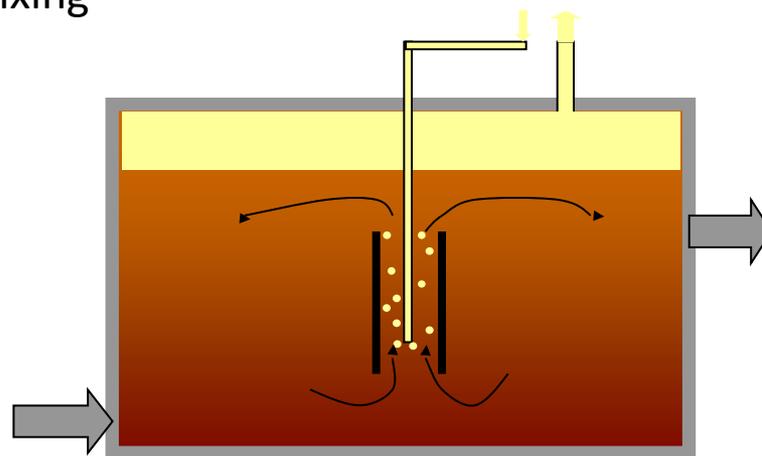
Reactor mixing technologies



Mechanical mixing



External Recirculation



Gas mixing (mammoth pump)

Slow rotating Paddel Stirrers



- Operated at app. 10 to 300 RPM
- Operated continuously
- Electric motor outside fermenter
- One or more agitators in one digester
- Mixing shaft bearing at one or two points

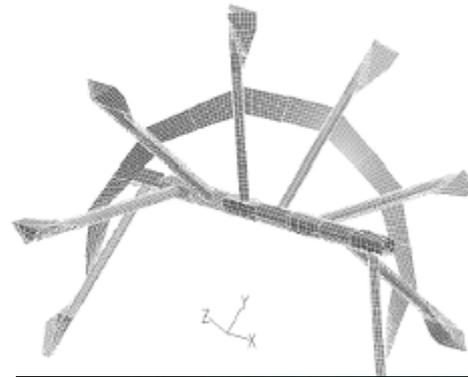
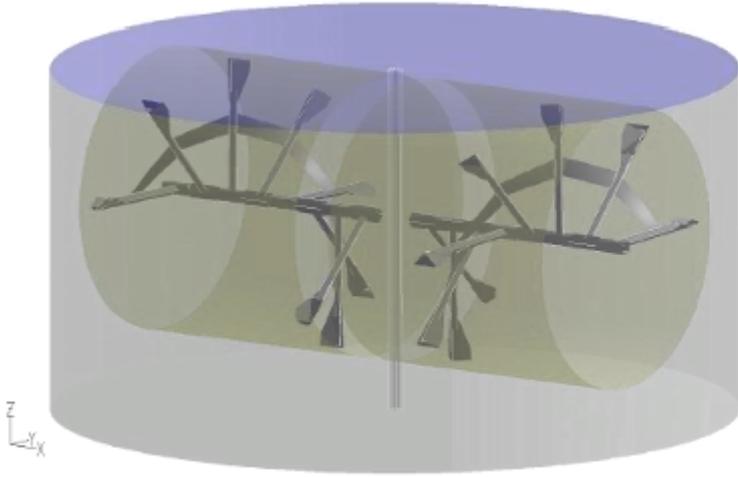
+

- Good mixing results
- Low energy demand
- Prevention of sedimentation and scum layers
- Motor and gearbox outside the fermenter
- Very slow rotating paddles suitable for high viscose sludge

