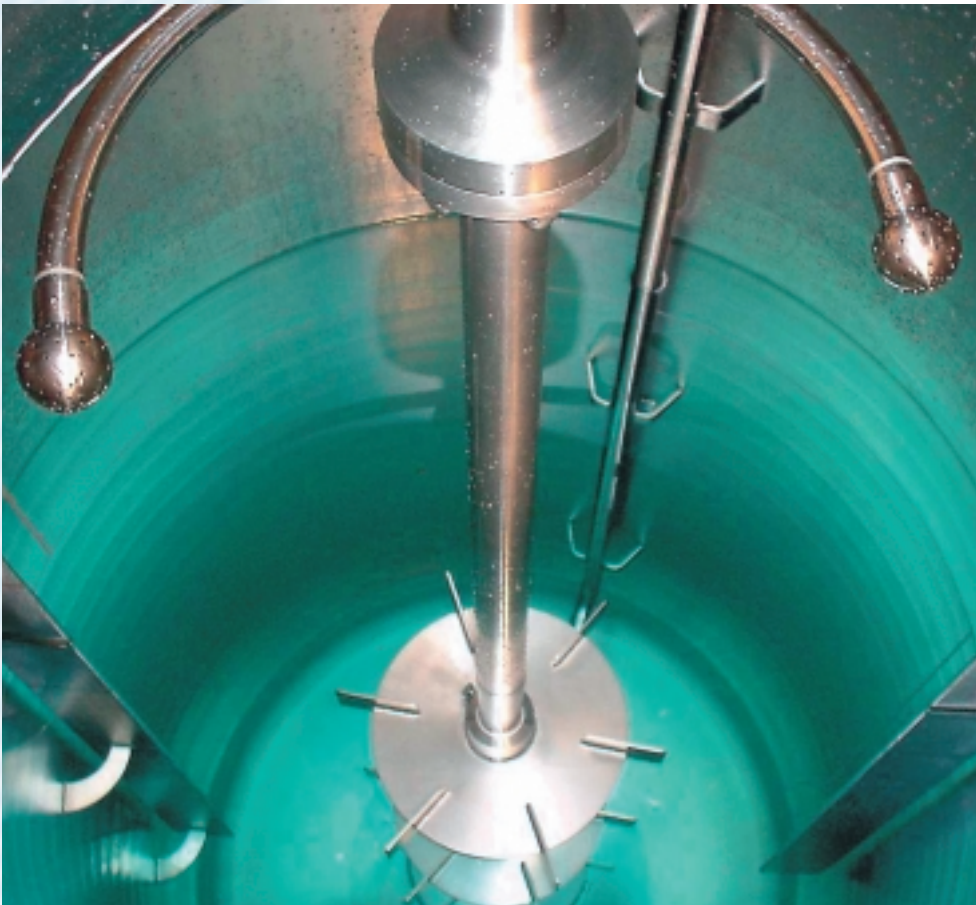


MAVADRIVE®

Sterile agitators



MAVAG AG

Business area: Mixing Technology



Scherrer-Group

MAVAG MIXING TECHNOLOGY

The performance of our company is hallmarked by decades of experience in many different fields of application surrounding industrial mixing technology.

Our focus is on sterile processes including bioreactor technology.

Similarly to our **MAVADRIVE®** magnetic agitators, the **MAVADRIVE®** range of sterile agitators is also particularly suitable for applications in the fields of:

- pharmaceuticals
- biotechnology
- food processing
- fine chemicals

where knowledge of process stages, specific design requirements, safety, quality and reliability is crucial.



Fermenter drive and Turbofofom® foam separator

DESIGN

The most up-to-date computation processes, databases containing our expert know-how, as well as the possibility of carrying out trials in our technical laboratory, all add up to our ability to provide you with the safety and reliability distinctive of **MAVAG** agitators.



*Agitator design using the program system **MARA***

QUALITY MANAGEMENT

MAVAG agitators are acknowledged for their quality and ease of maintenance.

Our high standards are based on sustained comprehensive internal quality procedures, ranging from the initial preparation of offers, over design, manufacture and documentation right through to final commissioning.

Under the term quality, apart from meaning a fault-free and mechanical durable product, we also expressly understand a construction engineered to conform to requirements, particularly with regard to the hygienic design of each and every component.

We are certified according to DIN/ISO 9001.

QUALIFICATION

From our experience in the field of plant validation, we understand the importance of qualification.

Our designs as well as our materials selection follow latest official guidelines (EU, FDA etc.), and we work closely together with independent institutes and associations (universities, VDMA etc.).



This facilitates Design Qualification DQ during order processing. IQ and OQ are also possible depending upon the scope of supply. For these procedures, we have developed our own qualification strategy. In this way, we ensure that the necessary documentation is available in time, complete and in the required quality, and that the customer receives full support during process validation.

