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温州市鹿城区戍浦江路28号 | 邮编：325019
No.28 Shupujiang Road,Wenzhou,325019,China
电话(Tel)：0577-85955555
售后服务：0577-85955055
邮箱(Email)：aaar@aaar.com.cn

720度企业全景 720 Aerial Panorama
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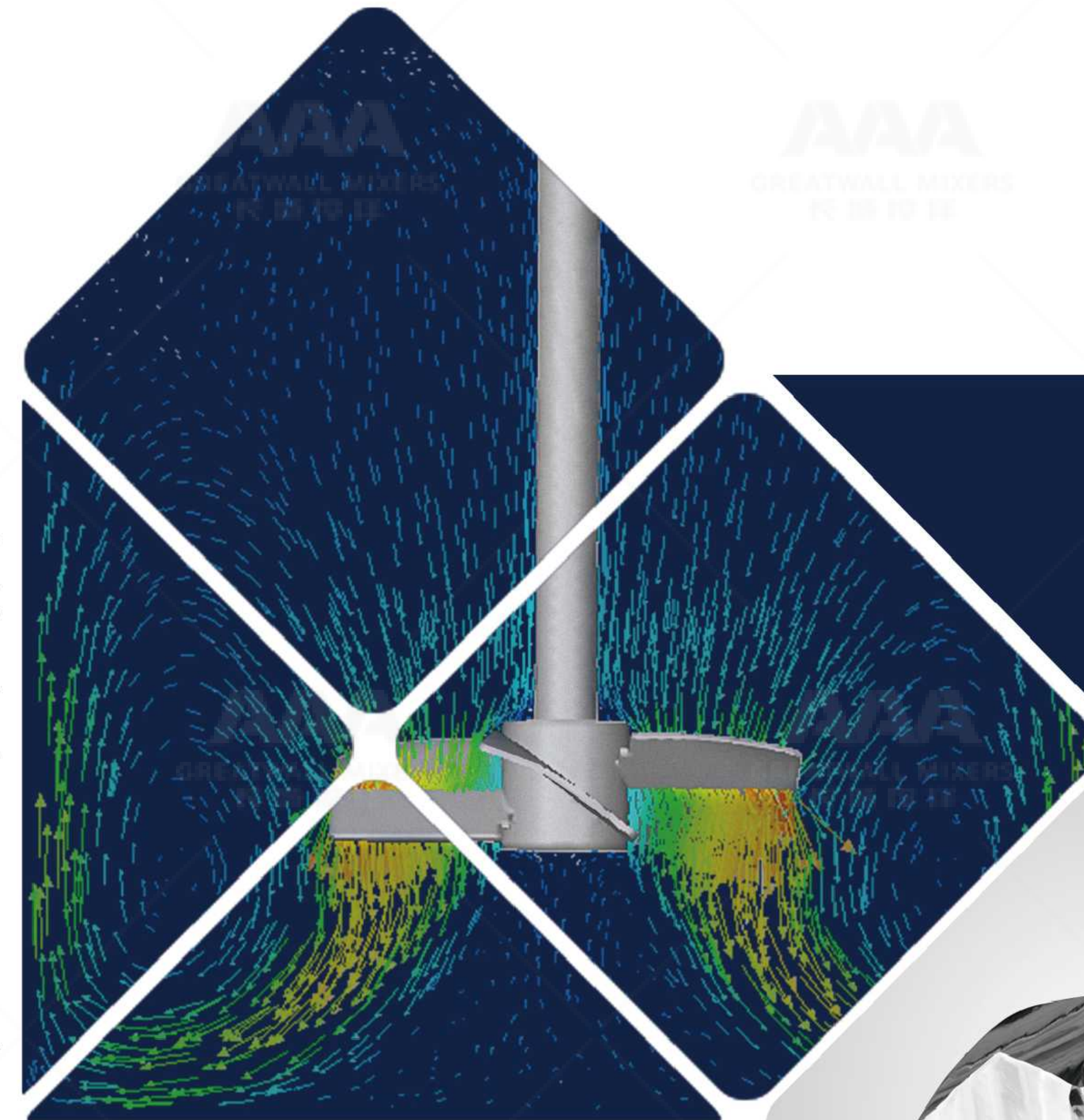
长城搅拌产品手册

GREATWALL MIXERS PRODUCT CATALOGUE

GREATWALL MIXERS
长城搅拌



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公司简介
COMPANY INTRODUCTION

浙江长城搅拌设备股份有限公司前身系“温州市长城减速机厂”，成立于1993年，从最初的专业减速机生产厂家已发展成为国内外知名的搅拌技术开发与搅拌设备设计、制造的创新型企业。在行业内牵头组织成立了搅拌技术专业委员会，连续组织参与了4届全国性搅拌会议，承担及参与制定行业标准17项，国家标准2项。

公司是国家高新技术企业，技术力量雄厚，技术团队拥有博士、教授级高工、高级工程师等各类高级技术人才。公司建立了国家级博士后科研工作站，浙江省长城搅拌技术与装备研究院，省级企业技术中心，省级院士专家工作站等研发平台。近年来完成多项国家及省部级科技开发项目，拥有专利技术及产品百余项，搅拌技术研发设计水平在国内同行业中名列前茅。

公司持有ISO9001/ISO14001以及ISO45001质量/环境/职业健康安全管理体系证书，同时产品出口也获得了CE和ATEX的认证。长城公司的技术与产品获得了国内外客户的广泛认可，广泛地应用于石油化工、生物医药、食品、能源、环保、水处理等行业，国内市场拥有丰富的业绩。

Zhejiang Greatwall Mixers Co., Ltd. (GREATWALL) was founded in 1993,but its history can be traced back to 1981. From the original manufacturer of reducers, GREATWALL has since become the leading company in China for mixing technology research, design, and manufacturing as well as the installation of agitators and mixers. We have specified and set 16 national and industrial standards for mixing equipment, organized mixing technology committees in China, and hold four National conferences on mixing.

GREATWALL invests heavily in R&D. The technical group is staffed by doctorates, professors of engineering, senior engineers and other technical specialists. Also, relying on strong collaboration with universities, such as ECUST, ZJUT, etc, GREATWALL has set up a National Enterprise Postdoctoral Research station, Provincial Mixing Research Iinstitute, Provincial Technical Center and Provincial Academic workstation. All these initiatives support and guarentee GREATWALL's advanced technology. GREATWALL has been awarded more than one hundred patents for mixing technology. All these guarentee the leading technology in domestic horizontal competition.

GREATWALL has obtained ISO9001, ISO14001 and OHSAS18001 certification. The products for export have obtained CE and ATEX certification, and cover a wide range of industries which include pharmaceutical, petrochemical, fine chemical, environmental protection, mineral processing, food and beverage, water treatment, etc.

资质荣誉 AWARDS AND CERTIFICATES


ATEX


CE


ISO9001


ISO14001


ISO45001

GREEN ENERGY

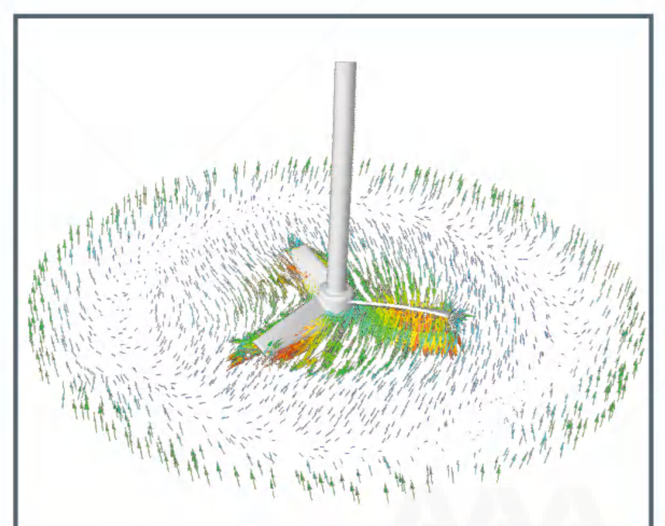
1MW并网光伏电站
POWER STATION
1 MW DISTRIBUTED SOLAR

低碳发展是长城公司的发展战略，我们不仅为客户提供节能和环境友好的产品和服务，而且建立了一个1兆瓦的光伏发电站，用绿色能源来生产和制造我们的产品。

Sustainability and green manufacturing is deeply rooted in GREATWALL' s business strategy. We not only supply environmentally friendly products or services to our customers worldwide, but also built a 1MW solar power station to provide renewable and clean source of energy to manufacture our products.

研究开发
RESEARCH & DEVELOPMENT

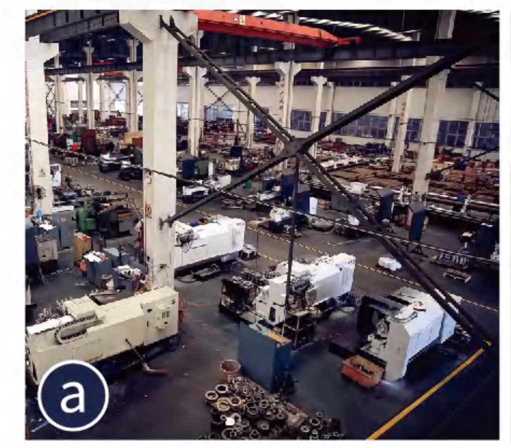
长城搅拌实验室
GREATWALL MIXING LABORATORY



计算机流体分析
COMPUTATIONAL FLUID DYNAMICS

专利及成果
PATENTS AND ACHIEVEMENTS

生产设备
FACILITY



a. 生产车间
WORKSHOP

b. 马扎克机床
MAZAKMULTI-TASK MACHINE

c. 搅拌试验槽
MIXERTESTINGTANKS

立式车床
VERTICAL LATHE

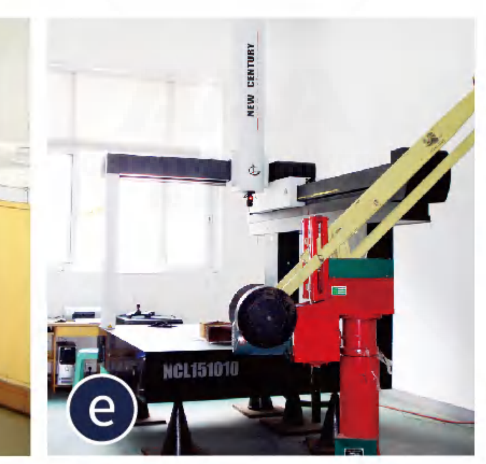
激光切割机
LASER CUTTING MACHINE

12米长轴加工车床
LATHE FOR LONG SHAFT 12M

d. 材料分析光谱仪
POSITIVE MATERIAL IDENTIFICATION (PMI)

e. 三坐标测量仪
THREE-COORDINATES MEASURING MACHINE

f. 动平衡测量仪
DYNAMIC BALANCE TEST PLATFORM



g. 机械密封实验台
MECHANICAL SEAL TEST PLATFORM

h. 超长轴天台试车
OVERBRIDGE TEST PLATFORM:HIGH 13M LENGTH 8M

产品系列
PRODUCTS

普通立式搅拌机 TOP-ENTRY MIXERS

GMV系列皮带搅拌机
GMV BELT MIXERS

双输出轴组合型搅拌机
DOUBLE-OUTPUT SHAFT MIXERS

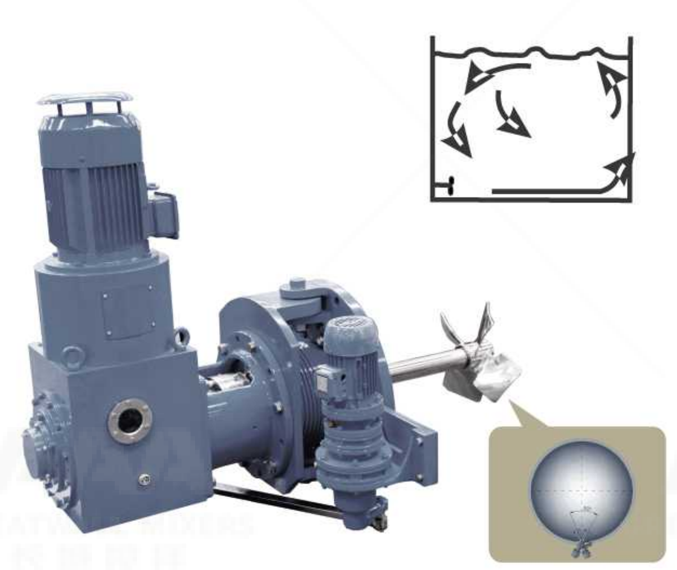
GMR系列直交轴搅拌机
GMR RIGHT-ANGLE MIXERS

GMP系列平行轴搅拌机
GMP PARALLEL SHAFT MIXERS

GMC系列同轴式搅拌机
GMC CO-AXIAL MIXERS

MTC系列磁力传动搅拌机
MTC TOP-ENTRY MAGNETIC MIXERS

侧入式搅拌机 SIDE-ENTRY MIXERS



CKJ 系列周期摆动侧入式搅拌机
CKJ SWIVEL ANGLE SIDE-ENTRY MIXERS

CFJ 系列齿轮传动侧入式搅拌机
CFJ FIXED ANGLE SIDE-ENTRY MIXERS

专用搅拌机 SPECIAL MIXERS

XKJ系列可移式搅拌机
XKJ SERIES PORTABLE MIXERS

管道混合机
PIPE MIXERS

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202,204系列单端面机械密封
202,204 SERIES SINGLE MECHANICAL SEAL

205,206系列双端面机械密封
205,206 SERIES DOUBLE MECHANICAL SEAL

261系列侧入式搅拌机机械密封
261 SERIES FOR SIDE-ENTRY MIXERS

285,286系列底入式搅拌机机械密封
285, 286 SERIES FOR BOTTOM-ENTRY MIXERS

搅拌器 IMPELLERS

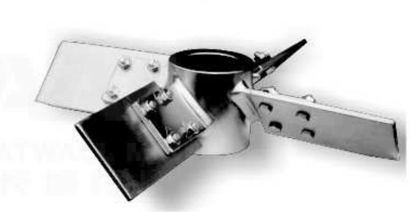
KSX

FY

CCJ

FY

BTD



XCK

HQ

ZCX


煤化工
Coal chemical industrial
石油化工
Petrochemical
生物发酵及制药
Pharmaceutical
环保-水处理
Environment Protection-
Water Treatment
盐化工
Salt chemical
industry
食品＆饮料
Food & Beverage
应用领域
APPLICATIONS
精细化工
Fine chemicals
新材料
New material
新能源
New energy
环保-烟气脱硫及固废
Environment Protection-FGD
Industry Leader
冶金矿业
Metallurgy
and mining

目 录 Contents

1 搅拌装置概述

General description for agitating equipment

1

搅拌操作有多种形式，如机械搅拌、气流搅拌等，在工业生产中应用最多的均系机械搅拌。本手册叙述的是常见的机械搅拌，以中、低压立式钢制容器的搅拌装置为主。典型的搅拌装置由如图 1-1 所示，其主要组成部分包括电机、减速机、联轴器、机架、轴封、安装法兰、搅拌轴、搅拌器、釜内支撑等。对于其它形式的搅拌装置，请参考本手册第九章的介绍。

There are various types of agitating, such as mechanical agitating, gas agitating, etc. The common type is mechanical agitating in industries. This catalogue focuses more on mechanical agitating, which is commonly used, especially for middle and low pressure conditions. A typical agitating equipment is shown in Fig. 1-1， which includes the following main parts, motor, reducer, coupling, pedestal, shaft seal, mounting flange, shaft, impeller, in-tank supporting parts, etc. For other types of mixers, please refer to chapter 9 for detail.

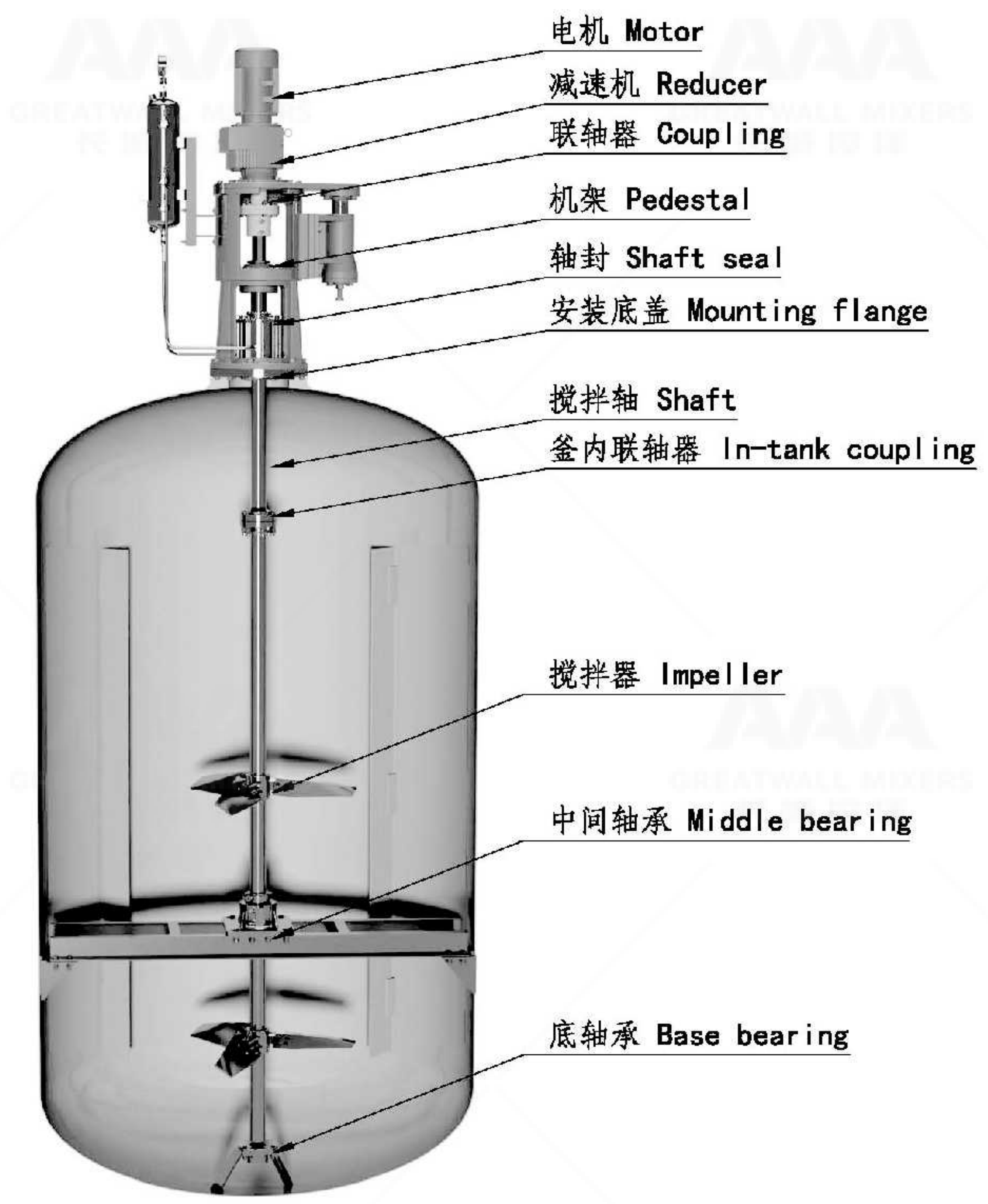


图 Fig.1-1 典型搅拌装置示意图 Sketch of typical agitating equipment

1.1 搅拌装置常规设计方法 General design method for agitating equipment

搅拌装置的设计是一个需要理论和经验密切结合的过程，进行搅拌装置的设计一般有如下几个过程：

①详细了解搅拌过程的工艺特性与要求，包括搅拌目的，物料特性，操作温度、压力等；
②根据搅拌目的和物料特性选择合适的搅拌器型式、内构件及运转参数；
③计算功率消耗、排出流量、固液悬浮临界转速等工艺参数；
④根据工艺要求选择合适的轴封型式；
⑤根据功率、轴封等选择合适的电机、减速机、机架、联轴器等传动装置；
⑥搅拌轴临界转速的计算与设计；
⑦其他搅拌装置部件，如安装法兰、釜内支撑等的设计；

在上述设计过程中，搅拌器的选型是非常重要的一步，也是最依赖经验的一步，需要从搅拌器的剪切－循环特性，对物料粘的适应性，流动型式等多方面了解搅拌器的特性后，再结合搅拌目的确定合适的搅拌器型式。目前的选型方法多数是根

据实践经验，选择习惯应用的桨型，再在常用范围内决定搅拌器的各种参数。也可以通过小型实验或计算流体力学模拟（CFD），取得数据，再进行放大的设计方法。

The design of agitating equipment needs the combination of theory and experiences. The general design steps are as follows:

① Get the detail of the process character and requirements, such as agitating purpose, fluid parameters, operating temperature and pressure, etc.

② Decide the proper impeller type, baffle conditions and speed according to agitating purpose and fluid parameters;

③ Calculate the mixer process parameters, such as the power consumption, discharge flow rate, critical suspension speed, etc.

④ Select proper shaft seal according to process requirements;

⑤ Select proper motor, reducer, pedestal, coupling according to the power and seal type;

⑥ Calculation of shaft critical speed and mechanical design of the shaft;

⑦ Design of other parts of the equipment, such as mounting flange, in-tank supporting, etc.

During the design processes, impeller selection is the most important step, which needs more experiences. The impeller characteristics, such as shear-circulation, adaptability of fluid viscosity, flow field type should be known carefully. Combine the agitating purpose, proper impeller type should be decided finally. At present, most of the mixer design is based on experiences, select the commonly used type and choose proper parameters from these types. There are also other design methods, such as getting design data from lab scale experiment or Computational Fluid Dynamics (CFD) and then scaled the mixer to industry size.

1.2 搅拌装置主要部件选型规范 Rules for main parts selection

1.2.1 电动机的选择 Selection of motor

1. 选定的电动机型号和额定功率要满足搅拌装置设备开车时启动功率增大的要求。
   The selected motor should have the consideration of power increase during equipment start-up.
2. 对于气体或蒸气爆炸危险环境，根据爆炸危险环境的分区等级或爆炸危险区域内气体或蒸气的级别、组别和电动机的使用条件，选择防爆电动机的机构形式和相应的级别、组别。
   For explosion conditions with gas or vapor, select proper motor type and explosion-proof grade according to the dangerous environment grade or gas (vapor) classification.
3. 处在化学腐蚀环境时，根据腐蚀环境的分类选择相适应的电动机。
   For corrosive conditions, select proper motor protection type according to environment classification.
4. 除上述因素外，还应考虑可能引起机械和电器损坏的环境（如灰尘、温度、雨水、潮湿、虫害等）而选择合适的防护型电动机。对于高防爆、小尺寸以及适应不同扭矩性能可选用液压及气动马达。
   Except the above factors, also consider other factors that may cause mechanical or electrical damage, such as dust, temperature, rain, wet, pest, etc. during motor selection. For high explosive, small dimension and torque adaptive requirement, hydraulic or air motor can be selected.

1.2.2 减速机的选择 Selection of reducer

1. 应优先选用标准减速机以及专业厂家的产品。
   Select the standard reducer or products from professional companies first.
2. 应考虑减速机在振动和载荷变化情况下工作的平稳性，并连续工作。一般选择传动效率较高的齿轮减速机。
   Consider the stable and continuous running at vibration or load variation conditions. Choose gear reducer first which has higher transmission efficiency.
3. 出轴旋转方向要求正反双向传动的，不宜选用蜗轮蜗杆减速机。
   For bi-directional running, do not use worm reducers.
4. 对于易燃、易爆的工作环境，一般不采用皮带传动减速，否则必须有防静电措施。
   For flammable and explosion conditions, do not use belt reducers. Otherwise, antistatic methods should be adopted.
5. 搅拌轴向力原则上不应由减速机轴承承受，若必须由减速机承受时，须经验算核定。
   Generally, the axial force should not be borne by reducer. Otherwise, please check the permitted load of reducer.
6. 减速机额定功率应大于或等于正常运行中减速机输出轴的传动功率（输出轴传动功率包括搅拌轴功率、轴封处摩擦损耗功率以及机架上传动轴承损耗等功率之和），同时还须满足搅拌设备开车时启动轴功率增大的要求。
   The reducer rated power should be no less than the output shaft driving power, which includes the shaft power, friction power at shaft seal and pedestal bearing. At the same time, also fulfill the requirement of power increase during start-up.
7. 输入轴转速应与电动机转速相匹配，输出轴转速应与工作要求的搅拌转速相一致。当不一致时，可在满足工艺过程要求的前提下相应改变搅拌转速。
   The reducer input speed should match motor output speed, and the reducer output speed should match the agitating speed. If there is confliction, adjust the agitating speed at the permission of process technology.
8. 输入和输出轴相对位置的选择应适合釜顶或釜底传动布置的要求。
   The choose of relative position for input and output shaft should fulfill the requirements for vessel top and bottom layout.
9. 减速机润滑冷却方式的选择（膨胀油箱、自冷、风冷、水冷、油泵外循环）。
   Selection of reducer cooling method (such as additional oil box, self-cooling, fan cooling, water cooling, pumping circulation).
10. 服务系数的选择，如无特别要求，中小功率搅拌≥1.8，大功率搅拌≥2.0
    Selection of service factor. For common middle and small gearbox, SF. ≥1.8, for large gearbox SF. ≥2.0.

1.2.3 机架的选择 Selection of pedestal

1. 应优先选用标准型的机架。
   Select the standard pedestal from this handbook first.
2. 无支点机架一般仅适用于传递小功率和小的轴向载荷；电动机或减速机具备两个支点，并经核算确认轴承能够承受有搅拌轴传递而来的径向和轴向载荷时可选用无支点机架。
   Generally, non-support pedestal is suitable for low power and low axial load mixers. There must be two support points in motor or reducer, and the bearings must be checked to be strong enough to bear the axial and radial load from the shaft.
3. 具备下列条件之一时，可选用单支点机架。Select single-support pedestal if one of the following is fulfilled.
   （1）电动机或减速机有一个支点，经核算可承受搅拌轴的载荷。
   There is one support point in motor or reducer, which can bear the shaft load.
   （2）设置底轴承，作为一个支点。
   The bottom bearing could be used as a support point.
   （3）轴封本体设有可以作为支点的轴承。
   The shaft seal could be used as a support point
   （4）在搅拌容器内、轴中部设有导向轴承，可以作为一个支点。
   There is guide bearing at the middle of shaft in vessel, which could be used as a support point.
4. 当不具备选用无支点或单支点机架的条件时，应选用双支点机架。
   Choose double-support pedestal if non-support or single support pedestal is not available.
5. 根据传递的搅拌轴载荷大小、方向以及对传动装置上各支点的总体对中要求等诸因素合理选择机架或搅拌轴上的轴承型式（如径向轴承、推力轴承、调心轴承或滑动轴承等）和尺寸。
   Choose proper bearing type (such as radial, thrust, self-aligning or sliding bearing) and dimension according to load rate and direction, aligning requirements, etc.
6. 采用柔性轴时应考虑到机架与搅拌容器之间是否需要隔振的问题。
   The vibration isolation between pedestal and vessel should be considered when flexible shaft is used.