-

- Fixed position in fermenter
- Maintenance on paddles and shaft very difficult

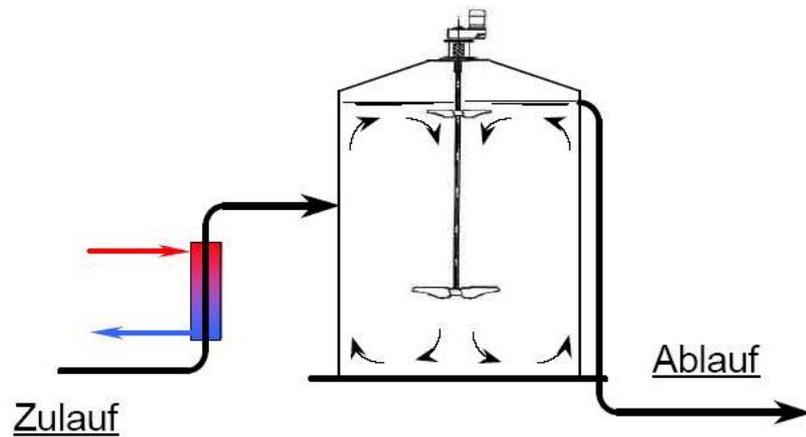
Slow rotating paddles



©TU Wien / Thöni



Slow rotating paddles



© Vonmeer



Fast rotating propellers



- Operated at appr. 300 to 1500 RPM

- Operated in intervals

- Electric motor often submerged in fermenter

- One or more agitators in one digester

- Motor cooling by fermenter sludge if submerged in sludge

+

- Good mixing results achievable

- Very flexible in installation (height and angle adjustable)

- Solving of sedimentation and scum layers

-

- High energy demand

- Sedimentation and scum formation because of interval operation

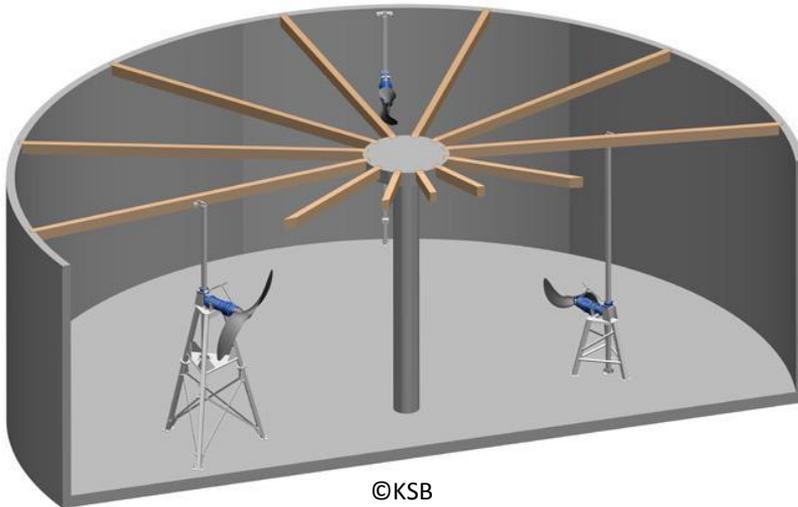
- Motor and moving parts in fermenter

- Problems with high viscose sludge

Fast rotating propellers



©Suma



©KSB



Gas mixing



- Biogas is compressed and reinjected to the fermenter
- Up flowing gas bubbles create turbulences and flows inside the fermenter => mixing

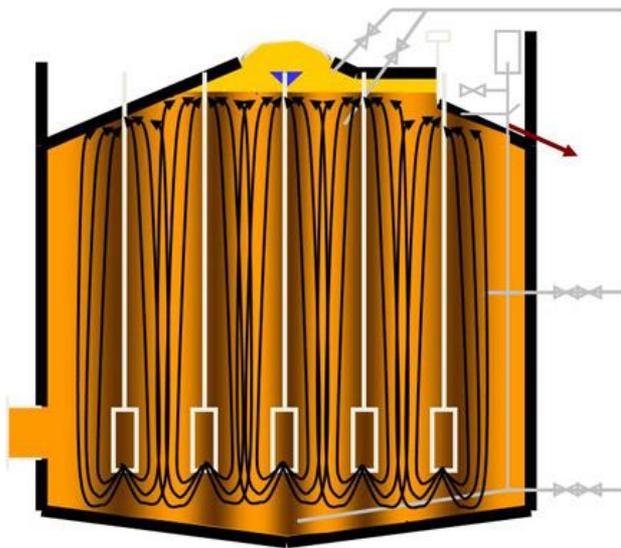
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- Good mixing results achievable
- Low energy demand
- No moving parts inside fermenter