Applications

Our top-entry and bottom-entry agitators are employed in processes requiring the following features:

- medium-wetted materials exclusively of stainless steel, e.g. 1.4435, 1.4539 or high-nickel stainless steel.
- Ferrite content according to customer specification or Bâle Norm BN2
- Surfaces polished to at least Ra <math><0.8 \mu\text{m}</math>, often electro-polished (according to customer specification)
- GMP-conform design
- Cleanable in place (CIP), as a rule also sterilizable (SIP)
- Complete with all necessary endorsements/certificates.

Application examples

- Fermentation plants and bioreactors, from small fermenters up to large-volume vessels with over 100 m³ working volume
- In associated upstream and downstream process stages
- Cleaning procedures, e.g. recrystallization
- Disposal, decontamination, denaturation,
- Make-up tanks for pharmaceutical products with the most varying of formulations
- Manufacture of ointments, jellies, creams
- Manufacture of maximum-purity substances in the field of fine chemicals
- Food processing, dairy products, fruit juices, baby food etc.

MAVADRIVE® sterile agitator technology

Product lines

MAVADRIVE® agitators in the following range of models cover a wide spectrum of applications:

- MRG
Top entry agitators for the small to medium capacity range, with shaft diameters 20 mm up to over 80 mm
- MRGDIN
Top entry agitators according to DIN 28162 (easy replacement of mechanical seal), for shaft diameters 60 mm up to over 140 mm
- MFR
Fermenter agitators for installation

through the base of vessels, designed for high specific capacities; with sterile seal, shaft diameters 20 mm up to over 200 mm

- MRH
The intelligent solution for simpler mixing tasks and limited demands on sterile design.
Hollow shaft drive, for shafts 35 mm up to over 60 mm
- Tailored solutions to suit your particular requirements
- Turbofom®
Mechanical foam separator

Drives

In our flexibly designed **MAVADRIVE®** program, nearly all types of commercially available drives are applied. These include in particular:

- 3-phase electric motors, including x-versions
- 3-phase speed-controlled motors, also with integrated frequency converter
- Mechanical variable speed gears
- DC drives
- Pneumatic drives
- Hydraulic drives

In combination with different types of gear configurations, the most suitable drive solution for your application can be established.

Advising you on the optimal drive concept is part of our service.



Fermenter agitator, Type MFR



Fermenter with 22 kW agitator, Type MRGH-DIN



Anchor agitator, Type MRG with adjustable gear

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Technical features of sterile agitator components

Stirrer shaft sealing

Sealing of the through-hole for the shaft of sterile agitators inside the vessel is carried out using mechanical seals. In each case, the seal is so arranged that the sealing area is readily cleanable from inside the vessel.

In processes with CIP requirements, a single internal mechanical seal can be sufficient. For sterile processes, sterilizable double mechanical seals are fitted at the atmospheric side.

The process-oriented choice of optimal sealing design is an important part of our know-how in sterile technology.

On request, **MAVAG** also supplies the necessary systems for pressure overlay, cooling and, if necessary, for sterilization of the seal.

Agitator mounting

Apart from the shaft seal, the construction of the mounting flange to fully meet sterility requirements is crucial for ensuring optimal cleanability of the agitator.

The small dimensions of our flanges allows space for other sockets in the base of the vessel.



Mechanical seal suitable for CIP



Shaft coupling, GMP design

Shaft division

For assembly reasons, partition of the stirrer shaft cannot always be avoided. Our sterile-technical design reliably prevents the ingress of substances at the interface of the two sections of the agitator shaft.

In shafts of small diameter, a screw joint can seal off the interface, otherwise modified flange couplings following DIN 28155 are used.

Impeller attachment

From a sterile-technical point of view, a welding connection is the optimal solution for the shaft/boss connection.

For assembly reasons, or in order to be able to adapt to changing process parameters, removable bosses can be used. In this case also, the special know-how of **MAVAG** allows a perfect sterile-technical design of the boss.

The following alternatives are offered:

- Sealed screw boss at the end of the shaft
- Sliding boss, also in sealed design
- Split clamp boss



Screw-type boss, GMP design

Turbofom® Mechanical foam separator

In many processes, but particularly in those carried out in bioreactors, formation of foam by the product ingredients through specific process conditions (gas transfer) is unavoidable.

The most effective and economic way to solve foam problems without the use of chemical additives is to employ our foam separator Turbofom®.