1.2.4 联轴器的选择 Selection of coupling

1. 应优先选用标准型联轴器。

Select standard coupling from this handbook.

2. 采用无支点机架，并且除电动机或减速机支点外无其它支点时，必须用刚性联轴器。
Choose rigid coupling for non-support pedestal (there is no other support except the motor and reducer).
3. 在中间轴承、底轴承和轴封不作为支点的情况下，单支点机架应该选用刚性联轴器。
If the middle, bottom bearing and shaft seal are not used as support point, choose rigid coupling for single support pedestal.
4. 采用双支点机架应选用弹性联轴器。
Choose flexible coupling for double-support pedestal.
5. 搅拌轴分段时，其自身连接必须采用刚性联轴器。
Use rigid coupling for connection of segmented shaft.

1

1.2.5 搅拌轴封的选择 Selection of shaft seal

1.2.5.1 机械密封的选择 Selection of mechanical seal

1. 适用于在腐蚀、易燃、易爆、剧毒以及带有固体颗粒的介质中工作的有压和真空的搅拌设备。
Suitable for pressured and vacuum vessel with corrosive, flammable, explosive, toxic fluid or fluid with solids.
2. 根据搅拌设备在化工系统的使用（如腐蚀）、安装及检修特点，一般采用外装式。
According to the usage in chemical equipment, installation and maintenance, external type should be used.
3. 对于搅拌介质与密封装置接触（如底入式搅拌）而且介质内含有固体颗粒的情况，宜采用内流式。
For seal contacted with fluid (such as bottom entry mixers) and the fluid has solids, inward flow type should be used.
4. 较高工作压力时，必须采用平衡型机械密封；低压下一般采用非平衡型机械密封。
Use balanced type for high pressure; non-balanced type could be used at low pressure.
5. 对于密封要求较高的如易燃、易爆、强腐蚀、带颗粒、低温介质以及真空操作等场合，应采用双端面机械密封。
Choose double mechanical seal for severe conditions, such as flammable, explosive, corrosive, low temperature fluid or fluid with solids, and vacuum conditions.
6. 当密封腔内介质温度超过 80℃时，对单端面和双端面机械密封的密封液都应采用取冷却措施。
If the seal liquid temperature is higher than 80℃, cooling system for the seal liquid should be adopted.
7. 机械密封所采用的密封液一旦漏入搅拌容器应不会影响容器内物料的工艺性能，不会使物料变质。并且密封液润滑性应良好，不腐蚀密封零件，有较高的汽化温度和比热。密封液的压力一般须高于搅拌容器内的工作压力 (0.1~0.2MPa)。
The seal liquid should not affect the material in tank if there is leakage. Also, it should have good lubrication performance, does not erode the seal parts, has higher vaporization temperature and specific heat. The seal liquid pressure should higher than vessel working pressure (0.1~0.2MPa).
8. 现行标准中的机械密封，其密封箱上部设置的轴承支承是为了控制搅拌轴的径向摆动量，在搅拌轴的计算中一般不作为一个支承点。
The bearing in the mechanical seal is to control the vibration at radial direction. Generally, it could not be used as support point at shaft design.
9. 动、静环材料的选用，满足耐腐蚀要求，一般选用硬质材料动环和软质材料静环配对。
Choose anti-corrosive material for seal rotating and stationary ring. Generally, choose hard material for rotating ring and soft material for stationary ring.
10. 除根据实际工况按各种轴封的适用范围和选用准则合理确定搅拌轴封外，在设计搅拌轴封时，还应注意到诸如底入式或侧入式搅拌轴封在停车、存液过程中，密封防漏等的特殊问题。
Except the above rules and seal selection according to seal's application range, pay attention to several special problems, such as maintenance of seal without drain out the liquid for bottom entry and side entry mixers.

1.2.5.2 填料密封的选择 Selection of stuffing box

1. 适用于常压、有压以及真空操作，并允许定期维护的搅拌设备。
Suitable for vessels of atmospheric, pressured and vacuum operations, and routine maintenance is permitted.
2. 当填料箱的结构和填料材质选择合理，并有良好润滑和冷却条件时，可在较高的工作压力、工作温度和搅拌轴线速度下使用。
If stuffing box is designed properly and has good lubrication and cooling system, it could be used at higher pressure, temperature and shaft speed.
3. 当填料无冷却、无润滑液润滑时，搅拌轴线速度不应超过 1m/s。
If there is not cooling system and lubrication, the shaft velocity should not exceed 1m/s.
4. 搅拌容器内介质温度大于 120℃时，应对密封填料进行有效冷却。
If the liquid temperature in tank is higher than 120℃, the stuffing box should be cooled effectively.
5. 需要从填料箱油环中压注密封润滑液时，润滑液压力一般应略高于被密封介质的压力，以防止容器内介质的泄露。采用密封润滑液时，还应考虑到漏入的密封液体对工艺性能的影响。
If seal oil need to be pressured into stuffing box, the oil pressure is usually higher than working pressure to prevent leakage from the vessel. The seal liquid should not affect the material in tank if there is leakage.
6. 填料箱一般可不设支承衬套，应将搅拌轴的支承设置在机架上。
There is not supporting bush for stuffing box. The shaft support is usually set on pedestal.

1.2.5.3 液封的选择 Selection of liquid seal

1. 为了防止灰尘与杂质进入搅拌设备的工作介质之中或者不允许工作介质与搅拌设备周围的环境介质相互接触时，可选用液体密封—液封。
Liquid seal could be used to prevent dust go into vessel or just isolate the working material with external environment.
2. 工作介质为非易燃、易爆、毒性为轻度危害的程度。
The working material should be non-flammable, non-explosive, or just mildly toxic.
3. 搅拌容器内工作压力等于大气压力；搅拌容器内工作温度根据不同封液的性质，一般在-20℃~80℃之间。
The working pressure is ATM, the working temperature is usually between -20℃ and 80℃ according to the character of different seal liquid.
4. 容积小于 0.63m³，轴径范围为Φ25~Φ40mm 的小型搅拌设备，搅拌转速最高可达到 1500r/min；容积大于 0.63m³，轴径范围为Φ40~Φ130mm 的一般搅拌设备，搅拌转速应限制在 320r/min 以内。
For working volume less than 0.63m³, shaft diameter range 25~40mm, the shaft speed could reach 1500r/min; for working volume greater than 0.63m³, shaft diameter range 40~130mm, the shaft speed should be limited to 320r/min.
5. 液体工作介质不可充满搅拌容器。
The working fluid should not fill the whole volume of the vessel.
6. 应采用搅拌容器内工作介质，或与工作介质不发生物理化学作用的中性液体作封液，封液在搅拌容器的工作温度下必须极小挥发且不污染大气。
Choose the working fluid or other neutral fluid that does not react with working fluid as seal liquid. The seal liquid should difficult to evaporate at working temperature, and does not pollute the air.

1.2.6 搅拌轴的设计 Design of shaft

1. 搅拌轴一般应选用塑性好的材料加工制作而成。
Choose material with better plasticity for shaft.
2. 根据安装和维修的需要，插入容器部分的搅拌轴可设计成分段结构，采用“(釜内) 联轴器”连接；容器外搅拌轴头与减速机出轴之间也可采用“带短节联轴器”连接。
For convenient installation and maintenance, the in-tank shaft could be segmented and connected with in-tank coupling. The connection between agitating shaft and reducer shaft could use coupling with stub.
3. 对顶插式轴，必要时应考虑在轴头设计吊轴结构；在轴上设计搁轴结构，以防止检修中搅拌轴下滑。
For top entry shaft, consider shaft lift structure at shaft end if necessary. Also consider shaft support structure for

maintenance.

4. 设计搅拌轴时应计算轴的强度（扭矩和弯矩组合作用强度）和临界转速，当有要求时还应计算轴的刚度（扭矩变形和弯曲挠度）。
   Calculate the shaft strength and critical speed for shaft design. If necessary, shaft rigidity also should be calculated.
5. 按柔性轴设计搅拌轴时，必须符合以下条件：
   Flexible shaft design must fulfill the following conditions.
   (1) 除单跨轴跨间段应是等直径轴段外，悬臂轴的跨间和悬臂两个轴段的直径也必须相等。
   The shaft diameter should be consistent for the single-span shaft and overhung shaft.
   (2) 在轴的计算长度范围内不应装设可拆的联轴器。
   Removable coupling is not permitted in the calculating part.
   (3) 轴上只允许安装三叶后掠式搅拌器、开启涡轮搅拌器、圆盘涡轮搅拌器及推进式搅拌器等转速较高的搅拌器。
   Flexible shaft is only suitable for high speed impellers, such as three sweptback, open turbine, disc turbine and propeller etc.
   (4) 不允许在无折流挡板的搅拌容器中安装其它内件。
   Internal parts are not permitted for vessel without baffles.
   (5) 不能在气体介质和气—液介质中使用。
   Flexible shaft could not use in gas and gas-liquid conditions.
   (6) 搅拌容器的充液高度应不低于 1/2 容器直径。
   The liquid level should not less than 1/2 of the vessel diameter.
   (7) 斗状漩涡液面凹下深度不应超过 1/2 充液高度，且漩涡最低液面不得低于搅拌器。
   The vortex depth should not exceed 1/2 liquid height and also should not lower than impeller.
   (8) 当搅拌器旋转使介质产生轴向流时，应保证搅拌轴仅受拉力为宜。
   For axial flow from the impeller, let the shaft just bear pulling force.

1.2.7 搅拌器的选择 Selection of impeller

搅拌目的的多样性，物料的多样性，以及搅拌设备形式的多样性再加上设备内部流动的复杂性，使得搅拌器的选型、设计变得比较复杂和专业。目前选型的资料比较多，但是各自的研究重点不同，彼此的结论也不尽一致。详细内容可参考相关书籍和研究报告，限于篇幅，在此不详述。

The variety of agitating purpose, working fluid, vessel types and complexity of flow field make the selection and design of impeller complicated and professional. There lots of research for impeller selection, but the different research emphasis leads to different conclusions. Please refer to the related books and research reports for detail.

2 常用搅拌机产品 Commonly Used Mixers

2.1 通用立式搅拌机 General Vertical Mixers

通用立式搅拌机主要有 GMC 系列同轴搅拌机，GMP 系列平行轴搅拌机，GMR 系列直交轴搅拌机和 GMV 系列皮带搅拌机四种型式。GMC 系列配置的是同轴减速机，该系列结构紧凑、维护方便、传动效率高、噪音小、适应领域广，可靠性高，属于中低功率的搅拌机，电机功率一般为 132kW 以下。GMP 系列配置的是平行轴减速机，具有传动平稳，噪声低，承载能力大，温升低等特点，电机功率可达 200kW。GMR 系列配置的是直交轴减速机，承载能力大，寿命长，噪音低，特别适合于高功率以及空间受限等场合。GMV 系列配置是皮带减速机，具有结构简单、传动平稳、安装和维护方便等优点。通用立式搅拌机广泛适用于生物制药、石油化工、冶金矿业、精细化工、食品饮料、环境保护等行业。

General Vertical Mixers mainly include GMC co-axial Mixers, GMP Parallel Shaft Mixers, GMR Right-angle Mixers and GMV Belt Mixers. GMC series with co-axial reducer have the advantages of compact structure, convenient maintenance, high transmission efficiency, low noise, widely use , high reliability. GMC series belong to low or medium power mixers, motor power is generally below 132 kW. GMP series with parallel shaft reducer have the advantages of stable transmission, low noise, heavy load capacity, low temperature rise. Motor power can reach at 200 kW. GMR series with right-angle reducer have the advantages of heavy load capacity, long life, low noise, which are particularly suitable for high power and limited space situations. GMV series with belt reducer have the advantages of simple structure, stable transmission, convenient installation and maintenance. General Vertical Mixers are widely used in bio-pharmaceutical, petrochemical industry, metallurgy, mining, fine chemical, food and beverage, environmental protection and other industries.

GMC 系列同轴式搅拌机 GMC Co-axial Mixers

GMP 系列平行轴搅拌机 GMP Parallel Shaft Mixers

GMR 系列直交轴搅拌机 GMR Right-angle Mixers

GMV 系列皮带搅拌机 GMV Belt Mixers

图 2-1 通用立式搅拌机的类型（GMC、GMP、GMR 和 GMV 系列）
Fig. 2-1 Types of General Vertical Mixers (GMC、GMP、GMR and GMV series)

2.2 CFJ 系列齿轮传动侧入式搅拌机 CFJ Series Gear Drive Side-Entry Mixers

CFJ 系列侧入式搅拌机采用一对螺旋齿轮传动，结构紧凑，传动效率高。箱式结构设计，外型简洁美观，电动机和安装机架直接固定在箱体上，安装调整方便快捷。搅拌轴通过锥面安装在箱体内的空心轴内，取消了联轴器，缩短了整机长度，增加了系统稳定性。配合 261 型侧搅拌专用机械密封和危机遮断机构，适合于含固体颗粒等的复杂工况。

CFJ series side-entry mixer is driven by a pair of spiral gears, so the structure is compact and the transmission efficiency is high. With box structure design, the appearance is nice. The motor and pedestal are all mounted on the box, and the adjustment is convenient. The shaft is fastened by cone sleeve in the box. The coupling is cancelled, so the length is shortened and the stability is strengthened. With 261 mechanical seal for side-entry mixers and special shut-off device, the mixer is suitable for complex conditions, such as fluid with solids.

表 Table 2-1 CFJ 系列搅拌机主要参数表
Main parameters for CFJ mixers

型号 type	电机功率(kW) Power	出轴转速(r/min) Rotation Speed of Output Shaft			
		配 4 极电机 Use 4-pole Motor		配 6 极电机 Use 6-pole Moto	
		i_I	i_{II}	i_I	i_{II}
CFJ1	0.55，0.75，1.1，1.5	350	280	230	190
CFJ2	2.2，3，4	350	280	230	190
CFJ3	5.5，7.5，11	350	280	230	190
CFJ4	15，18.5,22	350	280	230	190
CFJ5	30，37, 45	340	250	230	170

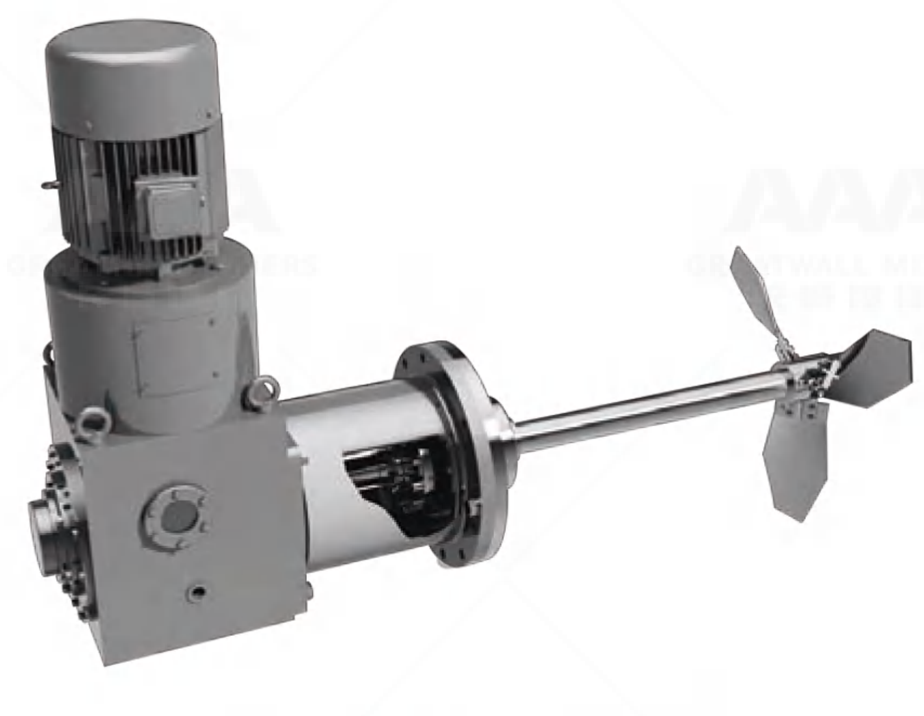


图 Fig. 2-2 CFJ 搅拌机 CFJ mixers

2.3 CKJ 系列周期摆动侧入式搅拌机 CKJ Series Swivel Angle Side-Entry Mixers

CKJ 系列周期摆动侧入式搅拌机是在 CFJ 固定角度搅拌机的基础上，增加周期摆动结构与密封装置设计而成。特别适合于原油储罐等特大型容器或对混合要求比较高的工况。可降低功耗，缩短混合时间，提高混合效果。配合 261 型侧搅拌专用机械密封和危机遮断机构，可实现带料更换和维护密封环与机械密封。

CKJ series swivel angle side-entry mixers are developed based on CFJ fixed angle mixers by adding periodically swivel device. It is suitable for such supergiant vessels, such as slurry or crude oil storage tanks, or vessels which needs perfect mixing. The swivel angle design could reduce power consumption, shorten mixing time and enhance mixing effect. With 261 mechanical seal for side-entry mixers and special shut-off device, the seal faces and mechanical seal could be maintenance without drainage of the tank fluid.

表 Table 2-2 CKJ 系列搅拌机主要参数表
Main parameters for CKJ mixers

型号 type	电机功率(kW) Power	出轴转速(r/min) Rotation Speed of Output Shaft			
		配 4 极电机 Use 4-pole Motor		配 6 极电机 Use 6-pole Moto	
		i_I	i_{II}	i_I	i_{II}
CKJ1	0.55，0.75，1.1，1.5	350	280	230	190
CKJ2	2.2，3，4	350	280	230	190
CKJ3	5.5，7.5，11	350	280	230	190
CKJ4	15，18.5,22	350	280	230	190
CKJ5	30，37, 45	340	250	230	170

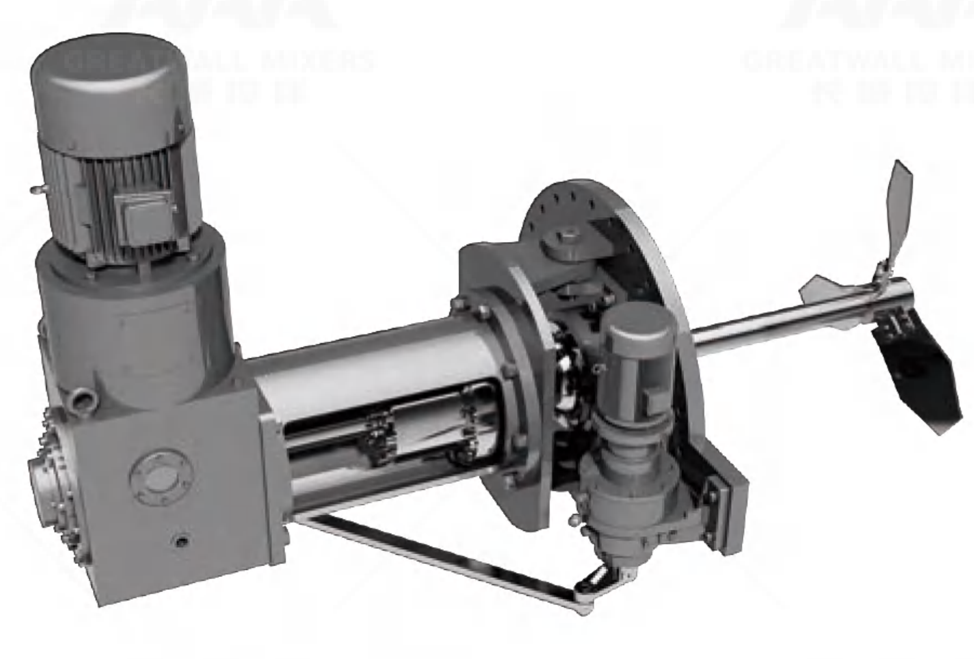


图 Fig. 2-3 CKJ 搅拌机 CKJ mixers

2.4 TD 系列带传动侧入式搅拌机 TD Series Belt Drive Side-Entry Mixers

TD 系列侧入式搅拌机采用同步齿形带传动，结构紧凑，传动效率高。设计带有内伸式支撑结构，适合于无固体颗粒的、轴伸较长的工况。内支撑架端部的危机遮断结构可实现带料进行机械密封和减速机的维修。

TD series side-entry mixers use synchronize tooth belt, so the structure is compact and the transmission efficiency is high. With inner pedestal structure, this mixer is suitable for such conditions as fluid without solids, or long extended shaft. The shut-off device at the head of the pedestal permit the maintenance of the seal or reducer without discharge the tank fluid.

表 Table 2-3 TD 系列搅拌机选型表 Selection table for TD mixers

输出转速 n (r/min) Output Speed	200	240	300	370	470	600
传动比 i Reduction Ratio	5	4	5	4	3.15	2.5
电机功率 P (kW) Motor Power	6 极电机 6-pole Motor		4 极电机 4-pole Motor			
0.55						
0.75						
1.1				TD_1		
1.5						
2.2						
3.0						
4.0			TD_2			
5.5						
7.5						
11						
15						
18.5			TD_3			
22	×					
30	×	×	×			

备注 Notes：

TD 型搅拌机安装形式按其输入功率大小分悬挂式和落地式两种，输入功率 0.55～7.5kW 为悬挂式结构，11～30kW 为落地式结构。

The mixer of 0.55～7.5kW is hanged by rope and 11～30kW is foot-mounted type.

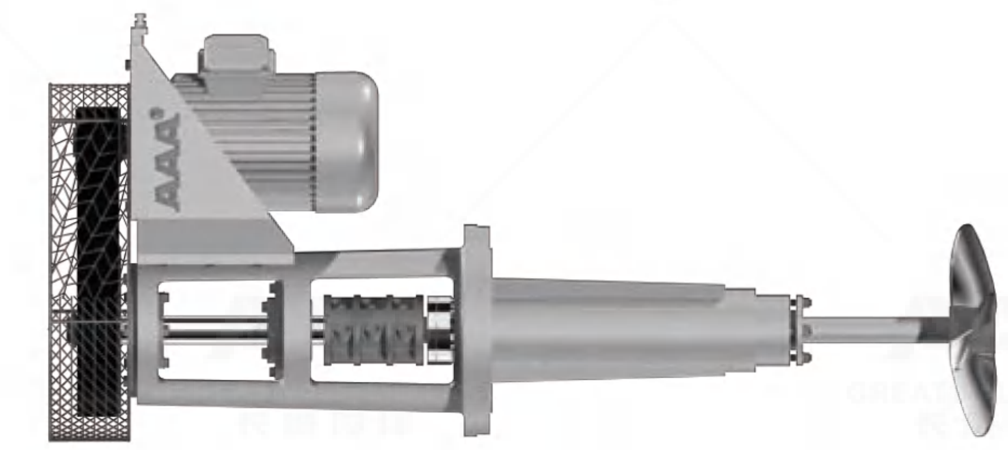


图 Fig. 2-4 TD 搅拌机 TD mixers

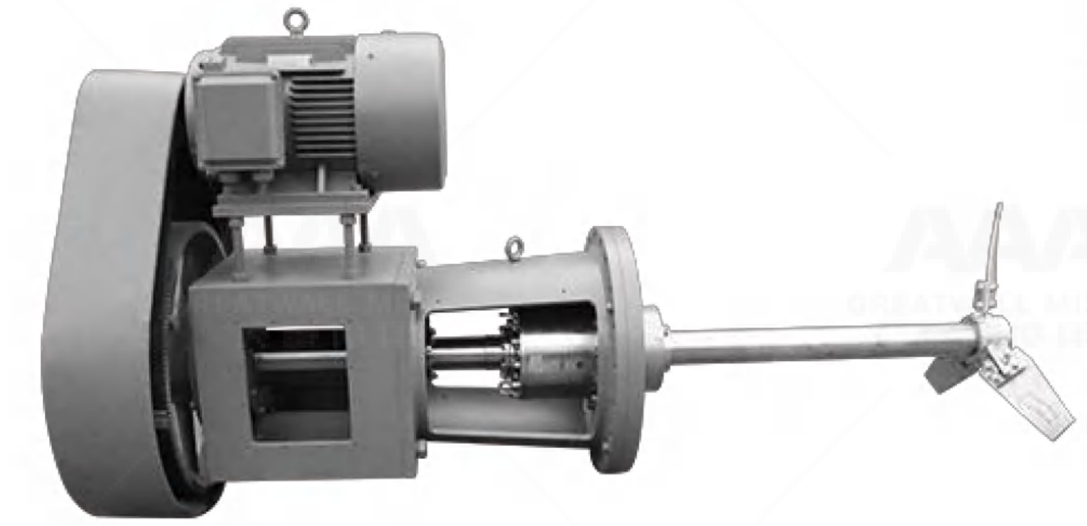


图 Fig. 2-5 CPT 搅拌机 CPT mixers

2.5 CPT 系列带传动侧入式搅拌机 CPT Series Belt Drive Side-Entry Mixers

CPT 系列侧入式搅拌机采用同步齿形带传动，结构紧凑，传动效率高。箱式结构设计，外型简洁美观，电动机和安装机架直接固定在箱体上，安装调整方便快捷。搅拌轴通过锥面安装在箱体内的空心轴内，取消了联轴器，缩短了整机长度，增加了系统稳定性。配合 261 型侧搅拌专用机械密封和危机遮断机构，适合于含固体颗粒等的复杂工况。

CPT series side-entry mixers use synchronize tooth belt, so the structure is compact and the transmission efficiency is high. With box structure design, the appearance is nice. The motor and pedestal are all mounted on the box, and the adjustment is convenient. The shaft is fastened by cone sleeve in the box. The coupling is cancelled, so the length is shortened and the stability is strengthened. With 261 mechanical seal for side-entry mixers and special shut-off device, the mixer is suitable for complex conditions, such as fluid with solids.