-

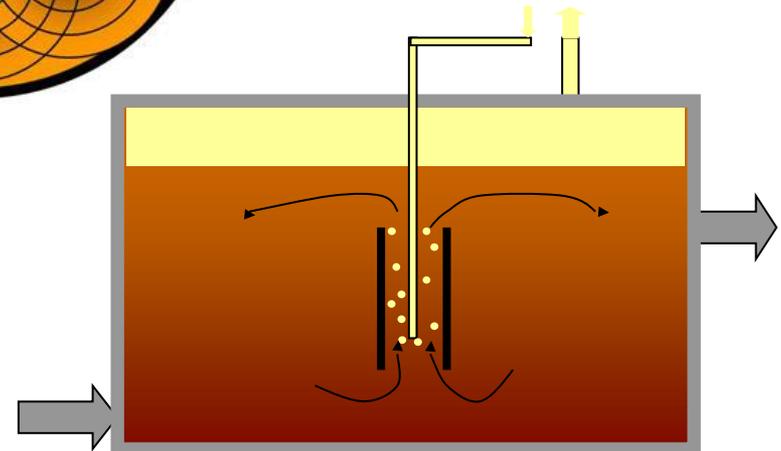
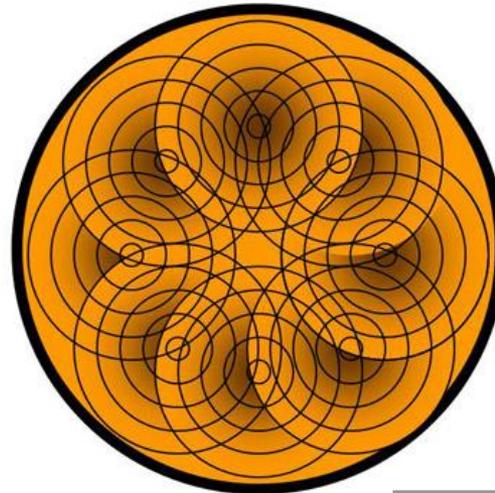
- Only suitable for very liquid substrates
- Increased foaming
- Sedimentation and scum formation

Gas Mixing



*Dark areas are better mixed

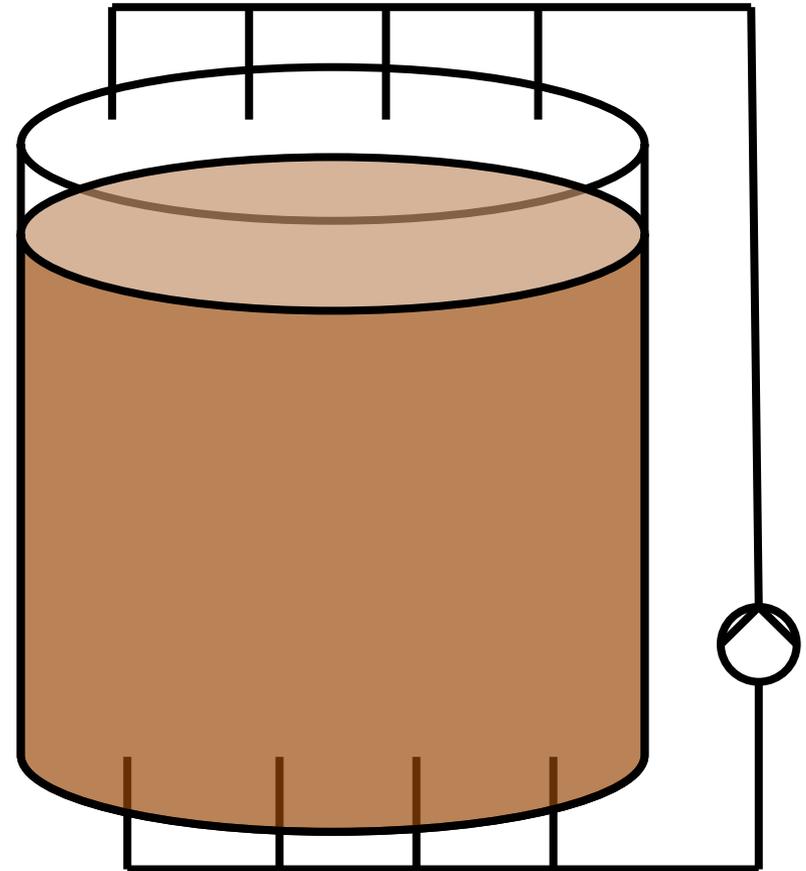
© Bluecompetence



Gas mixing (mammoth pump)