Advantages

- Better use of the available vessel volume
- No unwanted product ingredients in downstream processing stages (no blockage of the exhaust air filter)
- Low operating costs
- No alien auxiliaries/additives in the product

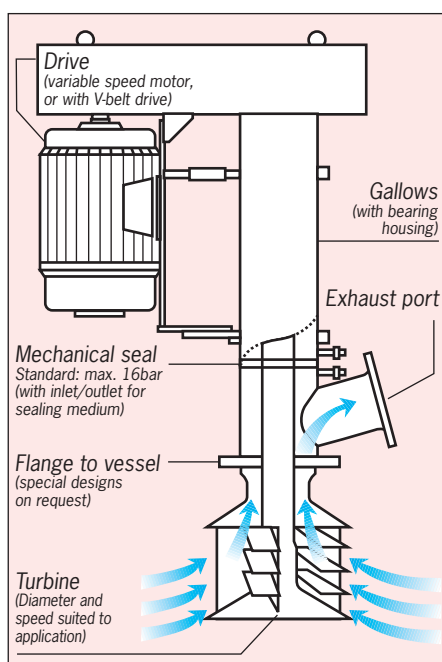
Function

A high speed turbine running at between 500 and 3000 rpm depending upon application and size, is arranged at the top end of the vessel. It separates the foam into gas and liquid droplets/solids by means of centrifugal force. The gas is removed through an integrated gas exhaust port, whilst the droplets and solids are centrifuged back into the process.

Technology

The design is similar to that of our agitators.

A motor with variable speed control is mounted on the galls supporting the agitator, either with direct coupling to the turbine shaft or in conjunction with a V-belt.



Turbofom®: principle drawing

The bearings of the turbine shaft are located inside the gallows casing, and sealing to the vessel interior is effected by means of a mechanical seal.

The flow of gas is transferred out of the vessel headspace by the turbine.

The gas pipe is connected to the exhaust port using, for instance, an aseptic threaded fitting following DIN 11864 or a connection according to your specification.

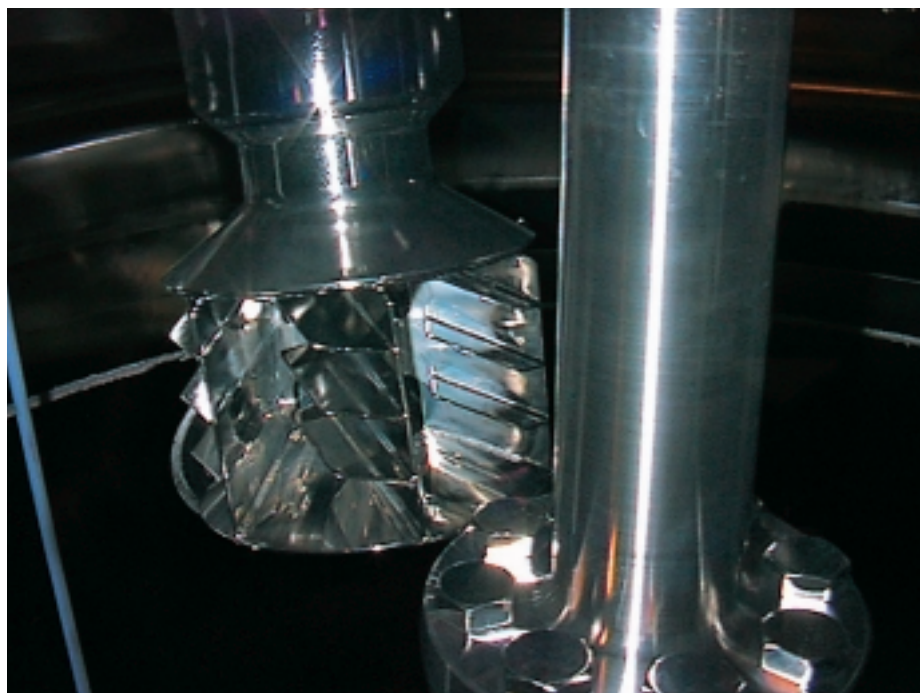
A range of sizes to cover gas throughputs from 50 l/min up to over 100 m³/min is available.

Even more mixing technology from MAVAG

Our agitator program is comprehensive. Additional ranges supplement the sterile agitators already presented above:

- **MAVADRIVE®** magnetic agitators, also as top entry models
- Tripod agitators
- Coaxial agitators
- Side entry agitators

Ask for our relative literature.



Turbofom® 7.5 kW, in a fermenter with a 75 kW agitator



A large-scale Turbofom.(90 kW, 100 N/min)

MAVAG PROCESS ENGINEERING

When designing agitators, we always take the specific process factors and vessel configuration into account. A combination of process engineering and mechanical engineering know-how characterizes our special knowledge base, built up through decades of experience.

Stirring/mixing tasks

The correct design of an agitator for any application begins by defining the specific stirring/mixing task from a process engineering point of view.

This, together with essential information about the product to be mixed or stirred, forms a basis for selecting the most suitable type of agitator, determining the speed of rotation and ascertaining transfer capacity.

Often, several stirring tasks have to be accomplished simultaneously in complex mixing processes.