表 Table 2-4 CPT 系列搅拌机选型表 Selection table for CPT mixers

输出转速 n(r/min) Output Speed		传动比 i Reduction Ratio	电机功率 P(kW) Motor Power												
			1.5	2.2	3	4	5.5	7.5	11	15	18.5	22	30	37	45
4 极电机 4-pole Motor	350	4.3													
	280	5.3		CPT2							CPT4			CPT5	
6 极电机 6-pole Motor	230	4.3					CPT3							×	×
	190	5.3												×	×

2.6 XKJ 系列可移式搅拌机　XKJ Series Portable Mixers

XKJ 系列可移式搅拌机分为齿轮传动和电机直连型，齿轮传动可移式搅拌机可以广泛用于简单和复杂的混合过程。电机配上变速器适用性更强。在保证足够的强度和安全系数条件下，其具有结构紧凑、重量轻巧，非常便携的特点。配上不同的安装支架，能用于很多特殊的场合。一次性投资可以满足很多应用场合。电机直连式可移式搅拌机速度比较快，适合于分散、乳化等需要剪切力比较大的过程。安装上锯齿圆盘涡轮桨非常适合干粉的分散和溶解过程。这两种搅拌机其减速机箱体等均采用铝合金制成，可用于制药、食品等行业，满足卫生级要求。

XKJ gear drive portable mixers are the best choice for various, from simple to complex, mixing applications. Various motor choice and adjustable speed by VFD (or speed controller) provider flexible usage. The compact structure and strong housing reduce weight for really portable and at the same time ensure enough strength and service life. With additional pedestal or adapters, it can also be used at lots of special conditions. On invest will fufill various applications. XKJ direct drive portable mixers provide high speed mixing for those jobs, such as dispersion, emulsification, etc., where greater shearing is needed and it is usually used for smaller batch mixing. Greatwall high shear saw teeth impeller can be used to create locallized high-velocity eddies to provide good mixing of two fluids or dissolving of dry powders into solution. Except that, the gear boxes of both potable mixers, could be made of aluminum alloy. They could be used for pharmaceutical, food industries, which have sanitary requirements

表 Table 2-5 齿轮传动 XKJ 系列选型表 Gear drive XKJ model list

型号 model	功率 power (kW)	转速 speed (rpm)	重量 Weight (kg)
XKJ37	0.37	190/215/260	~29
XKJ55	0.55	190/215/260/290/335/400/450/500	~32
XKJ75	0.75		~36
XKJ110	1.1		~40
XKJ150	1.5	290/335/400/450/500	~42

备注 Notes：

1. 转速可以通过安装速度控制器或变频器来调节 Variable shoud be equipped with speed controller or VFD.
2. 轴和搅拌器可以根据具体的应用重新调整 The shaft and impeller will be defined according to applications.

图 Fig. 2-6 齿轮传动 XKJ 搅拌机 Gear drive XKJ mixers

表 Table 2-6 电机直连 XKJ 系列选型表 Motor drive XKJ model list

型号 model	功率 power (kW)	转速 speed (rpm)	重量 Weight (kg)
XKJ37	0.37	0-1450	23
XKJ55	0.55	0-1450	27
XKJ75	0.75	0-1450	31
XKJ110	1.1	0-1450	35
XKJ150	1.5	0-1450	37
XKJ220	2.2	0-1450	45

备注 Notes：

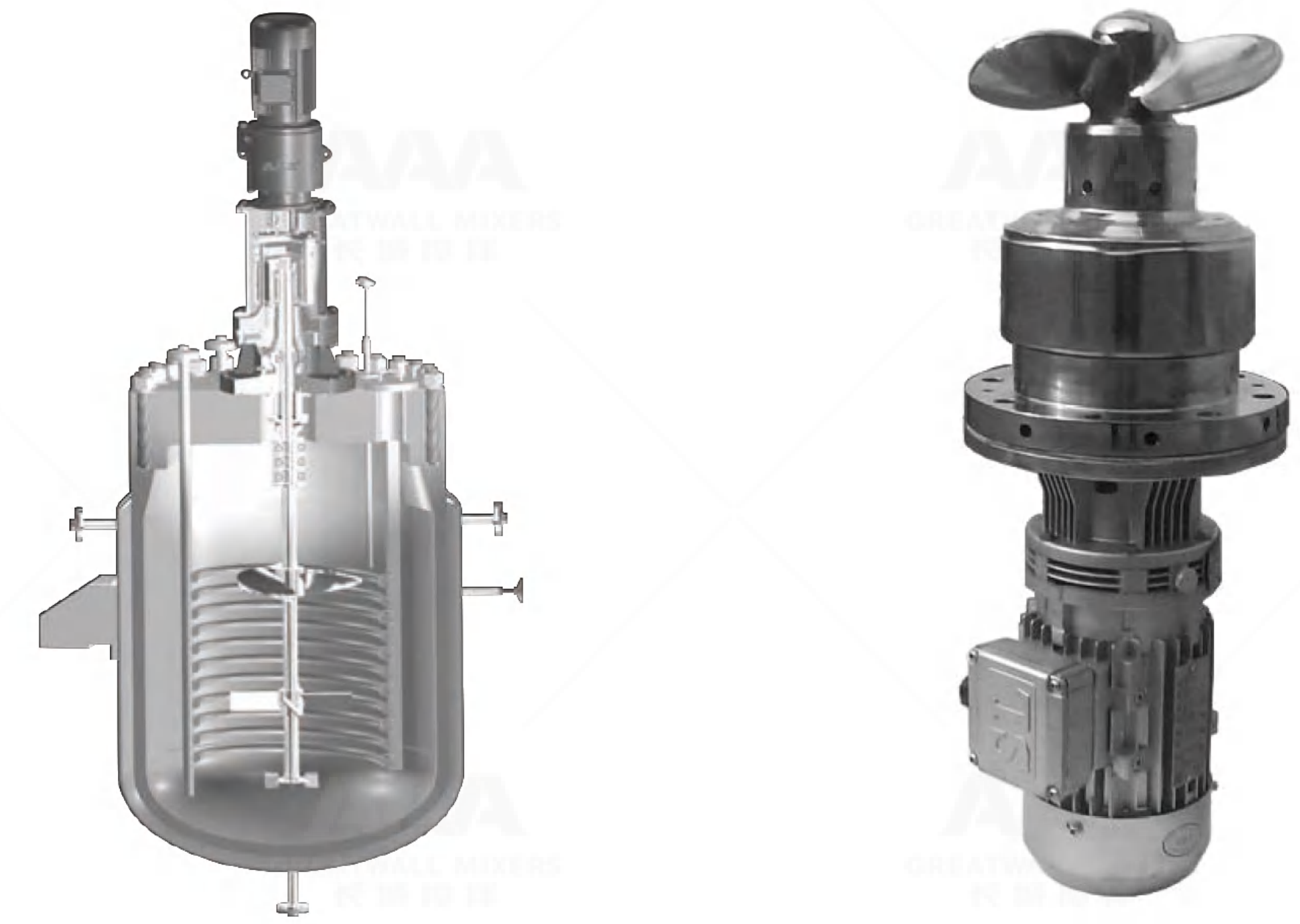
1. 转速可以通过安装速度控制器或变频器来调节 Variable shoud be equipped with speed controller or VFD.
2. 轴和搅拌器可以根据具体的应用重新调整 The shaft and impeller will be adjusted according to applications.

图 Fig. 2-7 电机直连 XKJ 搅拌机 Motor drive XKJ mixers

2.7 MTC 系列磁力传动搅拌机　MTC Series Magnetic Drive Mixers

MTC 系列磁力传动搅拌装置将永久磁性联轴器的工作原理应用于搅拌传动装置，由磁力耦合器无接触传递力矩，以静密封取代了传统的动密封（即填料和机械密封），从而彻底解决以前动密封无法克服的泄漏问题，使整个介质完全处于绝对封闭状态，适用于对泄漏有严格要求的制药、化工、生物、农药等行业。该装置可设计成顶入式和底入式结构，如图 2-8 所示。适用的温度范围-40-350 度，压力范围 0-15Mpa，扭矩范围 5-10000N.m。

MTC series magnetic drive use permanent magnet steel for the transfer of torque. Different from the moving seal (such as mechanical seal or stuffing box), the static seal solves the leakage problem at last. So it is suitable for industries which do not permit any leakage, such as pharmaceutical, chemical, biochemical, pesticide, etc. The MTC drive could be designed for top and bottom entry type, which is illustrated in Fig. 2-8. It is suitable for temperature from -40~350℃, pressure from 0~15Mpa, torque from 5~10000N.m.



(a) 顶入式 Top entry　type　　　(b) 底入式 Bottom　entry　type

图 Fig. 2-8 MTC 安装示意图 Sketch for MTC installation

表 Table 2-7 MTC 系列磁传动扭矩表　Torque list for MTC

磁传动型号 Type	第一系列 First series		第二系列 Second series		第三系列 Third series		第四系列 Fourth series	
	设计温度 Designed temp. (℃)	公称许用扭矩(N.M) Torque	设计温度 Designed temp. (℃)	公称许用扭矩(N.M) Torque	设计温度 Designed temp. (℃)	公称许用扭矩(N.M) Torque	设计温度 Designed temp. (℃)	公称许用扭矩(N.M) Torque
MTC40		30		25		30		25
MTC63		45		35		50		45
MTC80		55		45		60		55
MTC100		70		55		80		70
MTC125		90		70		95		85
MTC160		115		90		125		110
MTC200		145		115		155		140
MTC250		180		145		195		175
MTC315		225		180		245		220
MTC400	≤120	290	120～180	230	180～250	310	250～350	270
MTC500		360		290		390		340
MTC630		450		360		490		430
MTC800		580		460		620		550
MTC1000		720		570		780		690
MTC1250		900		720		970		870
MTC1400		1010		800		1090		970
MTC1600		1150		820		1250		1110
MTC1800		1300		1030		1400		1250
MTC2000		1440		1150		1560		1390

2.8 MTS 系列底入式卫生级磁力搅拌机
MTS Series Sanitary Magnetic Bottom-Entry Mixers

MTS 系列底入式卫生级磁力搅拌机同样是由磁力耦合器无接触传递力矩，克服了泄漏问题。适合应用于要求高清洁性和持久性的场合。其具有耐温和高效磁性等特点，轴承采用陶瓷轴承，一体化焊接隔离套，物料能够在搅拌器内部流通，从而消除了死角，可以实现在线清洗和灭菌。接液部件采用不锈钢 316L 材质。能适应容积范围到 30000 L，粘度能达到 1000cP。

MTS series magnetic drive mixers also use permanent magnets for the transfer of torque in order to prevent leakage. It suits applications which demand high levels of cleanability and durability. Features include temperature-resistant and high-efficiency magnets, ceramic bearing design, one-piece tank plate, flow-through channels can be cleaned in place and all wetted parts of the impeller and the tank plate made of AISI 316L stainless steel. It is suitable for up to 30000 liters and viscosity up to 1000cP.

表 Table 2-8 按粘度和体积选型图 Selection guide and options:

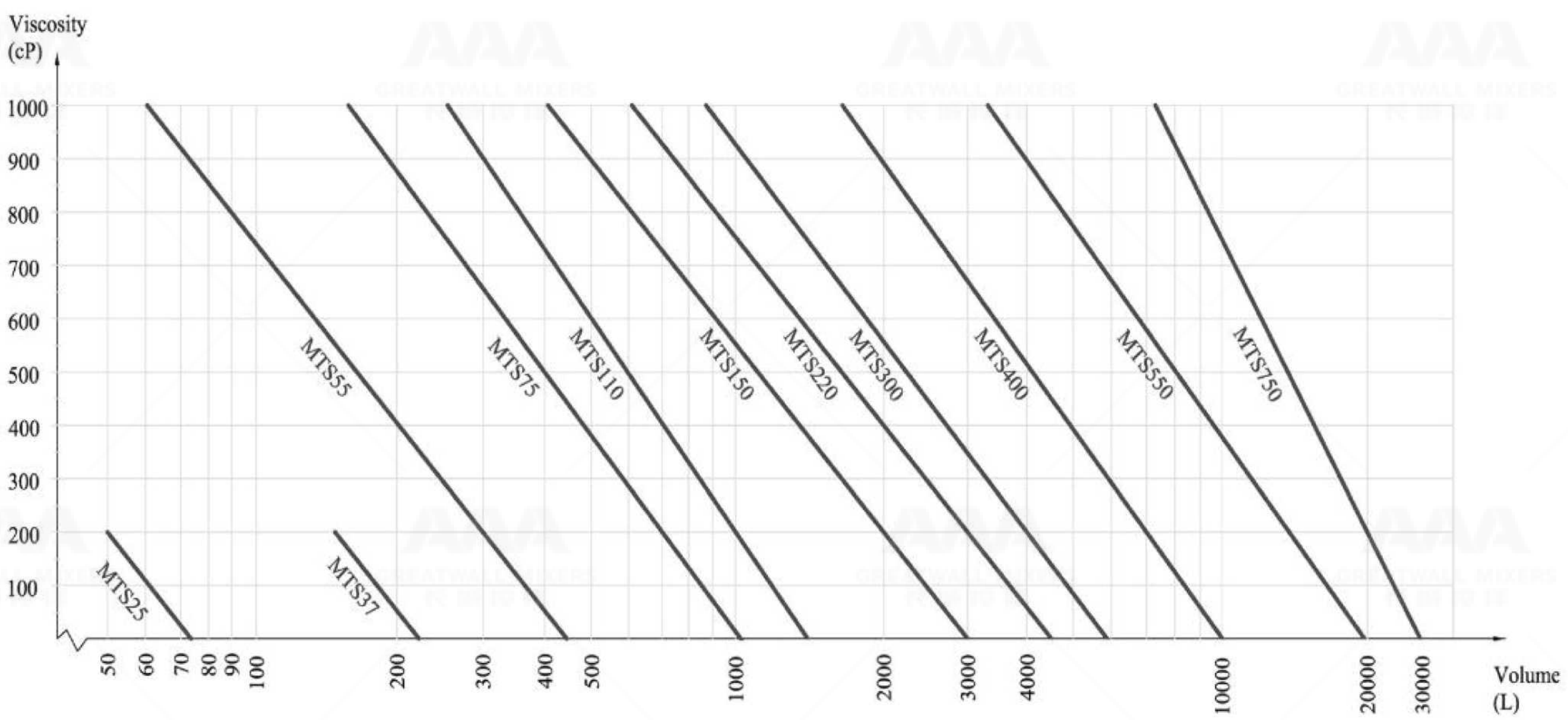


表 Table2-9 MTS 搅拌机选型表 Selection table for MTS mixers

型号 Model	功率 Power (kW)	转速 Speed (rpm)	桨叶直径 impeller diameter mm)	设计扭矩 Design torque (N.m)
MTS25	0.25	358	140	5
MTS37	0.37	358	140	5
MTS55	0.55	347	190	10
MTS75	0.75	347	190	30
MTS110	1.1	354	220	30
MTS150	1.5	352	280	63
MTS220	2.2	352	280	63
MTS300	3	302	330	100
MTS400	4	306	380	160
MTS550	5.5	278	420	250
MTS750	7.5	200	550	315

图 Fig. 2-9 MTS 搅拌机 MTS mixers

备注 Notes：
1.速度通过安装变频器条件 Speed varies when equipped with VFD;
2.搅拌器直径等参数也可以定制 Parametes such as diameter of impeller, etc. can be customized.

2.9 DTM 系列管道混合机 DTM Series Dynamic Stirring in-tube Mixers

管道混合机是用于连续生产的高性能设备，安装于管道上，一侧进料，一侧出料。高速旋转的刮刀配合进料口处的细化网可实现对物料的分散、乳化、均质处理，粒径分布范围显着变窄，物料混合更均匀，从而降低后续工序中的能量损耗，提高生产效率。主要应用于石化、精细化工、等行业中的在线混合，并可代替各行业传统的非连续配料工序。

Dynamic Stirring in-Tube Mixer (DTM) is a high-performance piece of equipment for continuous production processes. They are installed on pipelines. Feedstock is fed in on one side and discharged on another side. The dispersion, emulsification and homogenization of the material can be achieved by a high-speed rotating blade and a refined mesh at the inlet. Material mixing is more homogeneous and a narrow particle size distribution can be easily obtained, thereby reducing the energy loss in the subsequent step to improve productivity. It is mainly used for on-line mixing in petrochemicals, fine chemicals, etc. and can replace some traditional batch processes in various applications.

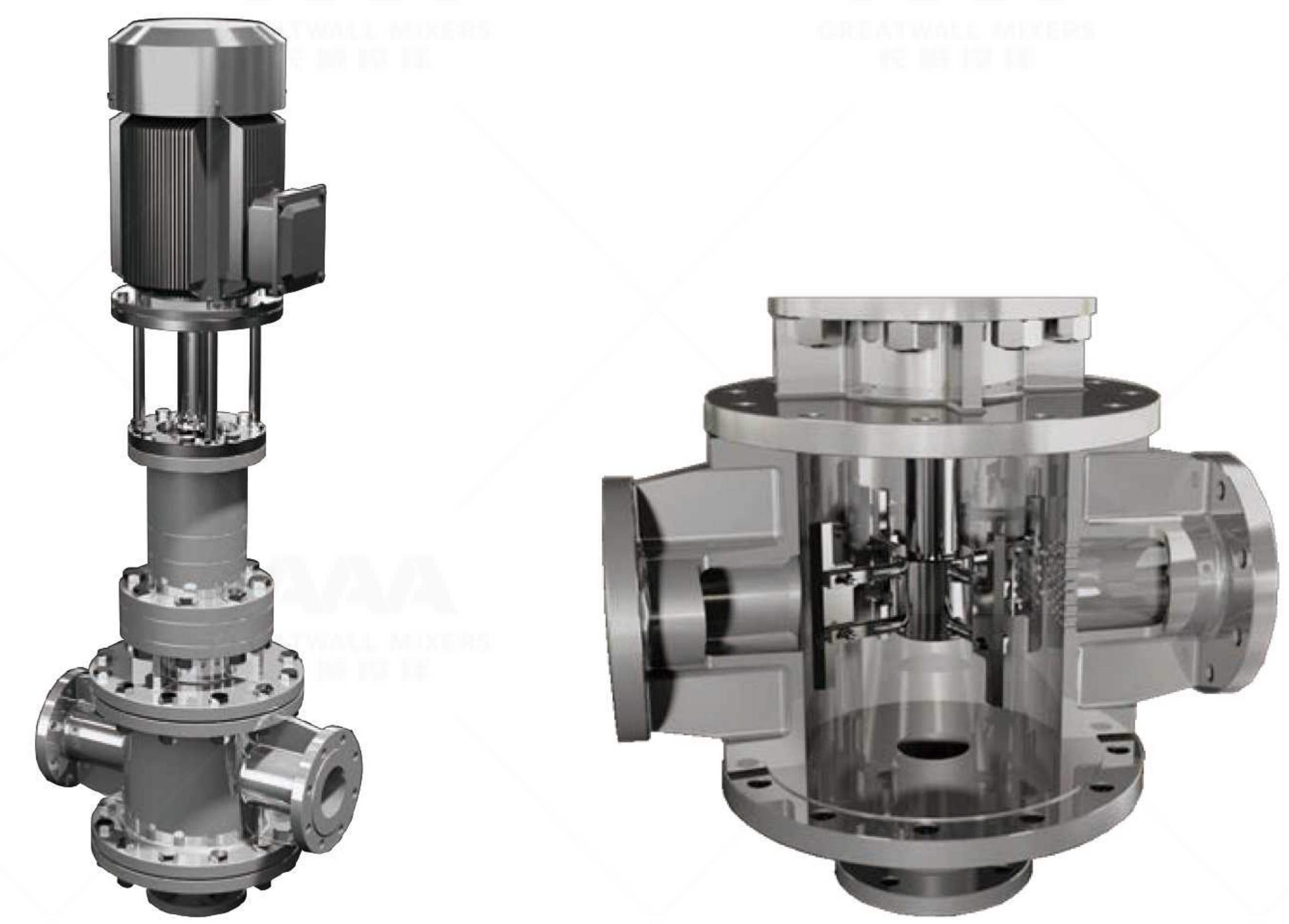


图 Fig. 2-10　DTM 系列管道混合机示意图 Sketch for DTM mixers

DTM 管道混合器的特点：
处理量大，适合工业化在线连续生产；
粒径分布范围窄，匀度高省时，高效，节约能耗；
消除批次间生产的品质差异；
操作简单，维修方便；
Features for DTM mixers：
Suitable for large flow capacities and continuous industrial production lines;
Material can be more homogeneous with narrow particle size distribution;
Save time, efficiency, save energy;
Eliminate quality differences in production between batches;
Simple to operate and easy to maintain;

表 Table2-10 DTM 系列管道混合机主要参数表
Main parameters for DTM mixers

类型 Type	功率 Power (kW)	转速 Speed (rpm)	管径 Pipe Diameter (mm)	流量 Flow Rate (m^3/h)
DTM110	1.1	1425	50	6
DTM220	2.2	1430	65	11
DTM400	4	1450	80	17
DTM750	7.5	1465	100	27
DTM1500	15	1470	125	42
DTM2200	22	1470	150	60
DTM3000	30	1480	200	100

备注 Notes：
1.配置变频器时可实现速度可调；
Speed varies when equipped with VFD.
2.所有技术参数可根据客户需求定制。
All the technical parameters can be customized.

2.10 HDM 系列一机多缸高速分散机

HDM Series High-speed Disperser with Multi-tanks

一机多缸高速分散机（HDM 系列）是一款具有分散、混合功能的批量化作业设备，具备使用寿命长、操作方便、噪音低等特点。可搭配不同规格及形式的分散搅拌器来满足不同的工艺需求，搅拌器更换方便。提升机构通常采用液压动力源，集成式的油路系统性能稳定、环保无泄漏。配备电动转向机构，可方便快捷的实现搅拌执行机构在多个工位间的切换，实现一机多缸，一般可根据需求配备 2-4 个缸体。

一机多缸高速分散机的应用领域及物料特性：涂料、油漆、油墨、胶黏剂、染料、农药、生物、医药等行业中物料的分散、混合应用。物料粘度在 50,000cps 以下，固含量在 60%以下的各种浆料，如乳胶漆、水性漆、油漆、水性油墨、农药、粘合剂等。

High-speed Disperser with Multi-tanks (HDM) is designed to disperse and mix materials in production lines with durability, reliability and minimal noise. The HDM can use a variety of mixing blades for various industrial applications. The HDM is very mobile due to it's reliable, environmentally friendly, non-leaking hydraulic system. The HDM's swivel system is capable of high turnover working with 2-4 tanks at once.

Applications for the HDM will involve the industrial mixing of organic materials, pharmaceuticals, food, paints, inks, adhesives and pesticides to name a few. The HDM can mix liquids with a maximum viscosity of 50,000 cps and solid content of less than 60% like emulsion paints, industrial paints, water-based inks, pesticides and adhesives.

图 Fig. 2-11 HDM 一机多缸高速分散机　HDM series High-speed Disperser with Multi-tanks

HDM 系列一机多缸高速分散机由转向机构、动力传递机构、搅拌执行机构、电动机和提升机构组成（见图 Fig.2-11）。搅拌器通常配锯齿圆盘型搅拌器（见图 Fig.2-12）。

HDM series high-speed disperser includes swivel system, force transmitter, disperser, motor and hydraulic system (see Fig.9.10-1). Toothed disc turbines (see Fig.9.10-1) usually be employed .

FY　TZC　FYM　FYU

图 Fig.2-12 搅拌器图 Toothed disc turbines

分散机及缸体选型推荐　Selection guide and options

物料的粘度：高速分散机通常使用的物料粘度在 50,000cP 以内，该设备非常适用于具有触变作用及流动性较好的物料搅拌。

容积：根据客户的搅拌容量要求选择与之匹配的设备，并根据客户现有的设备和人员配备进行优化选型。

缸体的设计选型：最好选择圆罐配合椭圆封头的缸体，椭圆封头的设计可以有效加速物料的循环流动以及减少死区，平底和斜底容器也是可选项，在设计上尽量采用 1：1 的高径比。考虑到非挡板条件下形成的旋涡，一般液位比缸侧壁低 30%，搅拌器直径一般是缸体直径的 1/3，搅拌器离底距离应为搅拌器直径的一半，搅拌器埋液深度一般为搅拌器直径的 1.5 倍。实际消耗功率由出轴转数、搅拌器的类型及直径、物料的密度和粘度等因素决定。

Viscosity: The upper viscosity range of materials is 50,000 centipoise. Materials are thixotropic and good liquidity under shearing conditions.

Volume: The volume of the product to meet production forecasts needs to be provided. Please consider the optimum production volume to match your capabilities considering your facilities and available staff.

Tank Design: The most suitable tank is one that has an elliptical bottom because this design optimizes the flow and minimizes the possibility of a dead zone. Flat and sloped bottom tanks can also be used but are not as optimal. Ideally a tank that has approximately the same diameter as the height is preferred for the dispersers. The liquid should only be filled up to 70% of the tank to allow for the vortex when in operation. The mixing blade should be half its diameter from the bottom of the tank. The tank diameter should be triple the diameter of the mixing blade. The liquid level should only go above the mixing blade by 1.5 times it's diameter. Power consumption is determined by the diameter of the mixing blade, density of the material and rotational speed of the mixing blade.

表 Table2-11　HDM 分散机选型表 Selection table for HDM disperser

型号 Type	功率 Power (kW)	转速 Speed (rpm)	搅拌器直径 Impeller diameter (mm)	容积 Capacity (L)	液压功率 Hydraulic power	提升行程 Lift (mm)
HDM750	7.5	0~1450	230	~400	0.55	900
HDM1100	11	0~1450	250	~500	0.55	900
HDM1500	15	0~1450	280	~700	0.55	900
HDM1850	18.5	0~1450	300	~800	0.75	1100
HDM2200	22	0~1450	350	~1000	0.75	1100
HDM3000	30	0~1450	400	~1500	0.75	1100
HDM3700	37	0~1450	420	~2000	1.1	1600
HDM4500	45	0~1450	450	~2200	1.1	1600
HDM5500	55	0~1450	500	~2500	1.1	1600
HDM7500	75	0~1450	550	~4000	2.2	1800
HDM9000	90	0~950	600	~6000	2.2	1800
HDM11000	110	0~950	700	~8000	3	2100
HDM13200	132	0~950	800	~10000	3	2300

备注 Notes:

1.表中容积是按水的物性参数，选型时应更具实际物料参数进行调整；

1. The capacity assumes materials with a viscosity of roughly 1000 cps and specific gravity of 1g/cm³.

2.表中所有参数可以根据用户需求进行调整。

2. All technical parameters can be adjusted to suit the application.

2.11 HZZC 系列回转支撑 HZZC Series Jointed Reducer

本系列回转支撑由由摆线针轮减速机，四支撑减速装置二级减速机组合而成，其结构型式见图 2.13。该种机型有两种报警控制型式，一种是用行程开关作为执行元件（用 S 表示），另一种是用压力传感器作为执行元件（用 F 表示），而且可以带提升装置，自动提升装置为标准型，手动提升装置用 A 表示，如无提升装置用 B 表示，该系列回转支撑主要用于超低速大扭矩的场合，配上耙式搅拌器（PSA、PSB）等特殊搅拌器，特别适用于澄清桶、浓缩池等搅拌槽。

This type of jointed reducer is assembled with cycloid pin gear reducer and four supporting reducing unit. The structure is showed in F.9.10.1. The unit has two types of alarming. One type uses the travel switch as run unit (denote by S), the other uses pressure senor (denote by F). The unit has lifting device. This standard type has automatic lifting device. Symbol A for the type with hand lifting device, and symbol B for the type without lifting device. This type of reducer is suited for super low velocity, high torque conditions. Equipped with rake agitator (such as PSA, PSB, or PSC), the unit performs well in settling tank, slurry tank etc.