Hydraulic mixing (external recirculation)

- Pumps with high capacity required
 - Effective discharge points and injection nozzles required to create flows => mixing
- +
- Good mixing results only in small reactors
 - No moving parts inside fermenter
-
- High energy demand
 - Sedimentation and scum formation



Digester Heating (Cooling) systems



- To maintain the exact process temperature all year round (important for microbiology)
 - To heat up (or cool down) fresh substrate fed to the digester
 - Heating systems always require effective mixing
1. Internal heat exchanger
 2. Wall and ground heating
 - Inside concrete (wall or ground plate)
 - Outside of steel tank
 3. External heat exchangers

Internal heat exchangers



+

- Good heat transfer
- Low operation costs
- Low equipment costs

-

- Difficult to clean and maintain
- More difficult to control temperature



Wall and ground heating



+

- No Contact between substrate and heating coil
- Low operation costs
- Low equipment costs

-

- Bad heat transfer
- More difficult to control temperature
- If inside concrete wall no possibility for maintenance
- Ground heating very sensitive to sedimentation



Exteranl heat exchangers

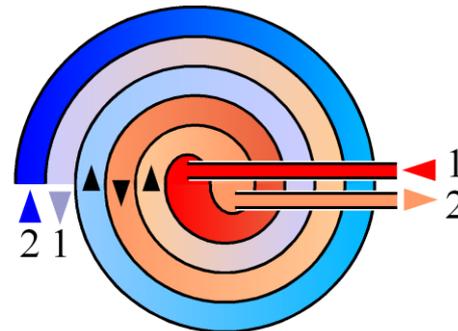


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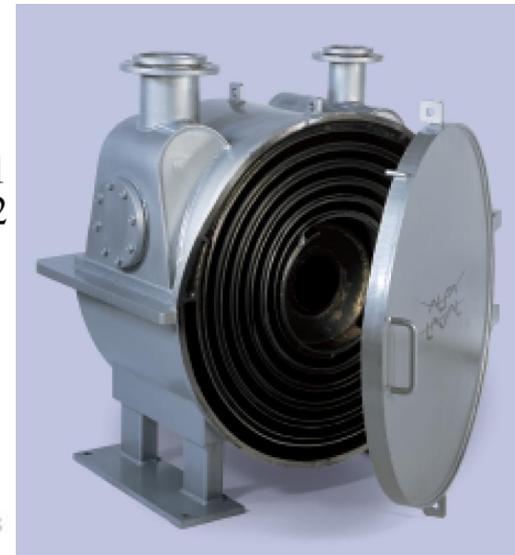
- Optimum heat transfer
- Easy to clean and maintain
- Good temperature control

-

- Additional pumping required
- Additional piece of equipment
- More installation space



© Alfa Lova



Pumping



- Necessary for transporting pump able substances in the biogas plant for
 - Feeding
 - Discharge
 - Transfer from one reactor to the next
 - Heating
 - Mixing
 - Substrate treatment (Particle size reduction, impurity removal, ...)



Centrifugal Pump

A spinning impeller accelerates the fluid which creates pressure and flow

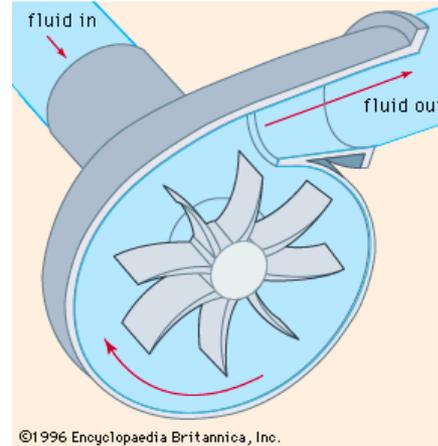
- Very common pump in waste water treatment
- Suitable for homogeneous sludge with low TS content (< 8 %)