Take for example, fermentation:

- Process gas has to be dispersed efficiently within the working volume in order to ensure optimal mass transfer
- Process heat generated has to be drawn off
- Nutrients and reagents for adjusting the pH value have to be dispersed rapidly and homogeneously

Factors surrounding the design of the agitator are overlapped by other requirements:

- Low-shear agitation, e.g. during cell culture processes
- Avoidance of superfluous gas feed in the event of the risk of foam formation
- Good cleanability attributes for CIP procedures



MAVA-Rut, segmented model for a 90 m³ fermenter

- Design aspects such as easy installation of the agitator, lowest possible torque, avoidance of oscillation etc.



MAVADRIVE® Type MRH, design for food processing applications with u/Z agitator

MAVAG knows the processes and possesses the necessary mechanical and process engineering know-how in order to supply you with perfect agitator systems for your sterile applications.

Impellers

MAVAG possesses design and process engineering know-how relative to a whole range of impeller types, with particular emphasis on:

- Impellers according to DIN 28131
 - Coaxial agitation systems
 - Custom-made impellers
- We supply the appropriate agitator system tailored to your application.

A selection of typical impellers

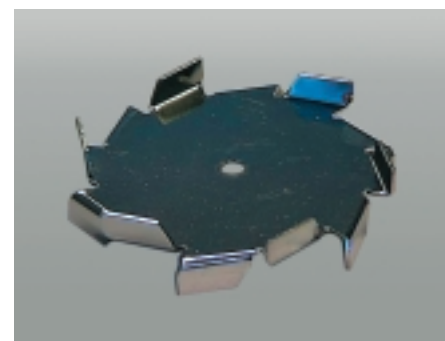
Impeller type	Primary flow direction	Preferred application	Diameter ratio d_2/d_1	Tip speed $u(\text{ms}^{-1})$	Flow characteristic	Remarks
MAVA-Prop	Axial	Homogenization, suspension	0.1 - 0.4	2 - 15	Turbulent ($Re_{\text{crit}} = 500$)	Frequently used propeller, good mixing performance
MAVA-PiB	Axial / with radial components	Homogenization, heat transfer, dispersion	0.2 - 0.5	2 - 6	Turbulent ($Re_{\text{crit}} = 500$)	pitch blade turbine, 4 or 6 blades
MAVA-RuT	Radial	Aeration, heat transfer	0.3 - 0.5	3 - 8	Turbulent, auch transit flow, ($Re_{\text{crit}} = 300$)	Often multistage (2-4 stages) high shear
MAVA-Dizer	Radial	Dispersion, desagglomeration	0.2 - 0.5	8 - 20	turbulent ($Re_{\text{crit}} = 500$)	Low flow rate capacity, often in combination with MAVA-Prop



MAVA-Prop



MAVA-PiB



MAVA-Dizer

MAVA-Cross	Axial/radial	Homogenization, heat transfer, suspension	0.4 - 0.6	2 - 5	Turbulent and transient flow ($Re_{\text{crit}} = 70$)	Multistage, cross blade, impeller
MAVA-MeG	Axial/radial distributed input	Homogenization, heat transfer, suspension, low shear	0.4 - 0.7	2 - 6	Turbulent and transient flow ($Re_{\text{crit}} = 50$)	Counterflow impeller, acc. DIN 281.31 multistage
MAVA-ASym	Axial/radial distributed input	Homogenization, heat transfer, low shear	0.4 - 0.6	1.5 - 3.5	Transient laminar flow ($Re_{\text{crit}} = 10$)	Asymmetrical, multi-stage impeller configuration
MAVA-HiVisc	Axial/radial	Homogenization, heat transfer,	0.8 - 0.95	1 - 3	Transit to laminar flow	Counterflow principle



MAVA-Cross



MAVA-MeG



MAVA-HiVisc

MAVAG PROCESS ENGINEERING

The products and services supplied by **MAVAG** in the field of process engineering include the development, design, manufacture and installation of highly demanding and efficient equipment, systems and plants.

MAVAG has broad experience in the realization of complete industrial plants. In addition to essential components and services, **MAVAG** has at its disposal the engineering capacity necessary for comprehensive project management, extending from the initial design concept through to final commissioning.

For our customers this means rational project processing and a clear scope of responsibility in one-stop shopping.

Our qualified engineering staff will accompany your project from the very first moment of discussion right through to the warranty period, from the specification stage right through to validation and personnel training.

Our business areas:

MAVAG Sterile technology

MAVAG Biotechnology

MAVAG Filtration technology

MAVAG mixing technology

Biotechnic/MAVAG USA

P.O. Box 1407
Windermere, FL 34786-1407
Tel: (407) 292-4812
Fax: (407) 292-5306
Web Site: www.biotechniconline.com
e-Mail: biotech1@concentric.net



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