型号表示方法及示例 Type Denotations and Examples

B HZZC— S A —3/4 — 0.112 III

轴结构类型（I 为夹壳型，II 为普通型，III 为法兰型）
code of output shaft type (I =clamp, II =general, III =flange)

输出转速 Output speed
主电机功率/电机级数 Motor power/Motor poles
提升装置类型 Lifter type (A: 自动 Auto; M: 手动 Manual; N: 无 None)
报警控制类型 Alarm type
(S: 行程开关 position switch: F: 压力传感器 Pressure sensor)
机型号 Mixer size
电机类型代号 Code for motor

表 Table 2-12 HZZC 系列搅拌机主要参数表
Main parameters for HZZC mixers

型号 Model	电机功率 kW Motor power	许用扭矩 Rated torque	提升电机功率 kW lifting device motor power
HZZC390	1.1～3	30000	0.75
HZZC590	2.2～5.5	45000	1.5
HZZC1070	3～7.5	60000	2.2

图 Fig. 2-13 HZZC 系列回转支撑 HZZC series jointed reducers

3 搅拌机部件产品 Parts of Mixers

3.1 电动机 Motor

搅拌传动装置使用的动力源主要有各类型电动机、液压马达、气动马达等。本章主要介绍电动机的选型，其它请参考相关说明。

Motor, hydraulic and air-driven motor can all be used for agitating equipment. This chapter just gives an introduction of the electric motor. Refer to other brochures for detail of hydraulic and air driven motor.

3.1.1 交流电动机的型号表示 Type denotations of motor

交流电动机的产品型号一般由产品代号、规格代号和特殊环境代号等三部分组成。

The motor product model usually composes of four parts, the product code, size code and special environment code. For detail, refer to standard GB/T4831

YB2 — 200L — WF1

特殊环境代号（参见表 3-2） Special environment code (Refer to table 2-2)
规格代号 Size code
产品代号（参见表 3-1） Product code (Refer to table 2-1)

表 Table 3-1 常用产品代号 Product code

代号 Code	含义 Meaning	代号 Code	含义 Meaning
Y	普通异步电动机 Common asynchronous motor	YBCT	隔爆型电磁调速异步电动机 Explosion proof electromagnetic speed-adjustable motor
YA	防爆安全型异步电动机 Explosion proof safety type	YEJ	制动异步电动机（附加制动器） Brake motor
YB	隔爆型异步电动机 Explosion proof type	YBEJ	隔爆型制动异步电动机（附加制动器） Explosion proof brake motor
YD	多速异步电动机 Multi-speed type	YVP	调速（变频）异步电动机 Variable Frequency Drive motor
YBD	隔爆型多速异步电动机 Explosion proof multi-speed type	YBVP	防爆调速（变频）异步电动机 Explosion proof variable frequency drive motor
YCT	电磁调速异步电动机 Electromagnetic speed-adjustable motor		

表 Table 3-2 特殊环境代号 Special environment code

代号 Code	含义 Meaning	代号 Code	含义 Meaning
W	户外型 Outdoor type	TH	湿热带型 wet and tropical type
WF1	户外防中等腐蚀型 Outdoor middle anticorrosive type	WTH	户外湿热带型 Outdoor wet and tropical type
WF2	户外防强腐蚀型 Outdoor strong anticorrosive type	TA	干热带型 Dry tropical type
F1	户内防中等腐蚀型 Indoor middle anticorrosive type	T	干、湿热合型 Mixed dry and wet type
F2	户内防强腐蚀型 Indoor strong anticorrosive type	H	船或海用 For ship or sea used type
		G	高原用 For highland used type

3.1.2 交流电动机的防护型式 Protection types of motor

交流电动机的防护型式用 IPXX 来表示。IPXX is used to describe the motor protection type.

第一位数字表示：防止人体触及或接近壳内带电部分及壳内转动部件，以及防止固体异物进入电机(参见表3-3)；第二位数字表示：防止由于电机进水而引起的有害影响（参见表3-3）。

The first X means: protect the body to touch the motor inner electric parts or rotating parts, and protect solid parts go into the motor (refer to table 3-3); the second X means: protect the motor damaged by water (refer to table 2-3).

表Table 3-3 防护型式数字的含义 Meaning of the first and second X

代号 code	第一位数字含义 Meaning of the first X	代号 code	第二位数字含义 Meaning of the second X
0	无防护电机 Without protection	0	无防护电机 Without protection
1	防止 ＞ Φ 50mm 固体进入壳内 Protect solids bigger than 50mm to go into the motor.	1	垂直滴水无有害影响 No effect for vertical water drop
2	防止 ＞ Φ 12mm 固体进入壳内 Protect solids bigger than 12mm to go into the motor .	2	电机从各方向倾斜 15 度，垂直滴水无有害影响 No effect for vertical water drop inclined 15 deg.
3	防止 ＞ Φ 2.5mm 固体进入壳内 Protect solids bigger than 2.5mm to go into the motor.	3	与垂直线成 60 度角范围内淋水应无有害影响 No effect for water splash in 60 deg from centerline.
4	防止 ＞ Φ 1mm 固体进入壳内 Protect solids bigger than 1mm to go into the motor.	4	承受任何方向溅水应无有害影响 No effect for water splash at all directions
5	防尘电机 Dust protection motor	5	承受任何方向喷水应无有害影响 No effect for water spray at all directions
6	尘密电机 Dust tight motor	6	承受猛烈的海浪冲击或强烈喷水时，电机的进水量应不达到有害的程度 No effect for strong waves or water spray
-	-	7	当电机浸入规定压力的水中经规定时间后，电机的进水量应不达到有害的程度 No effect for immersed in the specified pressure of water for a specified period of time
-	-	8	电机在制造厂给定的条件下能长期潜水 The motor can be submerged for a long time under the conditions given by the manufacturer

常用环境下电机防护类型的选择如表 3-4 所示。Refer to table 3-4 for motor protection selection.

表 Table 3-4 常见环境下电机防护类型的选择 Motor protection type selection

环境条件 Environmental condition	要求的防护型式 Protection class requested	可选用电机类型 Motor type available
普通环境条件 Common condition	一般防护等级不低于 IP23 Protection class ≥IP23	各类普通电动机 All kinds of common motors
湿热和潮湿场所(相对湿度≥90%) Hot & humid condition (relative humidity ≥90%)	湿热带型 一般防护等级不低于 IP55 Wet tropical type Protection class ≥IP55	1.普通电机加防潮处理 Common motor with damp-proof treatment 2.采用湿热带型电动机 Select wet tropical type motor
干热和高温车间 (环境温度≥40℃) Dry heat & high temperature workshop (ambient temperature≥40℃	干热带型 一般防护等级不低于 IP55 Dry tropical type Protection class ≥IP55	1.采用 F、H 高温升绝缘等级电动机或管道通风 Select F, H high temperature rise insulation class or pipe-ventilated motor 2.干热带型电动机 Select dry tropical type motor
粉尘较多的场所 Dusty condition	IP55 加封闭型或管道通风 IP55 with enclosed type or pipe-ventilated type	普通电机加封闭型 Common motor with enclosed type
室外、露天场所 Outdoor	防护等级不低于 IP55 Protection class ≥IP55	带防雨罩封闭型电机 Enclosed motor with weather-proof cover
有腐蚀性场所 Corrosive environment	防护等级不低于 IP55 Protection class ≥IP55	化工防腐型或管道通风 Chemical anti-corrosive type or pipe-ventilated type
爆炸性危险场所 Hazardous environment containing explosive materials	一般防护等级不低于 IP55 Protection class ≥IP55	采用隔爆型电机(YB) Select explosion proof motor (YB)
室外、有腐蚀、爆炸性气体场所 Outdoor, corrosive, with explosive gas environment	一般防护等级不低于 IP55 Protection class ≥IP55	采用室外、防腐、隔爆型电机 Select outdoor, anti-corrosive, explosion proof motor

备注 Note：正常环境条件指不受雨水侵蚀，-15℃≤环境温度≤40℃，相对湿度≤90%，海拔高度≤1000m。

Remark: Common environmental condition is defined as follows, not corroded by rainwater, -15℃≤ambient temperature≤40℃, relative humidity≤90%, height above sea level≤1000m.

3.1.3 交流电动机的绝缘等级 Insulation level of the motor

电机绝缘结构是指用不同的绝缘材料、不同的组合方式和不同的制造工艺制成的电机绝缘部分的结构型式。电机绝缘耐热等级及温度限值见表3-5。

The insulation structure of motor is different according to different insulation material, different combination type and different manufacture technology. The insulation level and limited temperature is listed in table 3-5.

表Table 3-5 Insulation level and limited temperature

绝缘等级 Insulation level	A	E	B	F	H	C
最热点温度 Highest temperature (℃)	105	120	130	155	180	>180

3.1.4 电动机的防爆 Explosion-proof of the motor

将工厂或矿区的爆炸危险介质，按其引燃能量，最小点燃温度以及现场爆炸性危险气体存在的时间周期进行科学分类分级，以确定现场防爆设备的防爆标志和防爆形式。

The motor explosion-proof types are classified according to ignition energy, minimum lighting temperature and existing time of dangerous gas.

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- 温度组别 Clarification of temperature (参见表 3-8，Refer to Table 3-8)
- 气体类别 Clarification of gas (参见表 3-8，Refer to Table 3-8)
- 防爆方式 Explosion-proof type (参见表 3-7，Refer to Table 3-7)
- 防爆声明 Label for explosion-proof

表 Table 3-6 危险场所危险性划分 Classification of dangerous zones

爆炸性物质 Explosion material	区域定义 Description of the zone	中国标准 Chinese standard	北美标准 (NEC)
气体 Gas (CLASS I)	在正常情况下，爆炸性气体混合物连续或长时间存在的场所 At normal conditions, explosion gas mixture will exist continuously or for long time.	0 区 Zone 0	Div.1
	在正常情况下，爆炸性气体混合物有可能出现的场所 At normal conditions, explosion gas mixture will probably exist.	1 区 Zone 1	
	在正常情况下，爆炸性气体混合物不可能出现，仅仅在不正常情况下，偶尔或短时间出现的场所 At normal conditions, explosion gas mixture will not exist. At unmoral conditions, it will exist occasionally or at very short time.	2 区 Zone 2	Div.2

表 Table 3-7 防爆方式 Explosion-proof types

序号 No.	防爆方式 Type	代号 Code	国家标准 Standard	防爆措施 Method for explosion-proof	适用区域 Application
1	隔爆型 Fame-proof	d	GB3836.2	隔离存在的点火源 Isolate the existed ignition source	Zone 1 zone 2
2	增安型 Increased safety	e	GB3836.3	设法防止产生点火源 Prevent the exist of ignition source	Zone 1 zone 2
3	本安型 intrinsic safety	ia	GB3836.4	限制点火源的能量 Limited the energy of ignition source	Zone 0~2
		ib			Zone 1 zone 2
4	正压型 Pressurized	p	GB3836.5	危险物质与点火源隔开 Isolate the dangerous material with ignition source	Zone 1 zone 2
5	充油型 Liquid immersion	o	GB3836.6	危险物质与点火源隔开 Isolate the dangerous material with ignition source	Zone 1 zone 2
6	充砂型 Powder filling	q	GB3836.7	危险物质与点火源隔开 Isolate the dangerous material with ignition source	Zone 1 zone 2
7	无火花型 No spark	n	GB3836.8	设法防止产生点火源 Prevent the exist of ignition source	zone 2
8	浇封型 Encapsulation	m	GB3836.9	设法防止产生点火源 Prevent the exist of ignition source	Zone 1 zone 2

表 Table 3-8 代表性气体分类与温度组别 Typical gas clarification and temperature grade

级别 Grade	允许最高表面温度组别（按爆炸气体引燃温度划分）℃ Allowable max surface temperature group (divide according to firing temperature of explosive gas) ℃					
	T1 (≤450)	T2 (≤300)	T3 (≤200)	T4 (≤135)	T5 (≤100)	T6 (≤85)
IIA	乙烷、丙烷、苯乙烯、二甲苯、苯、一氧化碳、丙酮、醋酸、氨、吡啶、等 Ethane, propane, styrene, xylene, benzene, carbon monoxide, acetone, acetic acid, ammonia, pyridine, etc	丁醇、丁烷、丙稀、醋酸乙烯、二氧乙烷、氯乙烯、氯乙醇、噻吩、环戊烷、二甲胺 Butanol, butane, propylene, ethylene acetate, dioxyethane, vinyl chloride, chloroethanol, thiophene, cyclopentane, dimethylamine	戊烷、癸烷、乙基环戊烷、松节油、石脑油、石油（包括汽油）、燃料油、戊醇四氯 Pentane, decane, ethyl cyclopentane, turpentine, naphtha, petroleum (including gasoline), fuel oil, pentanol tetrachloride	乙醛、三甲胺 Acetaldehyde, trimethylamine		亚硝酸乙酯 Ethyl-nitrite
IIB	丙炔、环丙烷、丙烯晴、氢化氨、焦炉煤气 Propylene, cyclopropane, propylene fine, hydrogenated ammonia, coke oven gas	乙烯、丁二烯-1,3、环氧乙烷、1,2-环氧丙烷、1,4-二氧杂环已烷、丙烯酸甲酯、丙烯酸乙酯、呋喃 1-氯-2,3 环氧丙烷 Ethylene, butadiene-1,3, ethylene oxide, 1, 2-epoxy propane, 1, 4-dioxane, methyl acrylate, ethyl acrylate, furan 1-chloro-2,3 epoxy propane	二甲醚、甲氢化呋喃甲醇、丁烯醛、丙烯醛、四氢呋喃、乙硫醇、硫化氢 Dimethyl ether, methylhydrofuran methanol, butenal, acrolein, tetrahydrofuran, ethylmercaptan, hydrogen sulfide	乙基甲基醚、二乙醚、二丁醚、四氯乙烯 Ethyl methyl ether, diethyl ether, dibutyl ether, tetrachloroethylene		
IIC	氢 hydrogen	乙炔 acetylene			二硫化碳 Carbon disulfide	

3.1.5 电机能效等级 Energy efficiency classes of the motor

电机能效标准的划分标准在不同的时期按照国家的标准是不一样的。不同国家的标准也是不同的。仅以我们国家来说，电机能效等级的划分也是随着时间的变化会变化的。具体的能效变化要求见下表。

The division of motor energy efficiency standards is different in different periods. For different countries, the standards are different. In China, the division of motor energy efficiency classes also changes as time passes. For the comparison of energy efficiency standards of three phased asynchronous motor, please see details below.

表 3-9 中小型三相异步电动机能效标准对比

Table 3-9 Comparison of energy efficiency standards of three phased asynchronous motor

IEC60034-30（国际国标/International standard)	GB18613-2020（2020 版中国标准/ 2020 China national standard）	GB18613-2012（2012 版中国标准/ 2012 China national standard）	GB18613-2006（2006 版中国标准/ 2006 China national standard）
IE5	能效一级/energy efficiency Level Ⅰ		
IE4	能效二级/energy efficiency Level Ⅱ	能效一级/energy efficiency Level Ⅰ	
IE3	能效三级/energy efficiency Level Ⅲ	能效二级/energy efficiency Level Ⅱ	能效一级/energy efficiency Level Ⅰ
IE2		能效三级/energy efficiency Level Ⅲ	能效二级/energy efficiency Level Ⅱ
IE1			能效三级/energy efficiency Level Ⅲ

备注 Note：

我国电动机能效标准仅对低压三相笼型异步电动机能效提出了要求。

The energy efficiency standard is available for low-voltage three-phased cage asynchronous motor.

3.2 减速机 Reducer

长城搅拌专业生产各种型式的釜用减速机，并且是行业标准《釜用立式减速机》（HG/T3139）的起草单位，主要产品如下所述。

Greatwall Mixers is the drafter of chemical industry standard “Vertical reducer for tank”(HG/T3139). Refer to the following for products detail description.

1. X 系列摆线针轮减速机 X series cycloid Pin Gear Reducer

特点 Characteristics:：

摆线针轮行星减速机，是一种应用行星传动原理，采用摆线针齿啮合的减速机构。它具有减速比大、结构紧凑、体积小，承载能力大、运转平稳等特点。

The reducer works on planetary transmission principle with pin gear meshing, which has the good features of high reduction ratio, compact structure, smooth run and heavy loads, etc.

转速范围 speed range(RPM): 0.002≤n≤160

执行标准 Standards: HG/T3139

2. LC 系列齿轮减速机 LC series Gear Reducer

特点 Characteristics:：

LC 系列减速机为两级同轴式硬齿面斜齿圆柱齿轮减速机，LC 为立式，LCW 为卧式。适用于各行业设备的减速装置，特别是搅拌传动装置，具有传动平稳、噪声低、效率高、承载能力高等特点。同时还具有组合配套范围广，可配多种系列的电动机、无级变速机、机架、联轴器及轴封，以适应有防爆要求的场所及工艺参数多变的工艺要求。

LC series are two-stage co-axial hard surface cylindrical gear reducer. LC is vertical type and LCW is horizontal type. It is suitable for various industries and has the features of smooth transmission, low noise, high efficiency, heavy loading, etc.

转速范围 speed range(RPM): 65≤n≤500

执行标准 Standards: HG/T3139

3. CF 系列齿轮减速机 CF series Gear Reducer

特点 Characteristics:：

CF 系列两级、三级减速机为同轴式硬齿面齿轮减速机，该机是在 LC 型减速机基础上吸取国外先进技术而设计的，采用模块化设计思路，具有结构紧凑体积小、承载能力大、寿命长、噪声低等特点。

CF series are co-axial hard surface gear reducer. Two-stage and three-stage are all available. It is designed from the combination of improvement of LC and international advantage technology. It has the characteristic of modular structure, compact volume, high loading, long life and low noise level. .

转速范围 speed range(RPM): 65≤n≤500

执行标准 Standards: HG/T3139

4. PF 系列齿轮减速机 PF series Gear Reducer

特点 Characteristics:：

PF 系列两级、三级减速机为平行轴式硬齿面齿轮减速机，该机是吸取国外先进技术而设计的，采用模块化设计思路，具有结构紧凑体积小、承载能力大、寿命长、噪声低等特点。

PF series are two-stage or three-stage parallel shaft hard surface gear reducer. It is designed based on international advantage technology. It has the characteristic of modular structure, compact volume, high loading, long life and low noise level.

转速范围 speed range(RPM): 12≤n≤320

执行标准 Standards: 企业标准 Enterprise standard

5. LP 系列齿轮减速机 LP series Gear Reducer

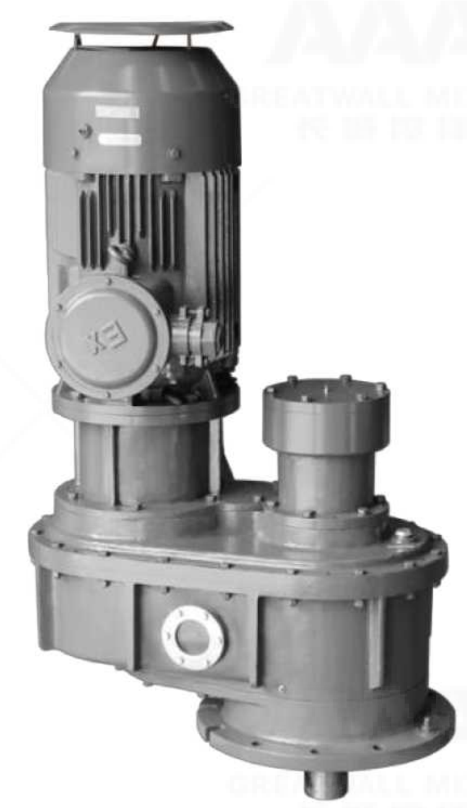
特点 Characteristics:：

LPJ 系列立式平行轴硬齿面斜齿圆柱齿轮减速机，是在 LC 型两级齿轮减速机基础上吸取国际先进技术而设计的，从最大程度上克服了漏油，并降低了噪声。电机与减速机之间采用弹性联轴器联接，检修、换件方便。LPP 型是在相同规格的 LPJ 型之前增加了一级带传动（窄 V 带或同步齿形带），最大传动比可达 100，选用时应校核输出轴许用扭矩。LPB 超长轴型搅拌减速机，可以在没有其它支承的情况下，借助刚性（刚性凸缘、夹壳式、三分式等）联轴器与搅拌轴直联使用，适用于超长悬臂搅拌装置。

The LPJ series is based on the experiences of LC and international advanced technology. Which is no oil leakage, low noise and easy maintenance. Adding one-stage belt (narrow V belt or synchronous cog belt) drive before type LPJ comes to type LPP. The maximum transmission ratio may reach 100.LPB is a long-shaft agitating reducer can connect directly to shaft through rigid coupling without other supports, which is suitable for agitating equipment within a very long overhang shaft.

转速范围 speed range(RPM): 16≤n≤330

执行标准 Standards: HG/T3139



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6. LP 改进系列齿轮减速机 LP improved series Gear Reducer

特点 Characteristics:：

LP 改进系列立式平行轴硬齿面斜齿圆柱齿轮减速机，是在 LP 系列齿轮减速机基础上采用中国重型机械联合企业标准 JB/ZQ 6101，同时吸取国际先进技术而设计的，进一步克服漏油，降低噪声，并提高了承载能力。

The LP improved series is designed based on the experiences of LP, and international advanced technology, which is no oil leakage, low noise and high loading.

转速范围 speed range(RPM): 16≤n≤750

执行标准 Standards: HG/T3139 JB/ZQ6101

7. FJ 系列齿轮减速机 FJ series Gear Reducer

特点 Characteristics:：

FJ 系列减速机采用硬齿面圆柱齿轮与弧齿锥齿轮设计，包含 FJ 型（标准型）；FJA 型（其输出轴设计成中空结构，搅拌轴可穿过输出轴并在减速机的两端设有大跨距独立支承，使搅拌轴的挠曲与减速机传动部分互不干涉，其结构虽复杂，但使用维修方便）；FJB 型（大跨距型）；FJC 型（双轴型）；FJD 型（底搅拌型）。该系列减速机采用方箱积木式结构，组合方便，型式多样，而且还可根据用户需要特殊设计。采用飞溅式润滑，还有特殊的干井结构，可在最大程度上确保不漏油。

FJ series reducer uses the combination of cylindrical and spiral bevel gears. It includes the following types, FJ (standard type), FJA (hollow output shaft, convenient maintenance), FJB (large span type), FJC (dual-shaft type) and FJD (bottom-entering type). The structure of this series use square box building block type, result in convenient assembly and various types. It can be designed according to special requirements. Its lubricating type is splash lubrication. The dry-well structure could avoid oil leakage.

转速范围 speed range(RPM): 12≤n≤150

执行标准 Standards: HG/T3139

8. ZF 系列齿轮减速机 ZF series Gear Reducer

特点 Characteristics:：

ZF 系列减速机为直交轴式硬齿面齿轮减速机，该机是吸取国外先进技术而设计的，采用模块化设计思路，具有结构紧凑体积小、承载能力大、寿命长、噪声低等特点。

ZF series are hard surface right-angle type gear reducer. It is designed based on international advantage technology. It has the characteristic of modular structure, compact volume, high loading, long life and low noise level.

转速范围 speed range(RPM): 13.5≤n≤265

执行标准 Standards: HG/T3139

3

9. P 系列皮带减速机 P series Belt Reducer

特点 Characteristics:：

本系列是在原化工部标准（HG5-747-78）的基础上改进和发展的产品。其中 PV 型采用窄 V 带传动，效率更高、寿命更长；PT 型采用同步齿形带传动，其外形紧凑、传动比准确、无滑差又节能。本系列减速机输出轴只有一种形式，并配套供应夹壳联轴器（HG5-213-65），若有特殊要求，须在订货时说明。本系列允许正反方向运转，也可用于有防爆要求的场合，除配上隔爆电机外，还须配上专用防静电 V 带。

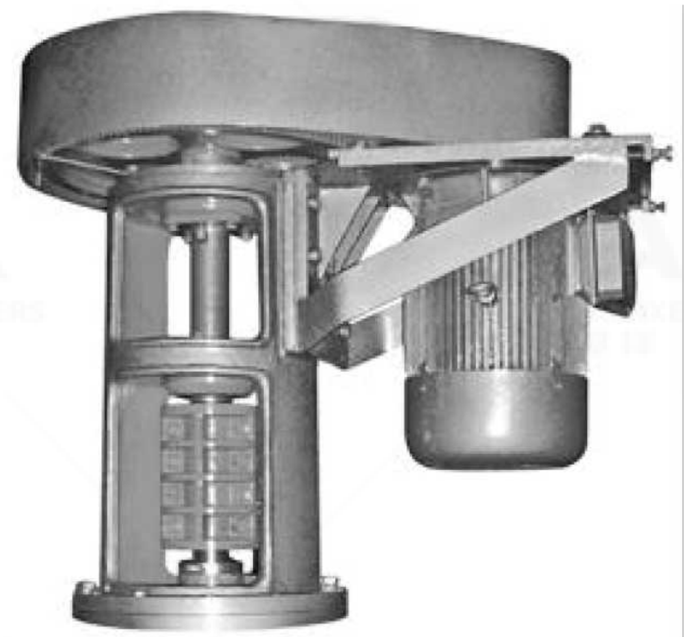
Driving belts with narrow V belts is very efficient and type PT with synchronous cog belts has a long life， and has a compact structure and calm driving

ratio, type LPV and PT especially used in sewerage .The output shaft matches clamp type coupling . If you have special requirements, contact us.Bi-directional rotation is allowable. For explosion-proof situation, select explosion-proof motor and special anti static V belts or synchronous belts.

转速范围 speed range(RPM): 200≤n≤500

执行标准 Standards: HG/T3139

10. FP系列皮带减速机 FP series Belt Reducer



特点 Characteristics:：

本系列减速机选用窄V带，承载能力比普通带高50%以上。适用于环境卫生标准要求高的食品、制药行业。出轴分Ⅰ型（与夹壳联轴器相配）和Ⅱ型（普通型），电机分立式（V_1安装型式）和卧式立装（V_6安装型式）两种。机座高度分降低型、标准型、增高型，供选配不同型式的联轴器及机械密封。型号后面必须用括号注明机座高度H的数值。

High-strength V belt or narrow V belt can improve load capacity by 50% than general V belt. It is suitable for high environmental health conditions such as food, pharmaceutical industries. The structure of the output axle head has two types: Ⅰ (connect with clamp coupling) and Ⅱ (general type). The height of the reducer base has three types: low type, standard type and high type to match variable couplings and mechanical seals. The height (H) should be marked in the parentheses at the end of the type denotation.