+

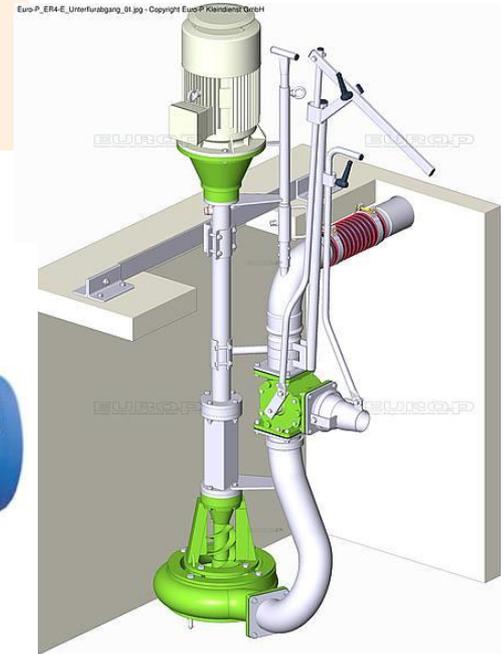
- Simple and robust construction
- High capacity
- Flexible use (submerged or normal installation)

-

- Problems with high fibre content (straw)
- Not self priming (needs to be installed underneath the tank level)



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Rotary lobe pump

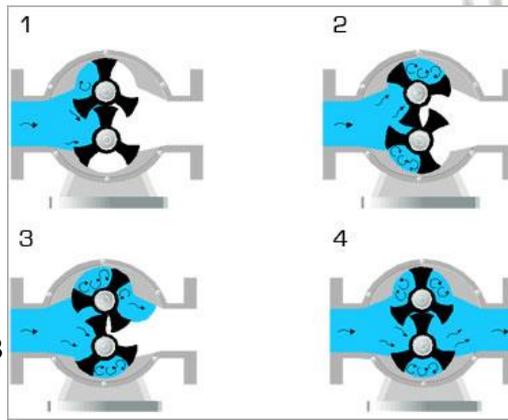
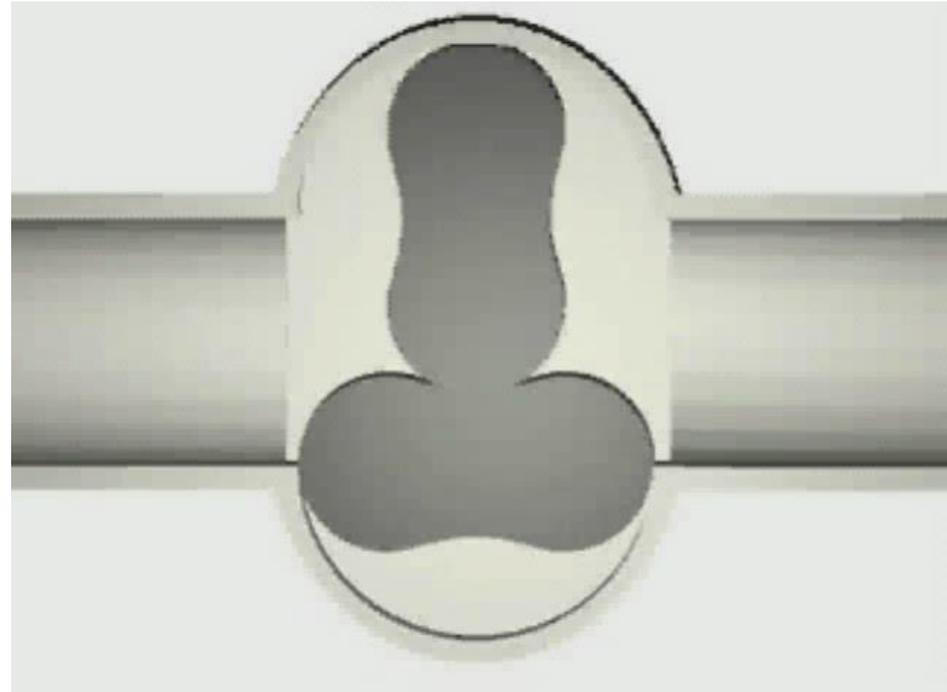
- Volumetric pump (displacement pump)
- Consists rotating lobes in chamber
- Very tolerant to high viscose solids containing fluids
- Limited maximum pressure