转速范围 speed range(RPM): 135≤n≤400

执行标准 Standards: HG/T3139

11. YP系列皮带减速机 YP series Belt Reducer

特点 Characteristics:：

采用大功率窄V带、高强力带，皮带传递功率会产生热量，但是不需要辅助冷却措施，皮带减速机结构简单，操作维修比较方便，适用于生物发酵系统等大功率电机的场合。

The YP series belt reducers use high power narrow V belt and high intensity belt. Belt transmission will produce heat, but do not require auxiliary cooling equipment. The structure of belt reducer is simple and operation and maintenance is convenient, so it is suitable for biological fermentation systems and so on.

转速范围 speed range(RPM): 85≤n≤250

执行标准 Standards: HG/T3139

3.3 联轴器 Coupling

联轴器的作用是将两个独立设备的轴牢固地联在一起，以进行传递运动和功率。常用的联轴器分为三大类：刚性联轴器、弹性联轴器和液力偶合器。

Coupling is used to connect the output shaft of two separate units, and at the same time movement and power is also transmitted. There are three kinds of coupling, rigid type, flexible type and fluid coupling.

1. 刚性联轴器 Rigid Coupling

刚性联轴器联接两轴时，轴线对中性好，允许在任何方向转动，结构简单，制造方便。常用的有夹壳联轴器、凸缘联轴器以及衍生出来的三分式联轴器。

Rigid coupling can be good center of axes, running in any direction, simple structure and easy manufacture. The following are common type of rigid coupling.

夹壳联轴器使用时装拆方便、快捷，径向尺寸小，但外型结构较为复杂，制造成本相对较高，一般用于中、低速需经常装拆及釜内轴头联接。（如JQ,JJQ）

Clamp coupling are easy to align and disassemble conveniently. The dimension of radial is small, but the frame of exterior is complex. The cost of produce is high. They are used in middle and low rotation speed which must be aligned and disassembled often and the connection of the ends which are in tank. (Model：JQ,JJQ)

凸缘联轴器。其中DT型带有轴端压板，能承受轴向负载。而GT型则不带轴端压板，只能传递扭矩。（如GT,DT）

Flange coupling have good center of axes. DT has press board and it can support axes load. GT has no press board and it can only transfer torque. (Model：GT,DT)

三分式联轴器是根据凸缘联轴器和夹壳联轴器，结合方便维护的功能需求，所衍生出来的产品。可实现不拆除减速机和机架的条件下更换密封和轴承室。（如DF,SF）

Triplex coupling is a product derived from clamp coupling and flange coupling, which combined for convenient maintenance. The pedestal's bearing and seal can be disassembled easily without removal of reducer and pedestal.

JQ,JJQ

GT,DT

DF

SF

2. 弹性联轴器 Flexible Coupling

弹性联轴器由于具有能够产生较大弹性变形和阻尼作用的弹性元件，因此具有较好的补偿相对位移和缓冲、吸振作用。常用型号的有T型梅花形弹性联轴器、TK型弹性块式联轴器、TL型为弹性套柱销联轴器、HL型为弹性柱销联轴器。

Flexible coupling has virtues of equalizing relative displacement and cushion, absorbing vibrancy, because it has elastic parts which can produce great spring transmutation and damp. The following are common type of flexible coupling.

T

TK

TL

HL

3.4 机架　Pedestal

搅拌装置所配的机架一般分为无支点机架、单支点机架、双支架机架以及一些特殊功能的机架。

1. 无支点 Nonsupport

特点及应用 Features and applications：

WJ 为标准型，LWJ 型为增高型。WJ 型一般用于单端面机封或填料箱，LWJ 一般用于双端面密封等高度较高的密封型式。减速机输出轴与搅拌轴联接用 JQ 型夹壳联轴器或 DT 型凸缘联轴器。

WJ is standard type and LWJ is heightened type. WJ usually used for single-face mechanical seal or stuffing box, while LWJ usually used for double-face mechanical seal. JQ or DT type coupling are used for the connection of reducer shaft and agitating shaft.

型号 Type：WJ　LWJ

规格系列 Specification：30-180

执行标准 Standards：HG/T 3139

2. 单支点 Single Support

特点及应用 Features and applications：

机架分普通型 DJ 和增高型 LDJ 两种，上部空间一般配 GT 型凸缘联轴器。机架下部空间可容纳轴封规格同 WJ(LWJ)。

DJ is the standard type and LDJ is heightened type. GT series flange coupling usually used for these pedestal. Rules for shaft seal are the same as WJ (LWJ).

型号 Type：DJ　LDJ

规格系列 Specification：25-180

执行标准 Standards：HG/T 3139

3. 单支点 Single Support

特点及应用 Features and applications：

JD(LJD)系列机架底部安装法兰采用 HG/T 20615 标准（ANSI 150#）。机架上部配 GT 凸缘联轴器，下部空间可容纳轴封情况同 WJ(LWJ)型机架。

The bottom flange of JD (LJD) complies with the standard HG 20615-97 (ANSI 150#). GT series flange coupling usually used for these pedestal. Rules for shaft seal are the same as WJ (LWJ).

型号 Type：JD　LJD

规格系列 Specification：20-180

执行标准 Standards：企业标准 Enterprise standard

4. 单支点 Single Support

特点及应用 Features and applications：

JXD 与 DXJ 两种机架的支承在机架底部，机架内没有轴封。减速机输出轴与搅拌轴联接一般用 GT 凸缘联轴器。这两种机架，常使用于常压或敞开式容器。JXD 安装法兰按 HG20615（ANSI 150#）。

The bearings are at the bottom of JXD and DXJ. There is no seal for these pedestals. It usually used for ATM or open tanks. The bottom flange of JXD complies with the standard HG 20615 (ANSI 150#).

型号 Type：JXD　DXJ

规格系列 Specification：20-180

执行标准 Standards：企业标准 Enterprise standard　HG/T 3139

5. 单支点 Single Support

特点及应用 Features and applications：

搪玻璃专用机架，减速机输出轴与搅拌轴用 GT 凸缘联轴器连接，机架空间可容纳目前所配搪玻璃专用轴封，如 212 型机械密封。

TB special single support pedestal is suitable for glass lining equipment. GT coupling usually used in this pedestal. Special mechanical seal for glass lining equipment, such as 212, usually used in this pedestal.

型号 Type：TB

规格系列 Specification：1-6

执行标准 Standards：企业标准 Enterprise standard

6. 单支点 Single Support

特点及应用 Features and applications：

XD 系列单支点机架为 HG21566 搅拌装置标准配套机架。机架分 A 型和 B 型两种。一般配套 2000 系列机械密封。机架上部空间配用 DF 凸缘三分式联轴器，可在不拆除减速机和机架的条件下拆装机械密封。

XD series pedestal complies with the standard HG21566 . It has two types, A and B. 2000 series mechanical seals usually used in these pedestals. With DF flange type triple clamp coupling, the seal could be repaired without removal of the reducer and pedestal.

型号 Type：XD

规格系列 Specification：1-7

执行标准 Standards：HG/T 3139

7. 双支点 Double Support

特点及应用 Features and applications：

SJ(LSJ)机架具有两个支点，一般配套弹性联轴器，SJ 为标准型和 LSJ 为增高型，下部空间可容纳轴封型式同 WJ(LWJ)。

SJ (LSJ) has two supporting points, and usually used flexible coupling. SJ is standard type, and LSJ is heightened type. Rules for shaft seal are the same as WJ (LWJ).

型号 Type：SJ　LSJ

规格系列 Specification：55-180

执行标准 Standards：HG/T 3139

8. 双支点 Double Support

特点及应用 Features and applications：

XS 系列双支点机架为 HG21567 搅拌装置标准配套机架。机架分 A 型和 B 型两种。一般配套 2000 系列机械密封和弹性联轴器。机架两支承间用 DF 凸缘三分式联轴器，可在不拆除减速机和机架的条件下拆装机械密封。

XS series pedestal complies with the standard HG21567-95. It has two types, A and B. 2000 series mechanical seals and flexible coupling usually used in these pedestals. With DF flange type triple clamp coupling used between the two supporting points, the seal could be repaired without removal of the reducer and pedestal.

型号 Type：XS

规格系列 Specification：3-7

执行标准 Standards：HG/T 3139

9. 其他 others

特点及应用 Features and applications：

SWJ, SDJ 系列升降式机架采用特殊设计的结构，能够在不需要拆卸减速机和电机的情况下实现搅拌装置中机械密封的维护和更换，从而减轻了设备维护的工作量。SWJ 为无支点系列，　SDJ 为单支点系列。配套本系列机架时需要设计有搁轴装置，机械密封优先选用 2000 系列机械密封。

SWJ and SDJ series pedestals are specially designed for convenient maintenance of mechanical seals. Without removing the reducer and motor, the mechanical seal could be replaced. This special design could reduce the work of equipment maintenance. SWJ is non-support type and SDJ is single-support type. If this series pedestal is selected, there should have shaft shelf structure, and 2000 series mechanical seals are recommended.

型号 Type：SWJ　SDJ

规格系列 Specification：1-5

执行标准 Standards：企业标准 Enterprise standard

3.5 轴封 Shaft seals

搅拌装置使用的轴封形式主要有机械密封，填料箱，唇封，液封等。

Shaft seal for agitating equipment usually use mechanical seal, stuffing box, lip seal or liquid seal etc.

3.5.1 机械密封 Mechanical seal

3.5.1.1 单端面机械密封 Single face mechanical seal

204 系列单端面机械密封 204 series single face mechanical seal

特点 Characteristics:

204、204F、204FF、204GF 型机械密封系单端面、多弹簧、传动螺钉传动平衡型釜用机械密封。适用于各种弱腐蚀性介质。204F、204FF、204GF 适用于各种无液体润滑工况下反应釜搅拌轴的密封。如发酵罐、霉菌罐、反应釜等。204FF 型静环为对开式，尺寸与 204F 完全相同，性能相似，常用于较大轴径情形。

204 series mechanical seal is single face balance type, which are widely used for common weak corrosion operations. By using proper seal rings, dry running designs (204F, 204FF) are widely used for fermentation processes.

适用工况 Working conditions：

温度 Temp.：-10℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：ATM~0.6MPa;　线速度 speed：0~2m/s

GW204 系列械密封　GW204 series single face mechanical seal

特点 Characteristics：

GW204 型机械密封是在原有 204 系列基础上开发的单端面、多弹簧、传动螺钉传动平衡型釜用机械密封。一般适用于各种普通或弱腐蚀性介质工况。通过选用合适的摩擦副材料可适用于各种无液体润滑工况下反应釜的密封，如发酵罐，种子罐等。GW204H 型设计带有碎片井结构，可防止摩擦屑进入罐体，适用于卫生级结构设计。

GW204 is updated version of 204 seals. With the collection well design, it can prevent the friction dust coming into the tank and can meet sanitary design requirement.

适用工况 Working conditions：

温度 Temp.：-10℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：ATM~0.6MPa　线速度 speed：0~2m/s

212 系列单端面机械密封 212 series single face mechanical seal

特点 Characteristics：

212 型机械密封为单端面、多弹簧、部分平衡型四氟波纹管机械密封。一般用于腐蚀性较强，无悬浮颗粒的操作工况，尤其适用于搪玻璃反应釜，钛合金釜等有一定真空要求及径向摆动稍大的场合。

212 series seals use corrugated PTFE pipe and ceramics as friction rings. By PTFE lining for inner surfaces, the seals can be used for high corrosion operations, especially for glass lining reactors, high alloy tanks, etc. This design is also suitable

for vacuum operations and allowable for high radial shaft run-out.

适用工况 Working conditions：

温度 Temp.：-10℃～120℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.5MPa　　线速度 speed：0~3m/s

2001 系列单端面机械密封 2001 series single face mechanical seal

特点 Characteristics：

2001 型机械密封为集装式，轴向单端面多弹簧，非平衡型机械密封。用于弱腐蚀性介质,密封要求一般的场合。

Type 2001 is packed, axial single face, multi-springs, non-balanced mechanical seal. It is applied to weak corrosive liquid and low leakage conditions.

适用工况 Working conditions：

温度 Temp.：-10℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.6MPa　　线速度 speed：0~2m/s

2002 系列单端面机械密封 2002 series single face mechanical seal

特点 Characteristics：

2002 系列机械密封为集装式，轴向单端面多弹簧，内置轴承，非平衡型机械密封。一般用于普通及弱腐蚀性介质等工况。

2002 series are single cartridge, balance type seals, used for operations of common or weak corrosion materials.

适用工况 Working conditions：

温度 Temp.：-10℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.6MPa　　线速度 speed：0~2m/s

261 系列单端面机械密封 261 series single face mechanical seal

特点 Characteristics：

261 系列机械密封为集装式，轴向单端面多弹簧，内置轴承，平衡型机械密封。是针对侧入式搅拌机专门开发的一种机械密封，采用硬对硬的摩擦副设计，适用于含固体颗粒的介质。经常应用于烟气脱硫吸收塔、沼气发酵罐、储罐等大型常压容器的侧入式搅拌机。

261 series seals are specially designed for side entry mixers. By using hard-hard friction rings, it is suitable for operations with solids, such as FGD absorption tower, biogas digester, oil storage tanks, etc.

适用工况 Working conditions：

温度 Temp. ：-10℃～130℃

压力 Press. ：0~0.6MPa　　线速度 Speed：0~3m/s

3.5.1.2 双端面机械密封 Double faces mechanical seal

GW205 系列双端面机械密封 GW205 series double faces mechanical seals

特点 Characteristics：

GW205 系列机械密封为集装式，轴向双端面多弹簧、内置轴承、非平衡型机械密封。一般用于弱腐蚀性介质且对密封泄露量要求严格的场合，如易燃、易爆、有危害性及高真空工况等。摩擦副采用硬对硬配对时可用于带固体颗粒的工况，如结晶过程等。

GW205 series seals are designed for low pressure, common or weak corrosion materials, but sealing requirement is high. The inner bearing will limit the shaft vibration. Proper sealing rings selection, such as hard-hard, will allowable for operations with solids, such as crystallization.

适用工况 Working conditions：

温度 Temp.：-40℃～350℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.6MPa　　线速度 speed：0~3m/s

206 系列双端面机械密封 206 series double faces mechanical seals

特点 Characteristics：

206 型机械密封为集装式，轴向双端面多弹簧、内置轴承、大气端平衡型机械密封。一般用于弱腐蚀性介质且对密封泄露量要求严格的场合，如易燃、易爆、有危害性及高真空工况等。摩擦副采用硬对硬配对时可用于带固体颗粒的工况，如结晶过程等。

206 series seals are designed for medium pressure, common or weak corrosion materials, but sealing requirement is high. The inner bearing will limit the shaft vibration. Proper sealing rings selection, such as hard-hard, will allowable for operations with solids, such as crystallization.

适用工况 Working conditions：

温度 Temp.：-40℃～350℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~1.6MPa　　线速度 speed：0~3m/s

207 系列双端面机械密封 207 series double faces mechanical seals

特点 Characteristics：

207 型机械密封为集装式，轴向双端面多弹簧、内置轴承、两端平衡型机械密封。一般用于弱腐蚀性介质且对密封泄露量要求严格的场合，如易燃、易爆、有危害性及高真空工况等。摩擦副采用硬对硬配对时可用于带固体颗粒的工况，如结晶过程等。

207 series seals are designed for high pressure, common or weak corrosion materials, but sealing requirement is high. The inner bearing will limit the shaft vibration. Proper sealing rings selection, such as hard-hard, will allowable for operations with solids, such as crystallization.

适用工况 Working conditions：

温度 Temp.：-40℃～350℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~2.5MPa　　线速度 speed：0~3m/s

GW2007 系列双端面机械密封 GW2007 series double faces mechanical seals

特点 Characteristics：

GW2007 系列机械密封是在原 2000 系列双端面密封的基础上改进而成，为集装式、轴向双端面、多弹簧、内置轴承平衡型机械密封。其结构紧凑，适用压力范围广，性能稳定。一般用于弱腐蚀性介质以及对密封泄露量要求严格的场合。可用于大部分需要配置双端面机械密封的工况。

GW2007 series seals, updated from original 2000 series, are designed for high pressure, common or weak corrosion materials, but sealing requirement is high. It has compact structure, and can be used for most of conditions which need double faces seal.

适用工况 Working conditions：

温度 Temp.：-40℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~2.5MPa　　线速度 speed：0~3m/s

2010 系列双端面机械密封 2010 series double faces mechanical seals

特点 Characteristics：

2010 系列机械密封是针对高压工况而设计的双端面机械密封，为集装式、轴向双端面、多弹簧、内置轴承平衡型机械密封。一般用于弱腐蚀性介质以及对密封泄露量要求严格的场合，尤其是针对高压而需要配置双端面机械密封的工况。

2010 series seals are designed for super high pressure operations. With inner bearing, balance type design, it is suitable for high pressure tanks with common or weak corrosion materials, but sealing requirement is high.

适用工况 Working conditions：

温度 Temp.：-40℃～350℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~4MPa　　线速度 speed：0~3m/s

221 系列径向双端面机械密封 221 series radial double faces mechanical seals

特点 Characteristics：

221 系列机械密封是一种径向双端面机械密封，集装式结构，特别适合于轴向尺寸受限的工作场合。可设计应用于强腐蚀介质，用于搪玻璃反应釜等；也可设计为常用不锈钢材料，用于弱腐蚀性介质的场合。

221 series are radial double faces mechanical seals, especially for conditions of limitation in axial spacing. It can be designed for glass lining tanks (high corrosion) or common stainless steel tanks (weak corrosion).

适用工况 Working conditions：

温度 Temp.：-40℃～250℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~1.6MPa　　线速度 speed：0~2m/s

3

285 系列底搅拌用双端面机械密封 285 series double faces mechanical seals

特点 Characteristics：

285 系列机械密封为集装式，带转轴支撑，前置填料密封，轴向双端面，非平衡型机械密封。根据介质性质确定材料及适用工况，常用于弱腐蚀介质的底入式及侧入式搅拌，密封要求严格的场合。将前置的填料密封改为单端面机封，可用于带颗粒、微粉的场合。

285 series are double cartridge mechanical seals. With specially designed shaft support and pre-stuffing, they are suitable for processes using bottom entry mixers with common or weak corrosion material. The pre-single face seal instead of pre-stuffing allows fluid with solids or powder.

适用工况 Working conditions：

温度 Temp.：-40℃～200℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.6MPa　　线速度 speed：0~3m/s

286 系列双端面机械密封 286 series double faces mechanical seals

特点 Characteristics：

286 型机械密封为集装式，轴向双端面，多弹簧，带转轴支撑，前置填料密封，大气端平衡型机械密封。根据介质性质确定材料及适用工况，常用于弱腐蚀介质的底入式及侧入式搅拌，对密封要求严格的场合。将前置的填料密封改为单端面机封可用于带颗粒、微粉的场合。

286 series are double cartridge mechanical seals. With specially designed shaft support and pre-stuffing, they are suitable for processes using bottom entry mixers with common or weak corrosion material. The pre-single face seal instead of pre-stuffing allows fluid with solids or powder.

适用工况 Working conditions：

温度 Temp.：-40℃～200℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~1.6MPa　　线速度 speed：0~3m/s

263 系列双端面机械密封 263 series double faces mechanical seals

特点 Characteristics：

263 型机械密封为集装式，轴向双端面多弹簧,内置轴承，平衡型机械密封。用于弱腐蚀性介质,常用于侧搅拌，含杂质介质，以及泄露量要求严格的场合。

Type 263 is packed, double face, multi-springs, inner bearing, balanced mechanical seal. It can be used for various weak corrosive medium and strict requirements for seal leakage, especially for side-entry conditions.

适用工况 Working conditions：

温度 Temp.：-10℃～150℃（不同温度匹配相应的冷却措施 With proper cooling method）

压力 press.：-0.1~0.6MPa　　线速度 speed：0~3m/s

3

3.5.1.3 釜用机械密封辅助系统 Auxiliary systems for seal

机械密封辅助系统对于机封的安全稳定运行至关重要，根据不同的操作温度或压力需要配套相应的辅助系统。对于密封辅助系统的选用，一般遵循的原则如下：

对于单端面机械密封：当釜口的工作温度 t≤100℃时，可直接在润滑盒内加注油或水(去离子水)或其他于净液体进行润滑和冷却；在 100℃<t<250℃时，可选择 XL,LT 型调温器(约加高 100mm)以降低密封腔温度，或者采用密封辅助系统；在 t>250℃时必须选择增高调温器（也可再配以相应的密封辅助系统)。

对于双端面机械密封：所有双端面机械密封原则上都应配有密封辅助系统，以保证密封液的压力始终至少高于釜内的最高工作压力约 0.1～0.2MPa。根据 API682 标准，一般选择 PLAN52/PLAN53/PLAN54 等辅助系统。

Auxiliary systems are critically important for the safe running of seals. Different cooling method (or system) should be used according to the temperature and pressure. For single face seals, when operating temperature is higher than 100℃, different types of cooler will be used. For double faces mechanical seals, different types of auxiliary systems (usually equal to API PLAN52, PLAN 53, PLAN54) must be used. The auxiliary system should keep pressure 0.1~0.2 Mpa higher than tank operating pressure.

调温器 Cooler

在机械密封用于温度较高的场合时，需要考虑降低密封腔的温度。在密封的下部增加冷却水是一种常用的方法。这样的装置称为调温器。对用于单端面机械密封的调温器可以和下静环座集成在一起，用 XT 或 LT 表示。对用于双端面机械密封的调温器也可以与密封做成一体，用 CT 表示。调温器的安装尺寸与对应机封的安装尺寸一致。

Cooler is cooling jacket designed at seal bottom to cool the seal. They can be integrated in the seal seat. XT or LT for single face seal and CT for double faces seal.

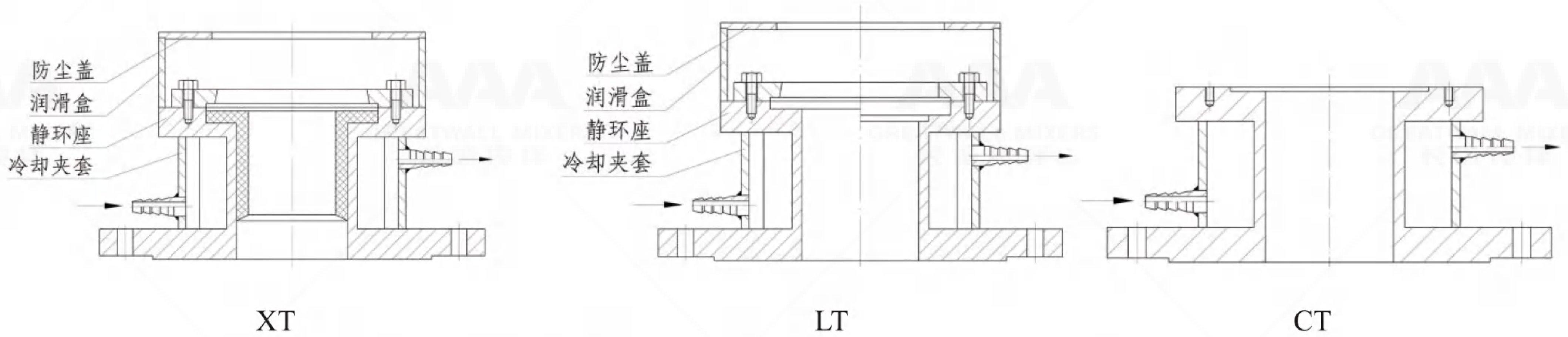


图 Fig. 3-1 调温器示意图 Sketch for seal thermoregulator

双端面密封辅助系统 Auxiliary systems for double faces seal

对于釜用机械密封的辅助系统参考 API682 标准,常用的形式为 PLAN52、PLAN 53(A,C)及 PLAN54 等。其中 PLAN53A 应用最广泛，其工作原理为：利用压力大于工艺流体和大气压力的隔离流体注入密封室中，由于隔离流体压力大于工艺流体压力，防止了工艺流体向隔离流体的泄漏，从而有效地防止工艺流体对大气和环境的污染。隔离流体压力至少比密封腔压力高 0.1-0.2MPa，隔离流体须清洁，润滑且和介质相溶，隔离流体的流向一般应与轴的旋向相同。隔离流体经常使用的有：工业白油、丙三醇（甘油)、乙二醇、去离子水、食用油等。

Referring to API682, PLAN52, PLAN53 and PLAN54 are usually used as auxiliary systems for double faces seals. Most of cases, PLAN53A is adopted. The sketch map shows the working principle. The sealing liquid with higher working pressure will isolate the tank fluid with atmosphere, and at the same time, lubricate and cooling the seal faces. The sealing liquid usually uses industry white oil, glycerine, glycol, de-ionized water, edible oil, etc.

G 系列平衡罐配套相应的压力、液位等装置可以实现等同 API682 标准的辅助系统。GCL 平衡罐适用于温度小于 100℃的工况（或温度小于 160℃，机封配有冷却夹套)，不需要外接冷却水，通过热虹吸及罐体自身的散热可以满足要求。对于温度较高的工况，一般配置 GDL 平衡罐，该平衡罐内置了冷却盘管，可以通冷却水冷却。平衡罐容量的选择与轴径及工作温度有关，平衡罐的有效容积有 2L、4L、10L 及 20L。

G series seal pot equipped with instruments for pressure and liquid level will equal to the API pipe plan. There are two types of seal pots, GCL and GDL. GCL, without cooling coil, is used for temperature <100℃ (or <160℃ for seal with cooler). For higher temperature, GDL with cooling coil is used. The seal pot volume (2L, 4L, 10L) is related with shaft diameter and temperature.

对于工作压力大于 2.5MPa 的工况，一般选择 PLAN54 辅助系统。D 型釜用机械密封液压泵站强制循环系统可以满足要求，具有润滑、调温、调压、监视、冷却等功能，可确保中高压、中高温机械密封稳定可靠地运行。

For operating pressure higher than 2.5Mpa, D series hydraulic power unit (equal to PLAN54) is used for the lubrication, cooling of the high pressure mechanical seals.