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- Simple and robust construction
- High capacity
- Self priming
- No problems with fibres
- Two flow direction possible

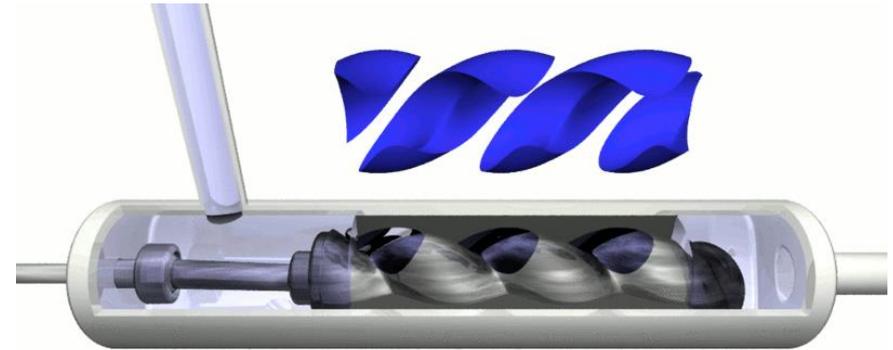
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- Fast decreasing capacity in case of abrasion



Excentric screw pump

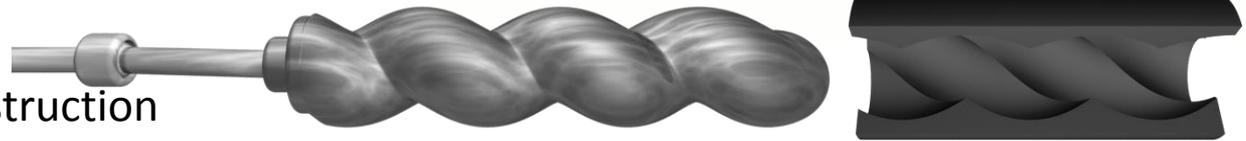
- Volumetric pump (displacement pump)
- Consists of a helical rotor and a rubber stator
- Very tolerant to high viscose and abrasive fluids



© Wikipedia

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- Simple and robust construction
- Self priming
- Build up of high pressure
- Tolerant to abrasive impurities (sand, glass, ...)
- Two flow direction possible



-

- High energy demand
- Sensible to dry run



© Pumpenfabrik Wangen

BDI BioDiesel

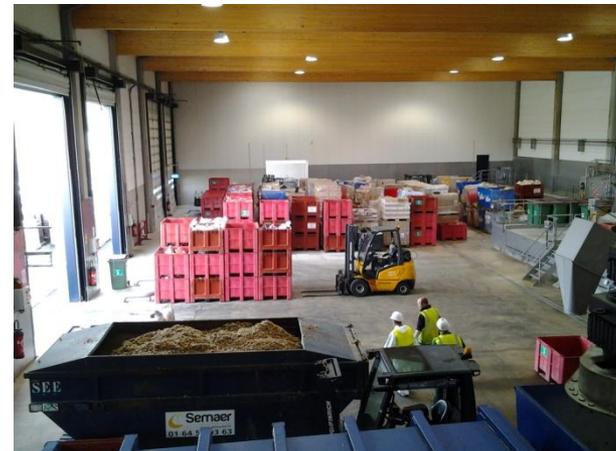
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Reception and dosing systems



- Tank reception
- Bunker reception
- Feed hopper
- Reception Pits (mixing Pits)
- Storage plates
- Silos