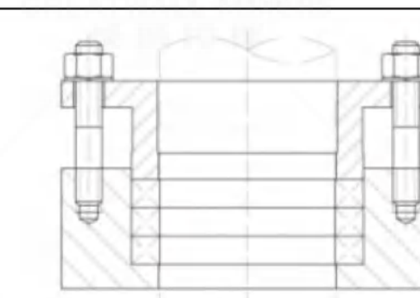
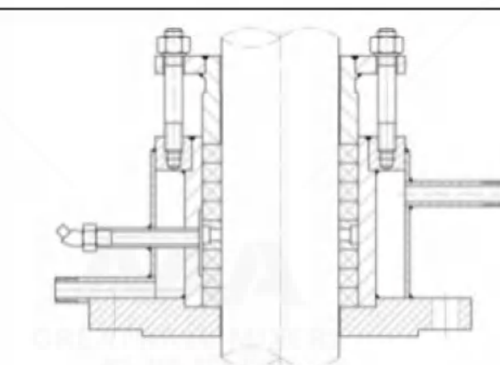
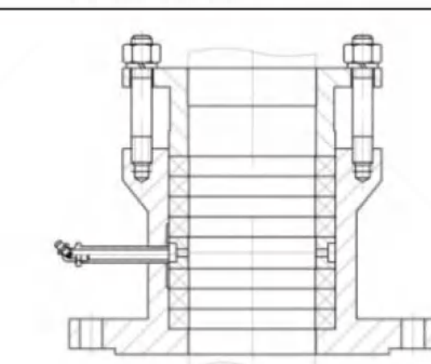
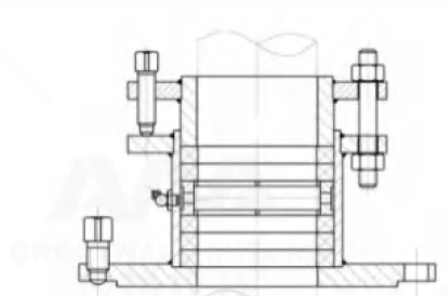
图 Fig. 3-2 GDL 平衡罐示意图 Sketch for GDL seal pot

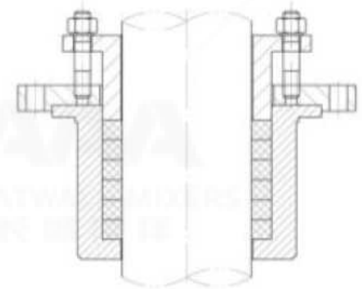
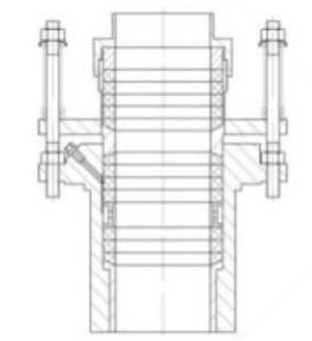
图 Fig. 3-3 Plan54 循环系统 Plan54 circulation system

3.5.2 填料箱 Stuffing Box

填料箱的分类、特点和主要工作参数如下表所述。

Types, features and main parameters of stuffing box are described in the following table.

型号 Model	类别 classification	示意图 Outline	特点及应用 Features and applications
218 1414	常压填料箱 normal pressure stuffing box		常压填料箱：218 为碳钢材质，1414 为不锈钢材质；运行参数： 温度<100℃，压力 ATM，线速度 ≤1m/s。 Normal pressure stuffing box; 218 is carbon steel, 1414 is stainless steel; Stuffing box 218 & 1414 are used for temperature ＜100℃, atmosphere pressure, tip speed ≤1m/s.
1410 1412	带冷却水套填料箱 with cooling water jacket		带冷却水套填料箱：1410 为碳钢材质，1412 为不锈钢材质；运行参数： 温度<250℃，压力≤0.6Mpa，线速度 ≤2m/s。 Stuffing box with cooling water jacket; 1410 is carbon steel, 1412 is stainless steel. Stuffing box 1410 & 1412 are used for temperature ＜250℃, pressure ≤0.6Mpa, tip speed ≤2m/s.
1411 1413	带油环润滑结构 with oil lubrication system		带油环润滑填料箱：1411 为碳钢材质，1413 为不锈钢材质；运行参数： 温度<100℃，压力≤0.6Mpa，线速度 ≤1m/s。 Stuffing box with oil lubrication system; 1411 is carbon steel, 1413 is stainless steel. Stuffing box 1411 & 1413 are used for temperature ＜100℃, pressure ≤0.6Mpa, tip speed ≤1m/s.
516 616	带油环润滑结构 with oil lubrication system		带油环润滑填料箱：516 为碳钢材质，616 为不锈钢材质；运行参数： 温度-20～300℃，压力≤1.6Mpa，线速度 ≤2m/s。 Stuffing box with oil lubrication system; 516 is carbon steel, 616 is stainless steel. Stuffing box 516 & 616 are used for temperature from -20 to 300℃, pressure ≤1.6Mpa, tip speed ≤2m/s.

401 402	下装式填料箱 bottom installation type		下装式填料箱：401 为碳钢材质，402 为不锈钢材质；运行参数： 温度≤100℃，压力≤0.6Mpa，线速度 ≤2m/s。 Bottom installation stuffing box; 401 is carbon steel, 402 is stainless steel. Stuffing box 401 & 402 are used for temperature ≤100℃, pressure ≤0.6Mpa, tip speed ≤2m/s.
403 404	双层填料箱 double layer type		双层填料箱：403 为碳钢材质，404 为不锈钢材质；运行参数： 温度≤100℃，压力≤1.6Mpa，线速度 ≤2m/s。 Stuffing box with double layer; 403 is carbon steel, 403 is stainless steel. Stuffing box 403 & 404 are used for temperature ≤100℃, pressure ≤0.6Mpa, tip speed ≤2m/s.

3.5.3 液封与唇封 Liquid seal and lip seal

液封与唇封一般用于常压，主要用来阻挡灰尘、油污，隔离空气等。

Liquid seal and lip seal are usually used at ATM conditions, to isolate dust, dirty oil, and air etc.

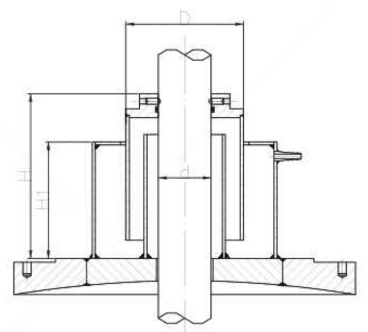


图 Fig. 3-4 LQS 系列液封示意图 Outline for liquid seal

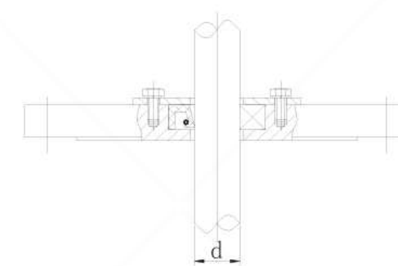


图 Fig. 3-5 LIS 系列唇封示意图 Outline for lip seal

3.6 搅拌器 Impellers

3.6.1 搅拌器概述 General description for impellers

搅拌器的种类繁多，根据结构划分，常用的有十几个大类，有桨式，开启涡轮式，圆盘涡轮式，圆盘锯齿式，推进式、轴流式，布鲁马金式，螺杆式、螺带式，锚框式及特殊类；根据使用工况，搅拌器一般可分为低粘液体用和高粘液体用两大类。

桨式，开启涡轮式，圆盘涡轮式，圆盘锯齿式，推进式、轴流式，布鲁马金式通常用于低粘液体的搅拌，在湍流状态下操作，其叶轮直径与槽内径之比通常为 0.3～0.6 左右。

锚框式、螺杆式和螺带式适合于高粘液体的搅拌，在层流或过渡流状态下操作。

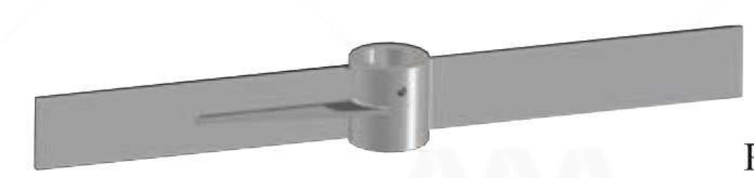
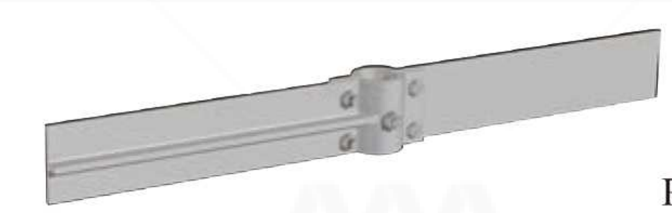
There are lots of types of impellers. According to the structure difference, there are more than ten types, such as paddle, open turbine, disc turbine, saw-teeth type, propeller, hydrofoil, Bulmarking type, screw, helical ribbon, anchor and gate type, and other special types. According to the usage, there are two types, low viscosity type and high viscosity type.

Paddle, open turbine, disc turbine, saw-teeth type, propeller, hydrofoil, Bulmarking type are low viscosity type impellers, operating at turbulent conditions, the ratio of impeller diameter to tank diameter is usually 0.3~0.6.

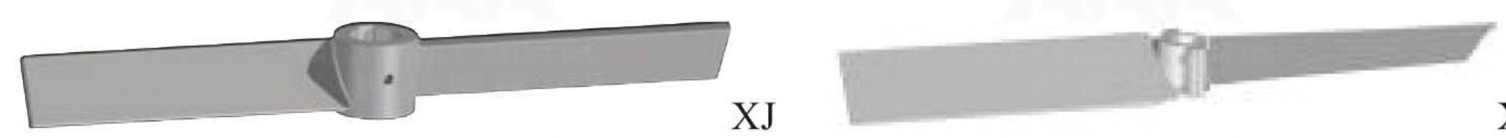
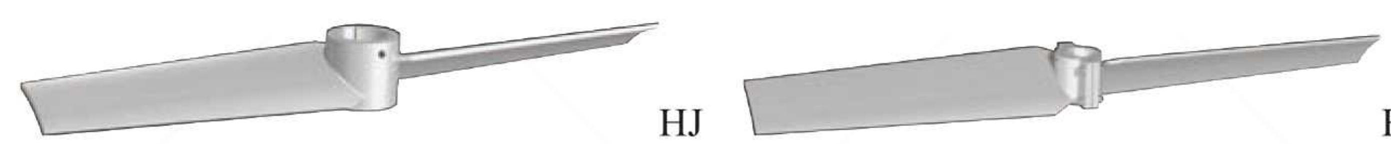
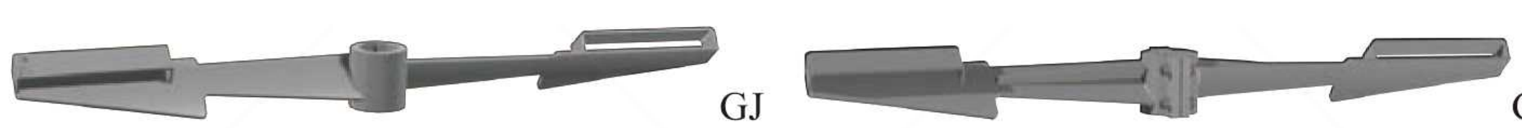
Screw, helical ribbon, anchor and gate type are high viscosity type impellers, usually operating at laminar or transition flow.

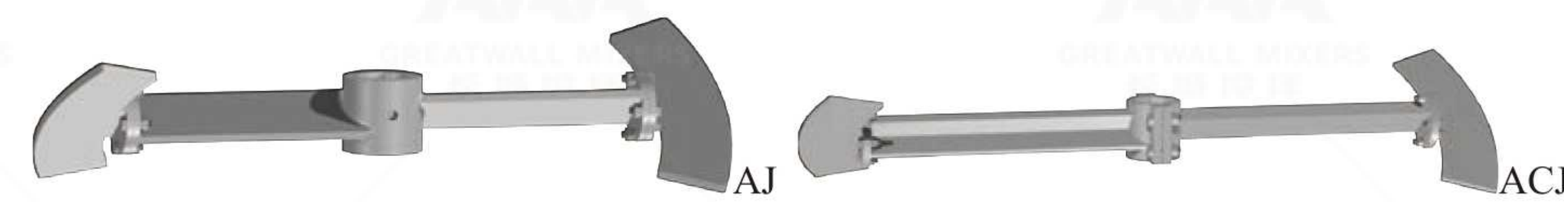
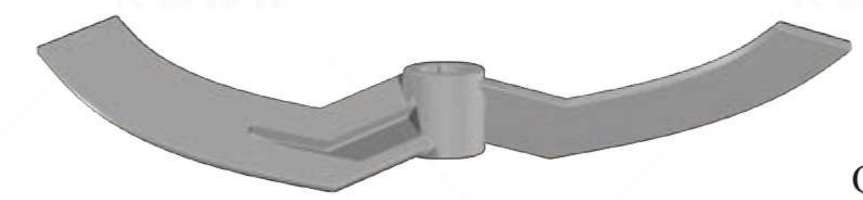
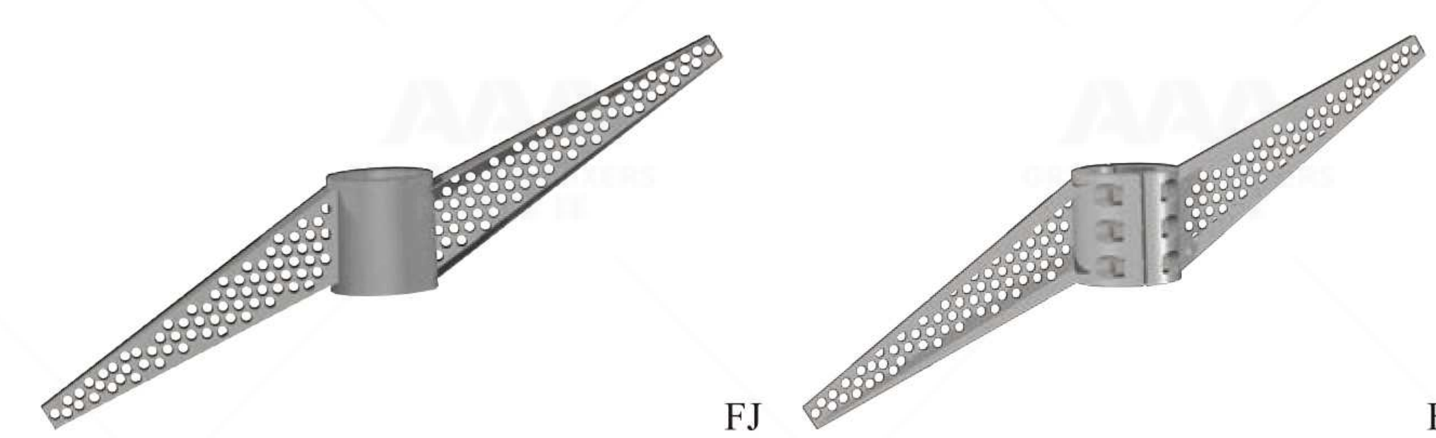
3.6.2 搅拌器的种类 Types of impellers

表 Table 3-15 搅拌器的分类、特点及应用 Impeller List

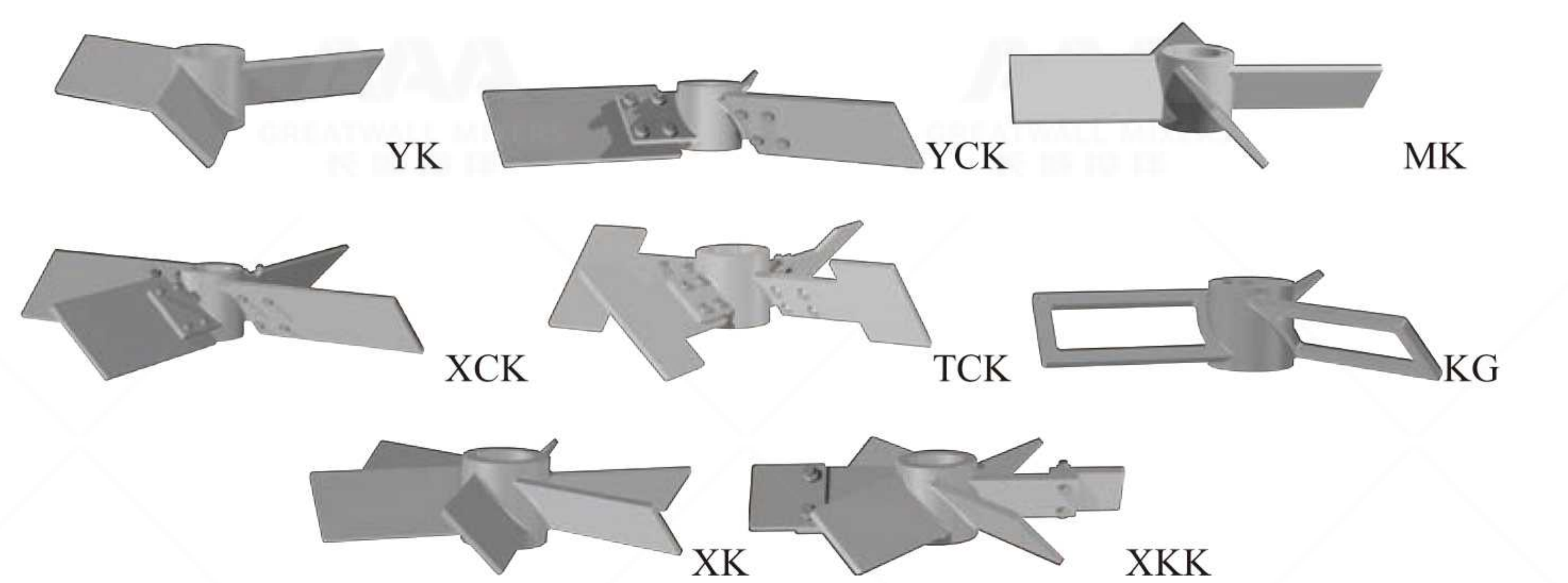
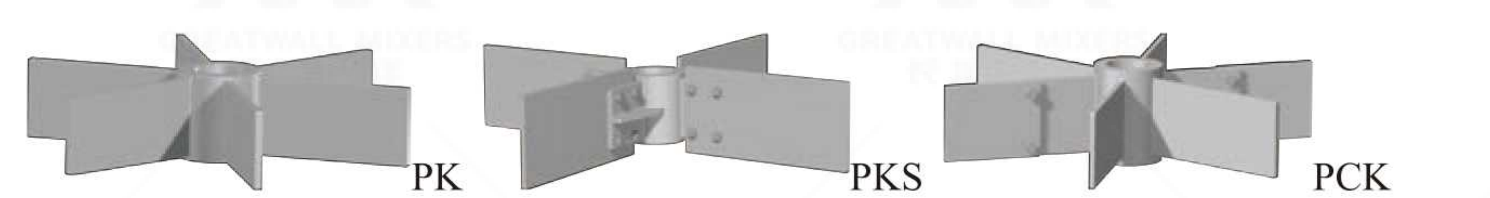
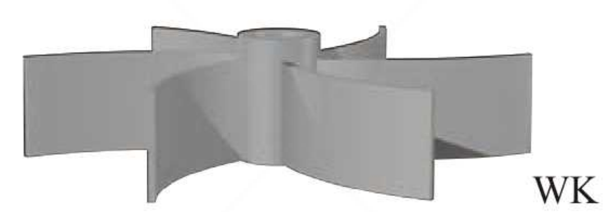
形式 Type		简述 Description	应用条件 Condition		
			桨叶直径 Impeller diameter dj(mm) dj/D	粘度 viscosity μ(cp)	线速度 Tip Speed V(m/s)
二叶桨式搅拌器 Paddle Type Impeller	平直叶桨式 Type PJ,PCJ	 PJ  PCJ 此类型为最基本的一种桨型，低速时以水平环流为主;高速时为径向流;有挡板时，为上下循环流。适用于低粘度液体的混合、均匀、调和、溶解、传热或结晶，或在高粘度下一般在层流状态下工作，采用多层大直径低速搅拌。 This general paddle acts as horizontal circular flow at low speed and as radial flow at high speed. If there are baffles, result in axial circular flow. It is suitable for mixing, homogenizing, dissolving, heat transfer and crystallization in low viscosity medium. Or operates in laminar region in high viscosity medium, be adopted multi-layer impellers of big diameter at low speed.	0.35～0.9 / 100～6000	<2000 100000 (Maximum)	1~5

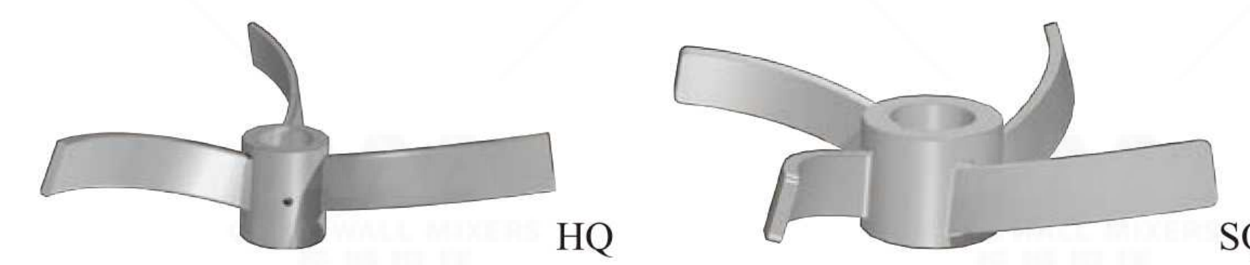
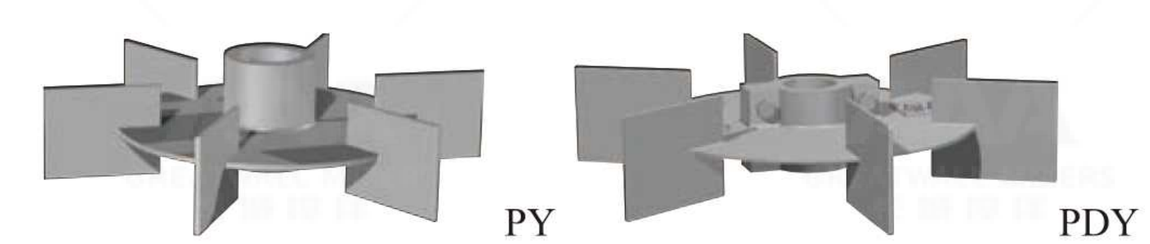
3

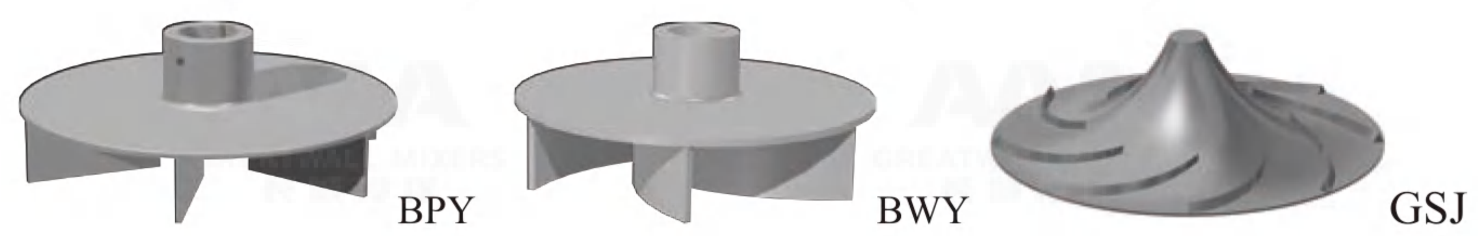
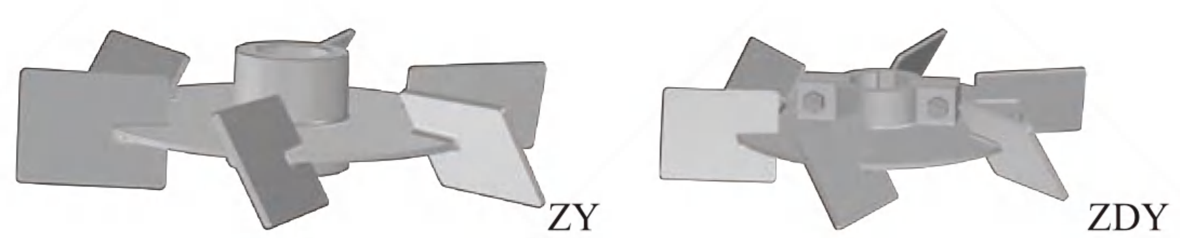
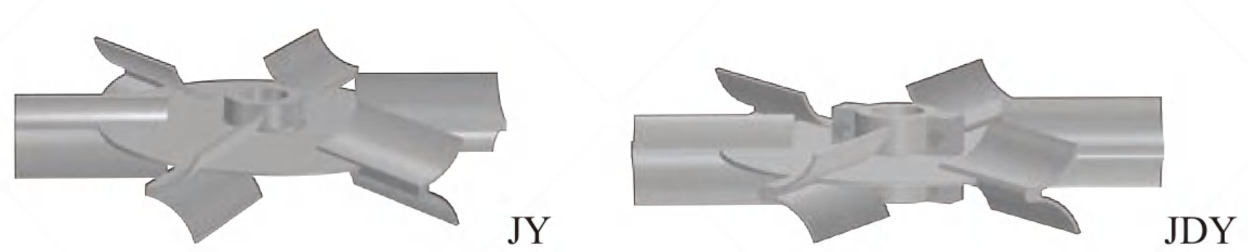
斜叶桨式 Type XJ,XCJ	 XJ XCJ 此类搅拌器可制成24°、45°或60°倾角，有轴向和径向分流，流型比平直叶桨式复杂，排出性能比平直叶高，综合效果更好，其适用条件等同PJ、PCJ，因此使用频率比平直叶桨式高。 The oblique angle of the impeller is 24°, 45° or 60°. It produces radial and axial flow and the flow is more complex than type PJ paddle. It features larger output energy compared to type PJ paddle and has same applications as type PJ, PCJ, so type XJ, ZJ are used more frequently.	0.4~0.95	100~6500	<10000	1~10
弧叶桨式 Type HJ,HCJ	 HJ HCJ 此类型为新开发的一种桨型，可替代XJ、ZJ。在同等使用条件，它的排出性能比XJ高30%，而功率水平可持平，综合性能也优于XJ。 This new paddle can substitute for type XJ and ZJ. In the same condition, the capability of discharging is 30% higher than XJ and the integrated capability is better than XJ.				
双折叶桨式 Type SCJ,CCJ	 SCJ CCJ 多段逆流型搅拌器，CJ型为SJ型的改进型，在运行时，可促进液体形成较大的轴向循环，可比传统的XJ减少30%的混合时间，一般多层搅拌器组合使用。特别适用于过渡流域下的混合、固液悬浮、液液分散、溶解、传热等 The contranatant paddle of several segments, type CJ is improved on type SJ. When it works, the paddle expedite liquid to come into being axial circulation flow, its mixing time is 30% less than type XJ. Usually multi-impellers are used together. It is suitable for mixing, solid-liquid dispersing, dissolving and heat transfer of transition region.				
复合折叶桨式 Type GJ,GCJ	 GJ GCJ 这是一种高效轴向流叶轮，它在主叶片上再增加了一个辅助叶片，该辅叶片有消除主叶片后方发生的流动剥离现象，使搅拌功率减少；同时在叶端能产生交叉的垂直分流，提高了混合效果，适用于中、低粘度的混合、分散、传热。特别适用于大型罐槽的固液悬浮。 This is a high efficiency and axial flow impeller. The assistant paddles which are on the master paddle can dispel the phenomenon whose flow peels off, and saves on the power of mixer, at the same time comes into being separate flow which is crossed and vertical to improve the mixing effect. It is suitable for mixing, dispersing, and heat transfer of low viscosity medium, especially for solid-liquid suspending of large-sized vessel.	0.35~0.6	100~6500	<5000	1~10