Energy Crop reception hoppers

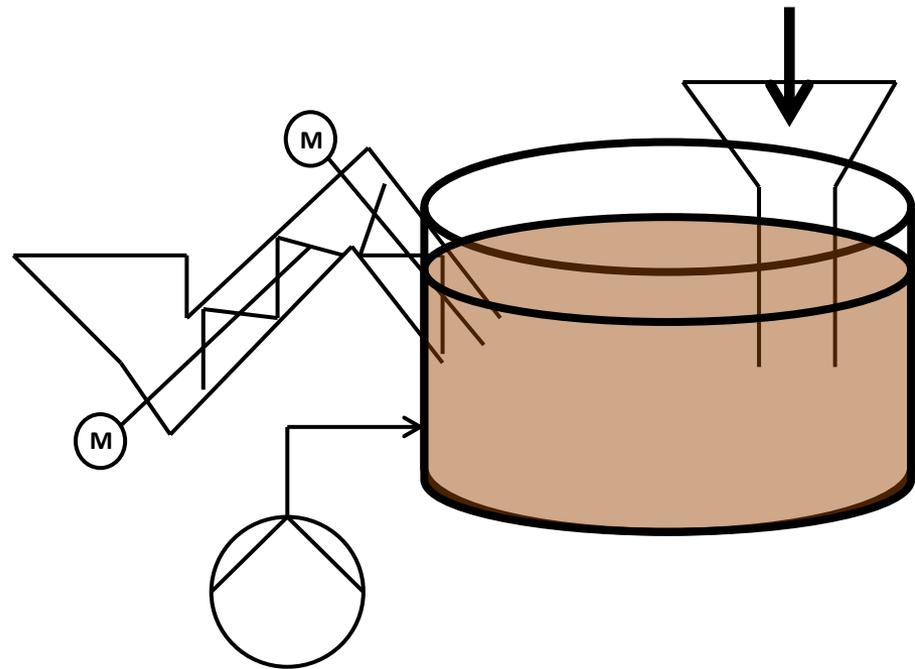


Waste reception bunkers



Dosing- / Feedingsystems

- Auger feeding
- Pump feeding
- Gravity feeding
- Combined systems



Examples for fermenter feeding systems

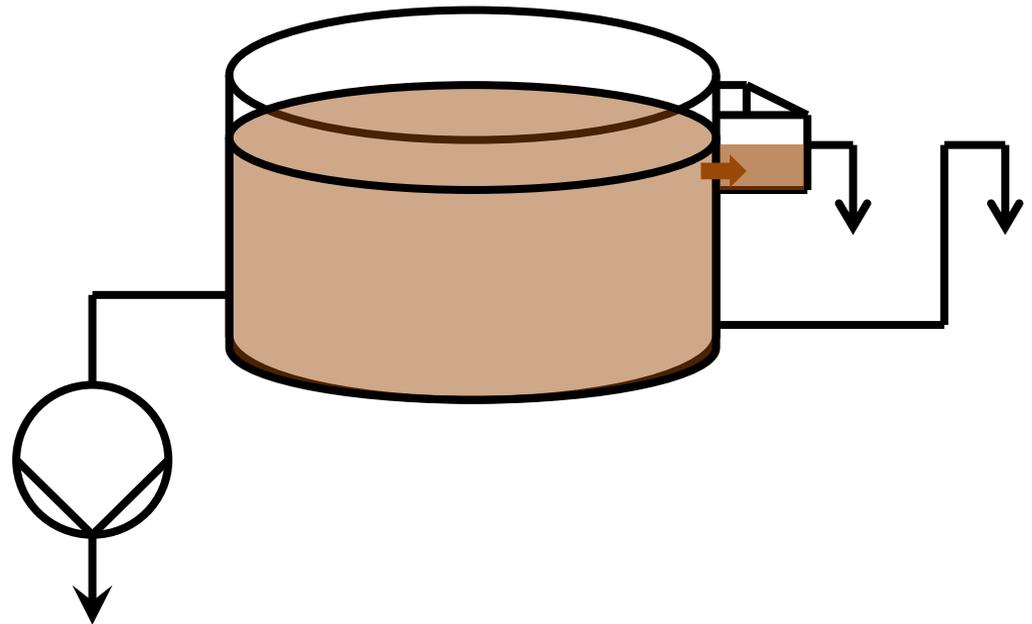


©Pumpenfabrik Wangen

Fermenter Discharge systems

Most common techniques:

- Pump discharge
- Gravity discharge



www.bdi-bioenergy.com



from waste energy

Reinhold Waltenberger / reinhold.waltenberger@bdi-bioenergy.com

BDI-Bioenergy International AG / Parkring 18 / A-8074 Grambach / Austria



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