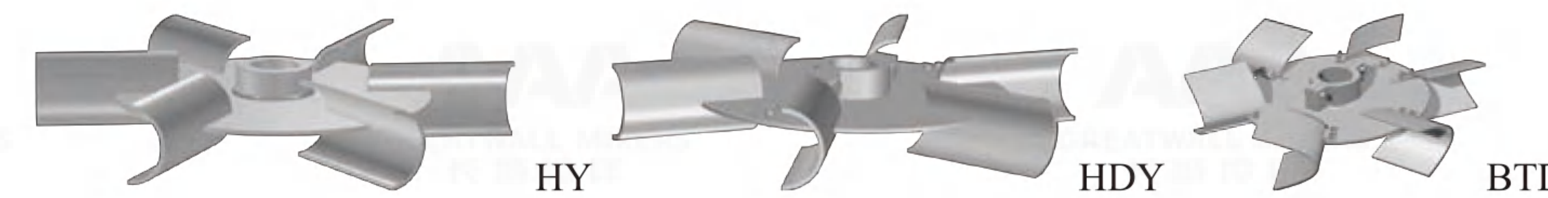
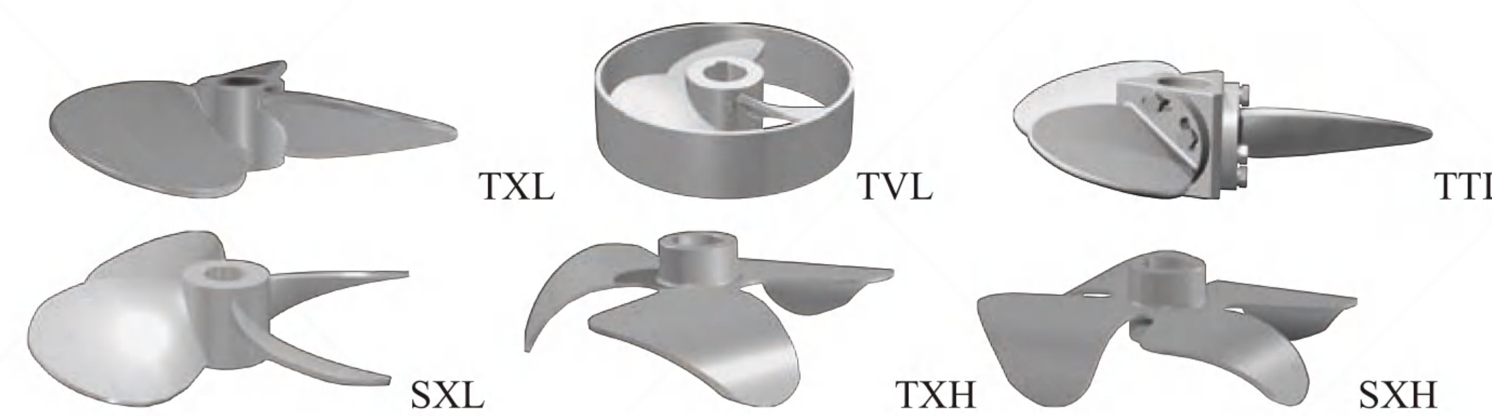
螺旋叶桨式 Type AJ,ACJ	 AJ ACJ 与罐体相适应的弧形叶片并与斜叶桨式组合，适用于中高粘度的混合、均质、传热、反应等操作，一般多层组合使用。具有双螺带桨的特点。 The paddle is made up of the arc paddle and the pitch paddle. It is suitable for mixing, homogenizing, heat transfer and reaction, etc. Usually multi-impellers are used together. It has the same feature as screw ribbon type.	0.85~0.95	100~5000	<50000	<3
曲边斜叶 Type QJ	 QJ 本类搅拌器是斜叶桨式的一种变型，桨底旋转面接近容器的椭圆面，桨叶平面与旋转轴垂直面又成倾角45，兼起刮板作用，多为低转速运行，可在过流或层流区操作。 These types are derived from type XJ paddle. They are used at low speed in laminar region.	0.6~0.9	100~5000	<5000	1~5
菱臂弧叶 Type BJ,BCJ	 BJ BCJ 本类搅拌器桨叶形状特别，是一些行业的专用搅拌器，适合漂洗、浸染类的操作，多为低速范围在层流下操作。 These types with special blades are used for situations like low circulating flow rate and low shearing force. It produces shake and turbulent flow inside and is applicable in process of bleaching and dip-dye.	0.4~0.8	100~5000	<5000	1~4
花板孔式 Type FJ, FCJ	 FJ FCJ 本类搅拌器形状特别，左右两桨叶一高一低，不以轴对称，能在低转速，层流条件下产生较好的微观剪切效应，是一些行业的专用搅拌器，常用于纤维物料的操作，也可作摆动操作。 The two blades of the impeller are unsymmetrically distributed. One is high, the other is low. It makes good shearing effect at low rotation speed in laminar flow region. Usually, it is used for agitating fiber medium. n=1～80rpm.		100~5000		

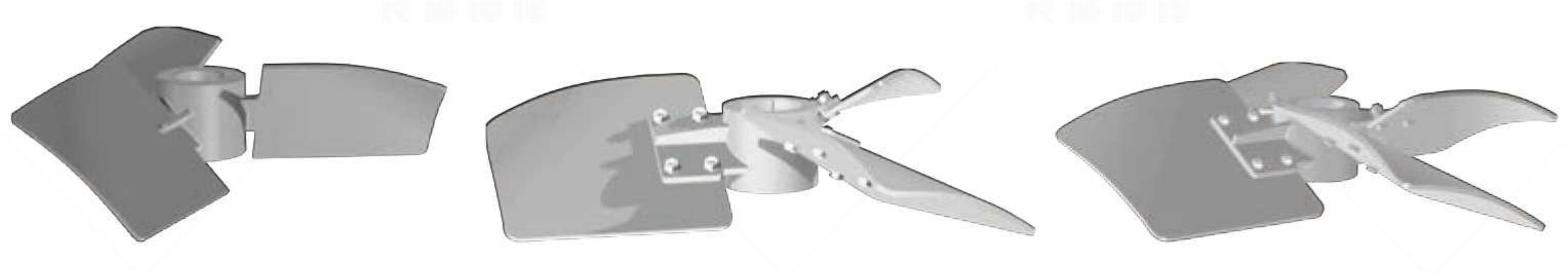
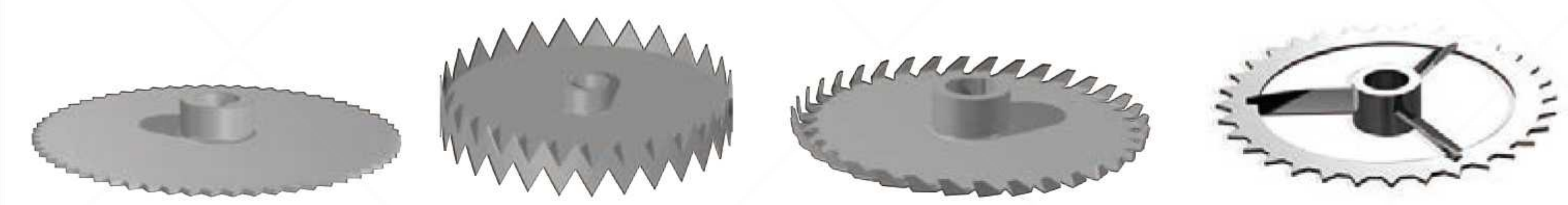
3

开启涡轮式搅拌器	斜叶开启涡轮 Type YK,YCK···	 轴流型搅拌器，有较好对流循环能力，并有一定的湍流扩散能力，适合应用于混合、分散、微粒结晶、反应、溶解、固液悬浮、传热等操作。带稳定片结构是这类涡轮的一种改进形式，主要应用在轴设计在临界点附近，轴需要径向扶正作用的场合。三框叶刮板式搅拌器：在层流区操作，防止重组份沉积底部，适用于结晶、萃取、洗涤等过程，也可用于高粘度液的传热过程。 The axial flow paddles which have convection circulation and onflow diffusivity capacities. It is suitable for mixing, dispersing, crystallization, reaction, dissolving, solid suspending and heat transfer, etc. The betterment type which has stabilizer uses for the occasion where the shaft which is designed critical point need radial support. Type KG works in laminar region to avoid heavy element depositing. It is also suitable for crystallization, extraction and washing, and heat transfer of high viscosity medium.	0.3～0.6	100～3000	<50000	2~8
	平直叶开启涡轮 Type PK···	 径流型搅拌器，使用转速范围大，使用粘度范围广，具有高剪切力及湍流扩散能力。因其没有圆盘，不会阻碍桨叶上下液层混合，在有挡板槽中可以形成较大的对流循环，特别适用于剪切分散操作，同时因其具有良好的循环和剪切能力，也用于一般的固体溶解、反应、传热、乳化、结晶、固体悬浮操作。 Radial flow type impeller with high shearing force and onflow diffusivity is used widely in varied speed and viscosity. Without disc, they don't counteract mixing and can become convection circulation. Make it especially for shearing and dispersing, and for dissolving, reaction, heat transfer, emulsification, crystallization and solid suspending.	0.2～0.5	100～3000	<50000	3～10
	弯叶开启涡轮 Type WK	 具有平直叶涡轮几乎所有的特点，又因其具有特殊的后弯结构，排出性能更好，桨叶也不易磨损，特别适用于固体含量多时固液悬浮的操作，一般配挡板使用；同时也适用于一般的反应、传热、乳化等操作。 The types which have back angle paddles have large output flow. Make it especially for solid suspending.	0.2～0.5	100～3000	<50000	2~8

	三直叶锥底式 Type SZP	 本类搅拌器为径流型搅拌器，使用条件同平直叶开启涡轮，适用于锥形容器搅拌的最下层搅拌，可应用于一般的反应、溶解、悬浮、传热、乳化、结晶等操作。 The radial flow paddles are used in the lowest layer of conical bottom tanks. Make it suitable for reaction, dissolving, suspending, heat transfer, emulsification and crystallization.	0.2～0.5	100～3000	<10000	2~8
	后掠式 Type HQ,SQ	 为径流型搅拌器，配合指型挡板，能得到大流量的上下循环流，且剪切作用好，适合应用于传热、传质、固体溶解、悬浮等。 Types HQ, SQ are axial flow type impellers. They produce strong circulation and good shearing force with finger baffles. They are used in processes of heat transfer, mass transfer, dissolving, suspending.	0.2～0.5	100～3000	<10000	2~8
	布鲁马金式 Type BM	 为径流型搅拌器，桨叶前端带有后掠角的大宽叶桨叶，排出性能优于直叶和弯叶开启涡轮，功耗低，剪切力小，有挡板时，可产生对流循环及湍流扩散，适用于传热、传质、混合、纤维物料的溶解。 These radial flow type impellers with good pumping rate, reduced shearing force and lower power consumption. Circulation flow and onflow diffuse can be produced when baffles are set. It is used in processes of heat transfer, mass transfer mixing and fiber dissolving.	0.2～0.5	100～3500	50000	2～8
圆盘涡轮式搅拌器	平直叶圆盘涡轮 Type PY,PDY	 径流型搅拌器，具有极高的剪切力，分散能力强。循环能力较好，一般在圆盘上下形成两股循环环流，因有圆盘的作用,能使气体分散更平稳、均匀。特别适用于气体的分散、吸收操作，同样也适用于固体悬浮、传热、非均相反应操作。 The radial flow type impellers have powerful shearing force and good circulation power and good dispersing power. Because of the disc, it can disperse gas smoothly. It is used specially in processes of dispersing, absorbing, and it is also suitable for suspending, heat transfer and non-homogeneous phase reaction.	0.2～0.5	100～3500	<50000	4~10

	单向圆盘涡轮 Type BPY,BWY	 单向涡轮为径流型搅拌器，有较大的离心辐射状流线，BYP 与 BWY 一般在中高速段使用，有类似叶片泵的功能，有较高的泵送能力，剪切力和分散能力高，特别适合于高强度要求的气体分散、吸收、萃取等操作；也适用于固体悬浮、传热、非均相反应操作。GSL 一般在低速段使用，适用于水处理行业。 The radial flow type impellers BYP and BWY have higher pumping-feeding power similar to pump and powerful shearing force and powerful dispersing force and used in high speed. It is used specially in processes of gas dispersing, absorbing, leaching, and it is also suitable for suspending, heat transfer and non-homogeneous phase reaction. GSL is generally used at low speed and is suitable for water treatment.	0.2～0.5	100～3500	<50000	4~10
	弯叶圆盘涡轮 WY…	 此类搅拌器性能基本同平直叶圆盘涡轮，后弯的桨叶并具有较大的后掠角，排出性能好，动力消耗低，桨叶不易磨损，适合气体分散、吸收及固液悬浮操作等。 The capabilities of these impellers are similar to type PY. Type WY impellers installed back bend blades with big sweepback can generate good pumping rate at low power consumption. It is used in processes of gas dispersing, absorbing, suspending.	0.2～0.5	100～3500	<50000	4~10
	斜叶圆盘涡轮 Type ZJ…	 斜叶圆盘涡轮的桨叶具有一个倾角，有一定的轴向流，循环性能好，剪切力低于直叶圆盘涡轮，螺距叶圆盘涡轮的桨叶有一个较大的后退角，排出性能好，动力消耗低，特别适合于非均相的混合、分散。也用于一般的传热、乳化等操作。 Pitch-blade types have slope angle and can produce axial flow. It has good circulation power but the shearing force is lower than straight-blade type. Curved blade types have back angle and have large output flow rate and low power consumption. It is used specially in processes of mixing, dispersing, and heat transfer, emulsification.	0.2～0.5	100～3500	<10000	2~8
	箭叶式轮圆盘涡 Type…	 箭叶式圆盘涡轮式搅拌器也是一种以径流为主的搅拌器，但其桨叶剖面为抛物面，因而轴向有上下两股斜向循环流，相对 PY 功耗低，且具有较高的剪切力，适用于气体分散、吸收、传质、混合、固液悬浮等操作。 The main radial flow type impellers have low power consumption and powerful shearing force. Make it suitable for gas dispersing, absorbing, mass transferring, mixing and suspending.	0.2～0.5	100～3500	<10000	4~10

	半管及抛物线圆盘涡 Type HY…	 HDY、BTD 都是径流式搅拌器，它们的叶片分别为凹圆弧型及抛物面，具有极强的径向排量及分散能力，在相同功率下，其传质系数比平直叶圆盘涡轮高 30%以上，持气能力提高 40%以上，且功耗比甚低，因此特别适用类似发酵工艺的溶氧操作，也适用于其它要求下的气体分散、吸收、混合、传质等操作。 The radial flow type impellers have large radial flux and powerful dispersing force. Its coefficient of mass transfer is advanced 30% and its power of gas holding is advanced 30% at same power. So it is used specially in processes of oxygen dissolving, and it is also suitable for gas dispersing, absorbing, mixing and mass transferring.	0.2～0.5	100～3500	<10000	4~10
推进式搅拌器	三、四叶推进式 Type TXL…	 三叶推进式是最典型的轴流型搅拌器，高排液量，低剪切性能；采用挡板或导流筒则轴向循环更强。排出性能明显提高，因为它循环能力强，动力消耗低，在大容量均相、混合过程中应用最能体现其优势，在低粘度的液体传热、反应、固液比小时的悬浮、溶解等过程中应用广泛。可调推进式的桨叶可转动±15°，调整倾角，在试验性的工艺过程中作用很大。可拆推进式的桨连轮毂分成三辨，组装方便，用在需要拆成小件的场合。带稳定环结构，可在高速运行中靠液体阻尼的作用起径向扶正作用，一般情况下可提高 10%～20%的临界转速。 Triple-blade propellers are typical axial flow type impellers with high output flow rate and low shearing force. Axial circulation is stronger and output rate is larger when baffles or flow guide tube is selected. Their powerful circulation capacity and low power loss can be fully applied in mixing processes of low viscosity, large volume homogenous medium. They are widely used in heat transfer, reaction of low viscosity and suspension, dissolving low content solute. Blades of adjustable propeller type impellers can be adjusted in a range of ±15°. That will take important effect in experimental technique process. Separable propellers have three blades which can be assembled expediently. The types with stabilizer ring are used to keep shaft stable in high speed, and its critical speed advance 10~20 percent.	0.1～0.5	100～2000	<2000	3~15

旋桨式搅拌器	变截面旋桨式 Type ZHX…	 ZHX ZCX 三窄叶旋桨式是一种应用范围广泛的轴流型搅拌器，它的桨叶是一种近似等螺距曲面，排出性能好，剪切力低，可在过渡流及湍流操作中得到较高的流动场，排出流量比推进式高出 20%，适用于低粘度液体的混合、溶解、固体悬浮、传热、反应、结晶等。是大型搅拌罐替代推进式搅拌器的最好形式。 The axial flow paddles are widely used. It has high output flow rate and low shearing force. Its output flow is advanced 20%. Make it suitable for gas mixing, dissolving, suspending, heat transfer, crystallization and reaction. It is the best type for large-sized mixing tank.	0.2~0.5	100~6600	<2000	2~15
	高效轴流旋桨式	 GXL ZSX 此类搅拌器属轴流型搅拌器，具有推进式及开启涡轮式的特点,动力消耗小，循环能力大，剪切性能低；适用范围广，对低、中、高粘度的混合、传热、溶解、反应中应用广泛。 The axial flow paddles are widely used. It has large circulation flow rate and low shearing force.	0.2~0.5	100~6600	<2000	2~15
	三、四宽叶旋桨式 Type KHX…	 KHX KCX KSX 轴流型搅拌器，螺旋圆锥曲面型叶片，具有很大的湍流扩散能力和较低的剪切力，相对于 PY 型搅拌器，在相同的搅拌强度下，可节约 30%～40%的电能，相同功耗时提高 20%以上的传质系数，特别适用于要求传质、传热、固体悬浮及要求低剪切力的生物发酵溶氧操作。 The axial flow paddles have large onflow diffusivity and low shearing force. It economizes power 30~40% in the same mixing intensity, and its mass transfer coefficient advanced 20% in the same power. It is used specially in processes of mass transferring, heat transfer, suspending and oxygen dissolving of biology ferment.	0.2~0.5	100~4000	<25000	2~10
高速分散式搅拌器	三叶后齿、翘曲式 Type CL,QL	 CL QL 三叶后齿相当于三斜叶开启涡轮式的叶子后缘成锯齿状，增大的剪切界面强化了小涡流的产生，溶解、分散能力更优，还具有分裂粉碎的作用，适用于低粘度介质固体溶解、分散及高粘度分散相的混合、分散。三叶翘曲式为轴流型搅拌器，翘曲弧叶面可控制液体的排出方向，产生较大的轴向流；功耗低；适用于溶解、混合、液液反应等操作。 Type CL increases small-vortex amount, improves performance of dissolving, dispersing and function of splitting and smashing. They can be used for dissolving and dispersing in low viscosity solid medium and mixing and dispersing in high viscosity dispersed phase. Type QL is an axial flow impeller, and has low power. Make it suitable for dissolving, mixing and liquid-liquid reaction.	0.2~0.5	100~4000	≤2000	8~15
	齿形圆盘 Type CY…	 CY TY FY TZC 盘外缘呈锯齿形，高速旋转下剪切性能很高，循环能力相对弱，分散、粉碎、剥离作用强烈，两相物性差异大的分散混合很适用，如涂料的分散过程。平齿形为一层水平的锯齿，翻齿形和贴齿形为上下两向立式锯齿， 前者为齿和圆盘一体冲成上下翻出，齿粗疏，后者为两边锯齿条焊于圆盘外缘，齿细密。 At high rotation speed, toothed disc turbine has high shearing force, but low circulation capacity. Dispersion and comminution are strong. They are used in mixing and smashing two different phases such as dope dispersing process. Type CY has horizontal teeth, thick and sparse. Type FY and TY have two layers of vertical teeth, thin and dense.	0.2~0.5	100~2000	≤50000	10~30
稳定环	稳定环 Type WH,WF	 WH WF 稳定环是配合搅拌器同时使用,使搅拌轴在工作过程中能起到径向扶正的作用。 Stabilizers are used with impellers to keep shaft stable.				

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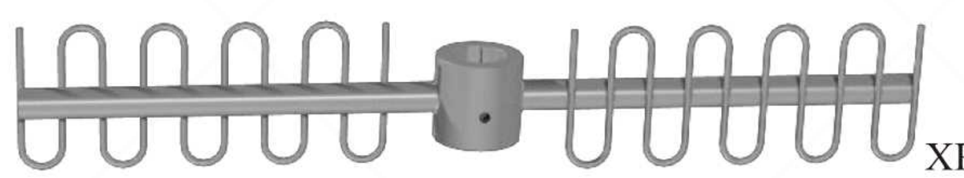
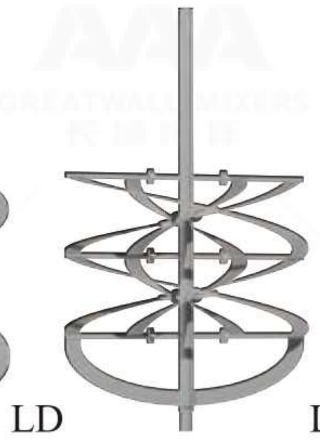
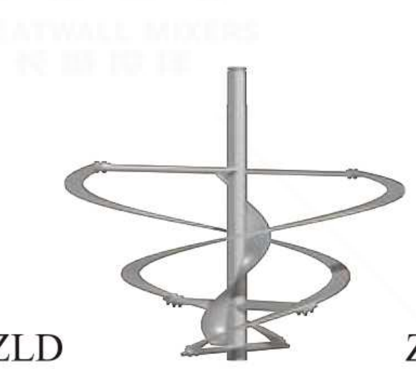
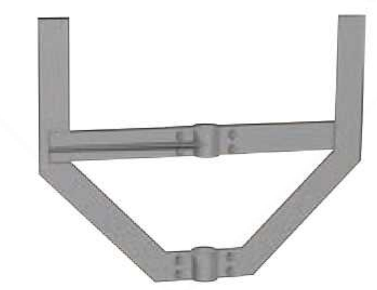
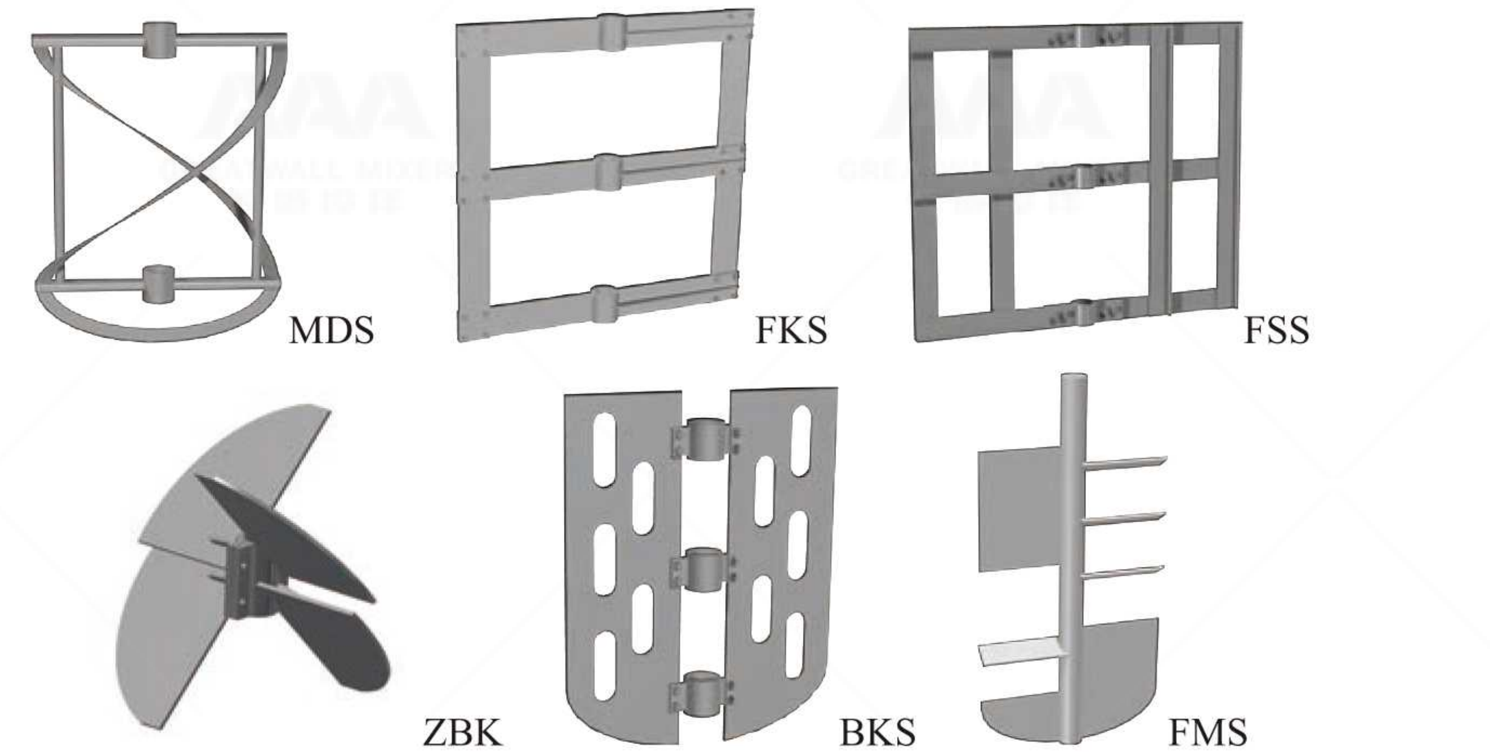
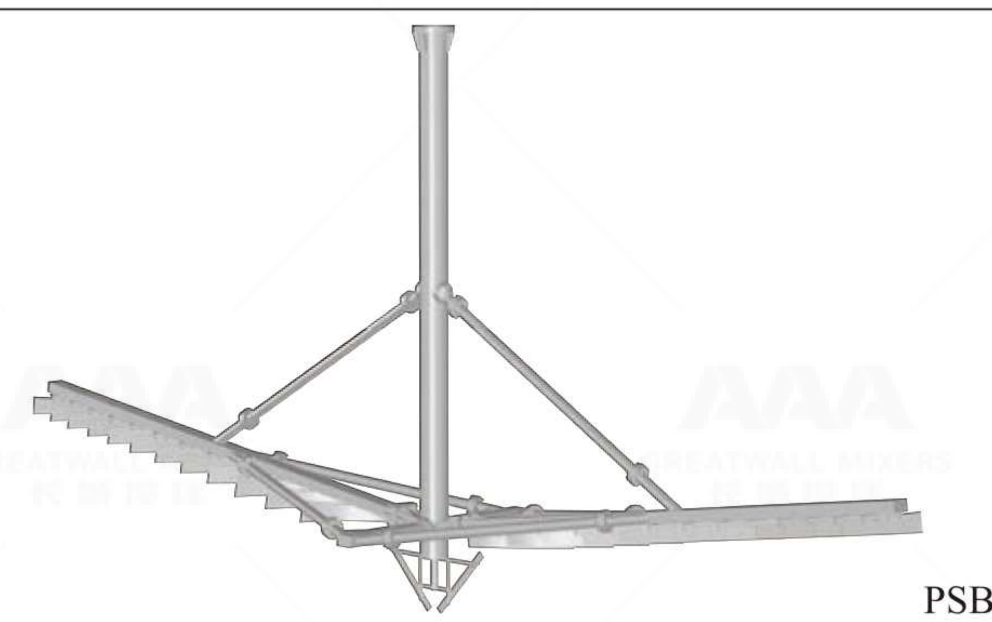
特殊用途搅拌器	曝气叶轮 Type BAY,BDY,BQY	 BAY  BDY 此类搅拌器专用于气液吸收，分散的搅拌器，它相当于低水头大流量的水泵高速旋转时中心吸入气体随液体离心抛出，桨叶对气相及液相产生剪切力，使气体破碎成大量微小的气泡，分散于液相中，它加强了相表面更新及湍动有利于相际扩散。常用于污水处理，传氧等过程。 These are special impellers used in gas-liquid absorbing and dispersing. They rotate with high speed and absorb gas. Liquid will be thrown off by centrifugal force. Inside the impeller, gas will be sheared into a lot of air bubble by paddle. With air bubble dispersing into liquid medium, turbulent flow will be increased. They are used in processes of wastewater treatment and oxygen transfer.	0.2～0.5	100～3500	<2000	2~15
	消泡搅拌器 Type XPY,XPJ	 XPY  XPJ 此类搅拌器是为消除液面上覆盖的大量泡沫而用。消泡叶轮为高速型，其高速旋转下产生的离心作用，使从中心吸进的泡沫，沿壁面汇成液珠抛出，消泡效果好，消泡桨为中低速型，旋转蛇形栅条桨，不断破坏生成的气泡，控制了泡沫的增加，发酵罐应用广泛、效果良好。 These impellers have a special usage, which can clear foam above liquid level. Type XPY is a high-speed impeller. Foam can be imbibed and thrown off through middle section. It has good performance of clearing foam, but it consumes much energy and increases cost. Type XPJ is a middle or low speed impeller. The rotating impeller strikes and breaks foam continuously and foam amount is under control. It is widely used in fermenter.		100～4000		
螺杆式搅拌器	螺杆式、带导流筒螺杆式 Type LG, LGH	 LG  LGH 此类搅拌器为慢速型搅拌器，在层流区操作，适用于中高粘度液的混和和传热等过程，螺杆式搅拌直径小，轴向推力大，螺杆带上导流筒，轴向流动加强，在导流筒内外形成向下向上的循环。 These low speed impellers operate in laminar region. They are used in processes of mixing and heat transfer of middle, high viscosity medium. The screw type impeller has the feature of small agitating diameter, strong axial thrust. Along the screwed plane, medium appears axial circulation flow.	0.4～0.5	100～1500	≥50000	<2

大直径式搅拌器	螺杆螺带式搅拌器 Type LD…	 LD  LDG  ZLD  ZLG 此类搅拌器为慢速型搅拌器，常在层流区操作，液体沿着螺旋面上升或下降形成轴向的上下循环，适用于中高粘度液体的混合和传热等过程。LD 螺带式搅拌器的螺带外廓接近于搅拌槽内壁，搅拌直径大，强化了近罐壁的液体的上下循环，高粘度液体的传热过程很适用。LDG 螺带螺杆组合式，同时具有螺杆和螺带的特性，强化了液体内外围的循环，特别对非牛顿型拟塑性及粘弹性液体有效。ZLD 锥底螺带型，ZLG 锥底螺带螺杆型，其特点是底形可和锥形釜底相配，可按要求设计. These low speed impellers operate in laminar region. Along the screwed plane, medium appears axial circulation flow. They are used in processes of mixing and heat transfer of middle, high viscosity medium. n=0.5～50rpm, μ＜100000 cP, v＜2m/s. Outline of type LD is close to the inwall of tank and type LD has a large mixing diameter, result in the increase of liquid circulation inside the tank. It has applications in processes of heat transfer of high viscosity medium. Type LDG impeller combines the features of helical ribbon and screw impeller. Type ZLD and ZLG are suitable for taper-bottom tanks.	0.8～0.98	100～4500	≤1000000	~
	锚框式搅拌器 Type MS…	 MS  KS  KSA  MKS  TS 此类搅拌器为慢速型搅拌器，适用于中高粘度液体的混和、传热或反应等过程。常在层流状态操作，产生水平环向流，如为折叶或角钢型叶，可增加桨叶附近的涡流。可根据需要在桨上增加立叶和横梁，以增大搅拌范围。 These low speed impellers are used in processes of mixing and heat transfer of middle, high viscosity medium. They produce horizontal circulation flow in laminar region. Vortex can be increased near blades when folded or angle blades are selected. Vertical and horizontal blades are optional for widening the mixing range.	0.8～0.98	100～4500	<100000	1~5

特殊框式搅拌器 Type MKS…	 此类搅拌器为慢速型搅拌器，常用于中高粘度液体混合、传热反应等过程。锚框式（MKS）低速旋转时沿壁面能得到大的剪切力，可防止沉降及壁面附着，底部形状贴合椭圆形罐与中间的底轴承。锚带式（MDS）是螺带和框式的组合，结合了螺带式和框式搅拌器的作用。方框式（FKS）、方栅式（FSS），形状简单制作容易，效能同框式，中等粘度的混合、溶解更适合些。板框式（BKS）是一粘度范围应用很宽的高效混合叶轮，叶轮结构简单，叶轮在搅拌罐的纵剖面上的投影面积占罐的纵剖面面积比例很大。具有很高的混合效率，并有较大的剪切力，适用于固液悬浮、液液分散、以及使气体从液体表面吸入的气液传质和传热操作。 These low speed impellers are used in processes of mixing and heat transfer of middle, high viscosity medium. The working conditions are : μ ＜50000cP, n=1～100rpm. Type MDS impeller combines functions of helical ribbon type and frame type. Type FKS and FSS impellers have simple structure and can easily be manufactured. Their performance is similar to frame impellers. They are suitable for mixing and dissolving middle viscosity medium. Type BKS is a simple low speed impeller. The holes in the frame can be adjusted.	0.5～0.98	100～4500	≤100000	～
耙式搅拌器 Type PSB	 低速搅拌器，依靠耙臂上的倾斜刮板，将沉淀物料或污泥刮集到中部排出。适用于给排水的沉淀池及废水处理池的污泥刮除。 The low speed impellers are used for deposit pond and liquid waste pond.	0.9～0.98	1000～20000	≤50000	<0.1

3.7 其它搅拌装置部件 Other agitating parts

3.7.1 搅拌轴 Shaft

搅拌轴有多种型式，其长度一般要根据所配机架和搅拌容器的高度来确定；其直径需要根据负载以及机架或减速机的支撑情况经核算强度后才能确定。

There are various types of shaft. The shaft length should be decided by the pedestal and vessel height; the diameter should be decided after strength check according to the loads and supporting conditions from pedestal or reducer.

搅拌轴型号标注方法 Model designations

S □ □

- 釜内联轴器代号 Code for in-tank coupling
  （C：配 DT 型刚性凸缘联轴器；D：配 JQ 或 JJQ 型夹壳联轴器； E：带焊接法兰式联轴器；F：带整体法兰式联轴器；整体轴不注。
  C for DT rigid flange coupling; D for JQ or JJQ clamp coupling; E for weld flange coupling; F for integral shaft flange; Omitted for no coupling)
- 搅拌轴型式代号 Code for shaft
  （A：不带搁圈；B：带搁圈，上装式；C：带搁圈，下装式。A for non-support type; B install the shaft from top with support; C install the shaft frombottom with support）

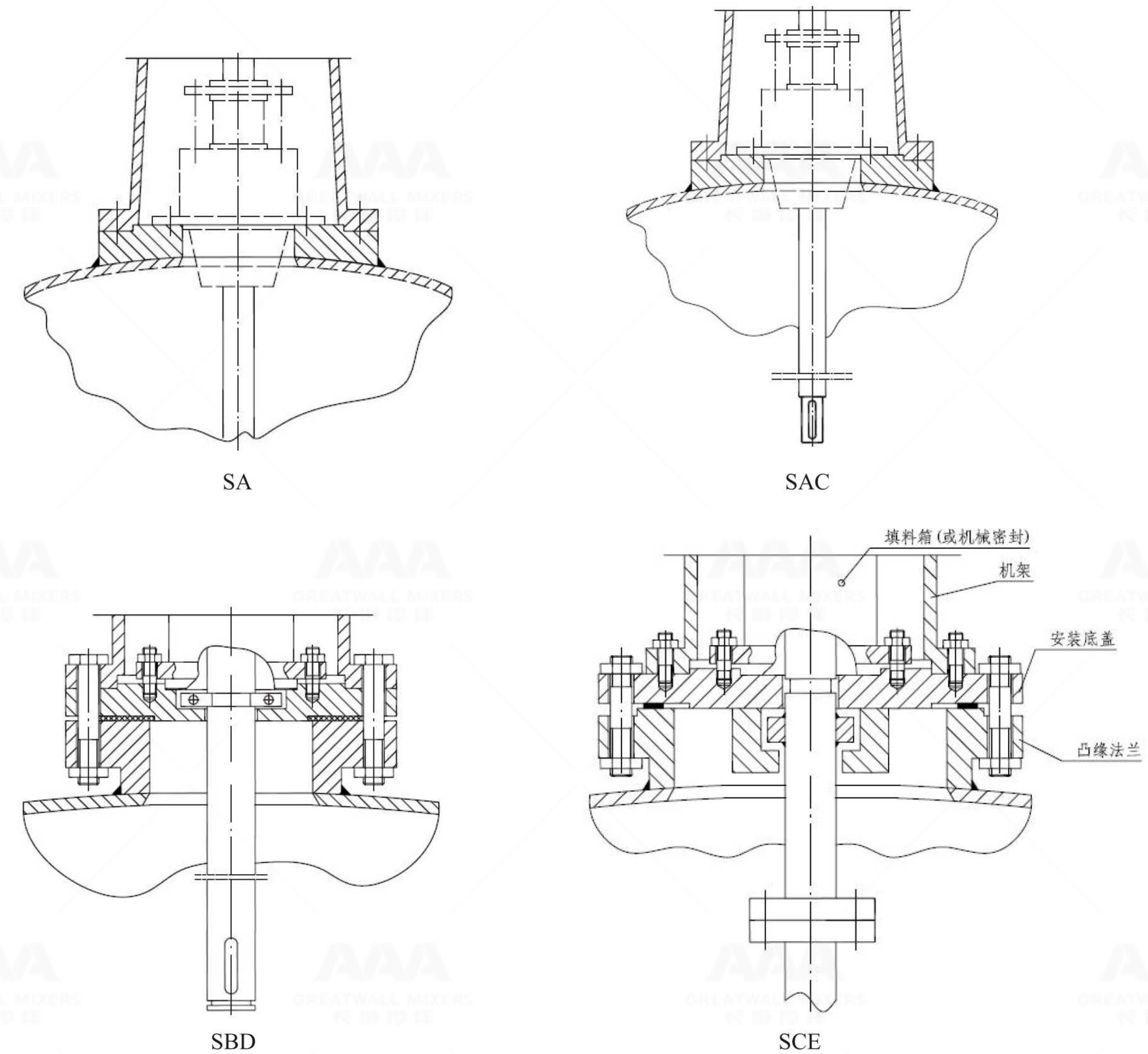


图 Fig. 3-6 搅拌轴型式示意图 Sketch for different types of shaft

3.7.2 安装法兰 Mounting Flange

安装法兰起着连接机架与罐体，同时还有固定轴封的作用。安装法兰有多种型式，一般要根据所配机架、轴封型式和尺寸以及搅拌容器的法兰来确定。安装法兰有 RS、LRS、RX、LRX、RM、LRM、R、UA、UB、UC、UD、VA 和 VB 十三种。

The mounting flange connects the pedestal and the vessel, and it also support the shaft seal. There are various types of mounting flange. The flange design should be based on the pedestal, vessel flange, shaft seal type and dimensions. There are thirteen types of mounting flange, RS、LRS、RX、LRX、RM、LRM、R、UA、UB、UC、UD、VA and VB.

表 Table 3-16 安装法兰型式代号表 Code for mounting flange

代号 Code	法兰型式 Flange type	代号 Code	法兰型式 Flange type
RS	上装式安装底盖（法兰） Mounting base (flange)	UA	平底型凸缘底盖 Flat mounting base
LRS	衬里型上装式安装底盖（法兰） Mounting base (flange) with lining	UB	凹底型凸缘底盖 Dish mounting base
RX	下装式安装底盖（法兰） Mounting base (flange)	UC	衬里平底型凸缘底盖 Flat mounting base with lining
LRX	衬里型下装式安装底盖（法兰） Mounting base (flange) with lining	UD	衬里凹底型凸缘底盖 Dish mounting base with lining
RM	凸缘法兰 Male and female flange	VA	分体平底型凸缘底盖 Split flat mounting base
LRM	衬里型凸缘法兰 Male and female flange with lining	VB	分体凹底型凸缘底盖 Split dish mounting base
R	方形安装底板 Rectangular plate		

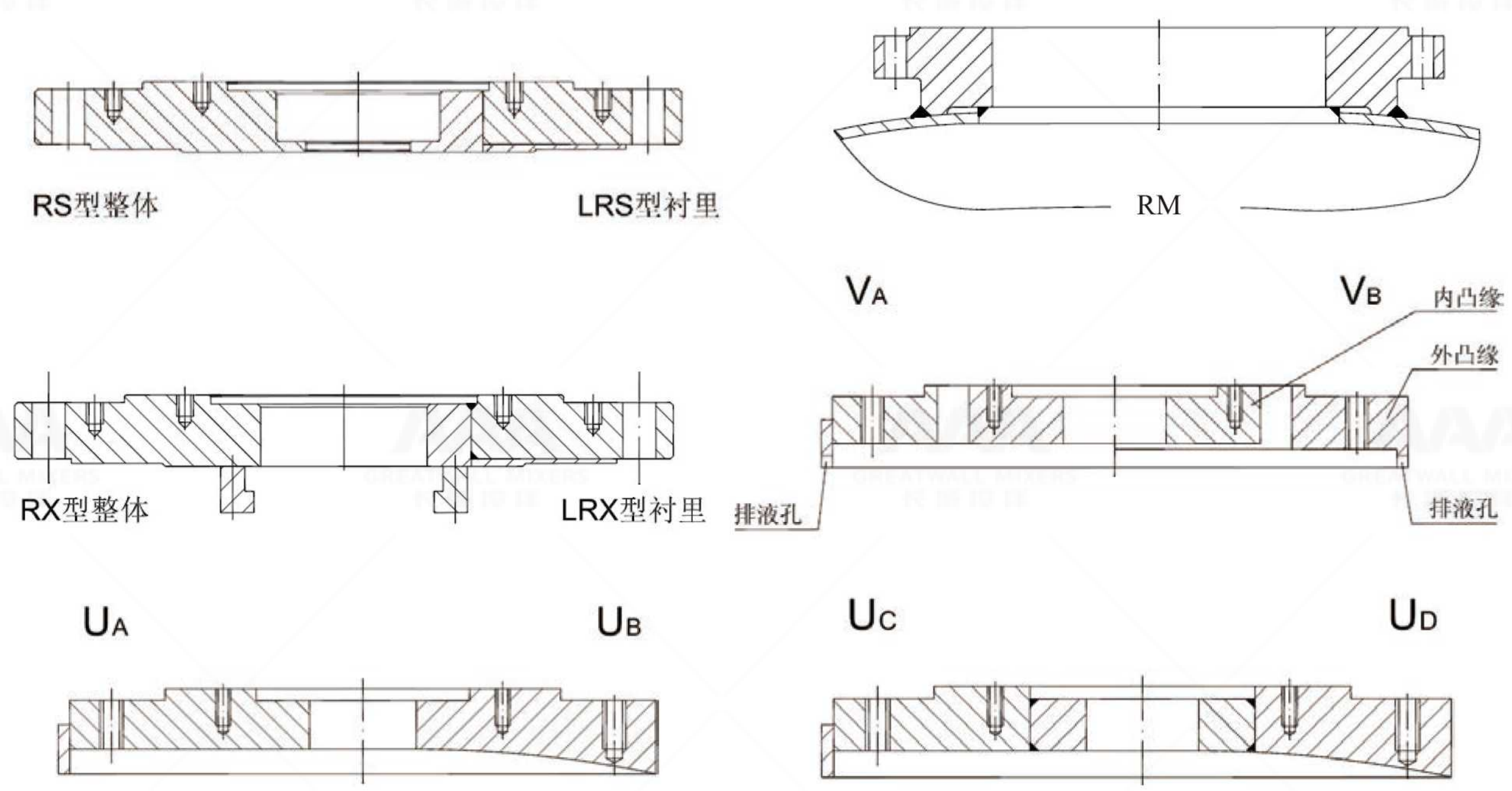


图 Fig. 3-7 安装法兰型式示意图 Sketch for mounting flange

3.7.3 中间轴承 Middle Bearing

中间轴承的型式主要有三拉杆式（SL 型），三槽钢三轴瓦式（SC 型），井字槽钢式（JC 型）。

There are four types of middle bearing, SL,SC and JC .

图 Fig. 3-8 SL 型中间轴承 SL middle bearing

图 Fig. 3-9 SC 型中间轴承 SC middle bearing

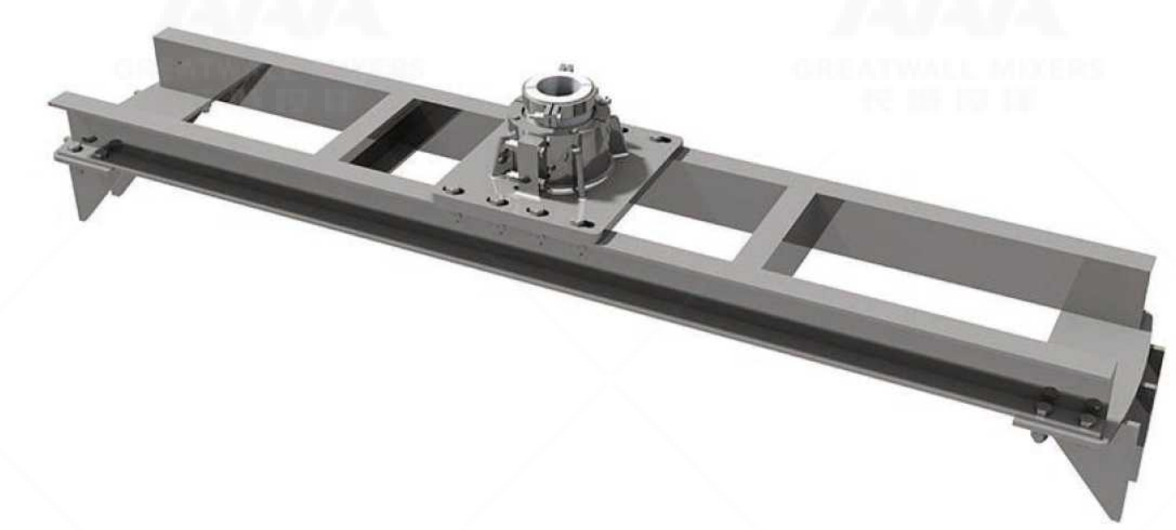


图 Fig. 3-10 JC 型中间轴承 JC middle bearing

3.7.4 底轴承 Base Bearing

底轴承主要有三足式（SZ）、迷宫三足式（MSZ）、迷宫底法兰式（MDL）、FSZP、FSDS 五种。

There are five types of base bearing, SZ,, MSZ, MDL, FSZP, FSDS.

图 Fig. 3-11 五种类型的底轴承 Five types of base bearing (SZ, MSZ, MDL, FSZP and FSDS)

搅拌参数表 (*表示必填项)

基本信息	*客户单位:		地 址:	
	*联 系 人:	*电话:	*手机:	传真:
	*E-mail:		业 主:	
	*项目名称:		位 号:	
	*设备名称:		*数 量:	
罐体信息	槽、罐或容器的简图示意(可附图):		*直径 mm ：________ *直边高 mm: ________ *封头形状 顶部: ________ 底 部: ________	
			*设计压力: ________ *操作压力: ________ *设计温度 ºC: ______ *操作温度 ºC: ________ 最高液面 mm: ______ 正常液面 mm: ________ 最低液面 mm: ______上封头与厂房顶部距离: ______ *盘管: □有 □无 空运转: □有 □无 *挡板: □有 □无，若有，宽度 mm: ____数量: ____ 人 孔: □有 □无，若有，人孔直径 mm: ________	
搅拌器数据	*安装方式: □ 中心顶部安装 □ 偏心顶部安装 □ 侧搅拌 □ 底搅拌 □ 其他: ________			
	*安装环境: □ 室内 □ 室外 □ 高原 □ 粉尘 □ 高温 □高湿度 □ 其他: ________			
	*输出转速 rpm:		旋转方向 (从电机方向): □ 逆时针 □顺时针	
	*搅拌轴材质:	搅拌轴直径 (mm):	搅拌轴长度 (mm):	
	*搅拌器材质:	搅拌器直径 (mm):	叶轮型式:	
	桨片数:	搅拌器层数:	离槽底距离 (mm):	
	底轴承: □ 有 □ 否	中间轴承: □ 有 □ 否	稳定环: □ 有 □ 否	
轴封	*请选择: □ 双端面机械密封 □ 单端面机械密封 □ 填料箱 □ 无 □其他: ________			

操作条件	*物料相态: □ 液体-液体 □ 液体-气体 □ 液体-固体 □ 液体-固体-气体						
	组分						
	*密度 kg/ m³						
	*粘度 cp						
	*重量比例%						
	粒度(固体)						
	*搅拌目的: □混合 □气体分散 □固体悬浮 □乳化 □传热 □ 吸收 □ 萃取 □溶解 □ 结晶 □反应 □发酵 □聚合 □浸取 □稀释 □刮泥 □ 曝气 □ 其它________						
	搅拌强度: □ 温和 □适中 □ 强烈 □ 剧烈						
	混合时间:			整体流动速度(m^3/s):			
	搅拌方式: □ 间歇 □ 连续（流量 m^3/h）________,存留时间: ________小时						
动力源	*请选择: □ 气动/液压马达 □电机			*电源: ____ V_____PH____HZ_______kW			
	*外壳形式: □普通型 □ 防爆型及防爆等级: ________				*变频: □ 是 □ 否		
	转速(rpm): ________			防护等级: ________			
防污染要求:	□卫生级 □ 工业级						
品牌 指 定:	电机: ________ 减速机: ________ 机封: ________ 轴承: ________						
备注							

AGITATOR DATASHEET

Item No.

Serial No.	Description:	
1	General	
1.1	Mounting type	□Top entry □ Side entry □Bottom entry
1.2	Location	□Indoor □ Outdoor
1.3	Quantity（Set）	
2	Vessel information	
2.1	Vessel diameter(mm)	
2.2	Vessel height(mm)	
2.3	Shape of vessel heads(top/bottom)	
2.4	No of baffles	
2.5	Operating pressure（barg）	
2.6	Operating temperature（℃）	
2.7	Fluid density（kg/m3）	
2.8	Fluid viscosity（cP）	
2.9	Fluid name	
2.10	Mixing purpose	
3	Impeller and shaft	
3.1	Impeller type	
	Impeller diameter（mm）	
	Impeller layer	
	Number of blades	
	Impeller material	
	Distance from vessel base（mm）	
	Tip speed m/s	
3.2	Shaft type	
	Shaft length（mm）	
	Shaft diameter（mm）	
	Shaft material	
	Rotation（view from drive to impeller）	Clockwise
4	Mounting flange	
	Mounting flange size	
	Mounting flange pressure rating	
	Mounting flange standard	
	Mounting flange material	
5	Seal	
	Type	
	Rotation and stationary ring material	
	O-ring and gasket material	
	Pressure reservoir	
6	Reducer/gearbox	
	Sub vendor	
	Cooling	
	Output speed（rpm）	
	Safety factor	
7	Motor	
	Manufacture	
	Energy efficiency	
	Power（kW）	
	Volt/Phase/Cycles(kV/Ph/Hz)	
	speed（rpm）	
	Explosion Protection	
	Variable-frequency Drive	□Yes □ No
	Protection Class	
	Temperature Rise Class	
	Insulation Class	
8	Safeguard	
	Coupling guard	□Yes □ No

Note: Red marked is key and necessary information for agitator design.

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All of them choose GREATWALL MIXERS

邦普循环	巴斯夫	阜丰集团	基伊埃	华陆工程
华友钴业	联邦制药	拉森.特博洛	苏伊士	万华化学
中国海油	中国石油	中国石化	中国五矿	中国天辰
阿拉宾度	阿科玛	艾仕得	阿克苏诺贝尔	安琪酵母
北方稀土	巴德富	拜耳	科伦药业	厨邦
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恒力石化	华鲁恒升	海天	惠生工程	华峰集团
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京博石化	金川集团	凯赛生物	科思创	开曼铝业
利尔化学	利柏特	乐金	美国特矿	蒙牛
梅花集团	迈图	诺力昂	PHOSAGRO	青山控股
赛托生物	塞拉尼斯	索尔维	沙特基础工业	斯尔邦石化
三星	石药集团	赛得利	神马	泰瑞制药
天冠集团	天齐锂业	陶氏化学	诺维信	皖维

威立雅	伍德工程	瓦克化学	沃利	维美德
希杰	新和成	晓星氨纶	赢创	伊品生物
延长石油	益海嘉里	中粮	浙石化	中国五环
中鼎集团	中伟	中国恩菲	中国成达	中盐集团
中国有色集团	浙江医药	中核集团	中泰化学	中国华电

备忘录 Memo