

# 提高海密梯克磁力泵运行可靠性的办法和途径

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**摘要** 简述了海密梯克磁力泵的特点,分析了该泵运行中常见故障问题的原因,并为确保和提高海密梯克磁力泵平稳运行可靠性,提出了相应措施和途径。

**关键词** 磁力泵 故障 可靠运行 措施 途径

## 1 前言

我公司 40kt/a 甲烷氯化物新装置已正式启用。在项目设备选型期间,我们经过广泛调研,坚持创新理念,根据生产工艺原理及输送物料介质特性,选用了 27 台海密梯克新型磁力泵。海密梯克磁力泵是由大连海密梯克密封泵有限公司生产的。

该泵设计先进,无轴封,作为一种无泄漏、免维护、运行可靠性好的离心泵,具有安全、高效、节能等特性。适用于输送有腐蚀性的、有毒的、易燃的、易爆的、昂贵的或易汽化的液体。除此之外,海密梯克磁力泵也适合输送高温、低温流体以及真空状态下的液体。

与传统密封泵相比,海密梯克磁力泵具有维护维修工作量小,无需外加润滑油,无泄漏,振动、噪声小等优点。但由于其自身的特点使其在很多方面又与传统离心泵不同,所以要在工艺、安装、操作等方面采取一些措施和途径来保证它的可靠平稳运行。

## 2 海密梯克磁力泵的特点

(1) 结构:磁力泵是轴向吸入、径向排出的卧式完全无泄漏离心泵,泵轴通过磁力联轴器传动,无旋转轴封装置,实现“零泄漏”。

(2) 轴承:磁力泵的驱动轴通过滚动轴承支承,滚动轴承由其自身的润滑脂进行润滑;泵轴通过水力滑动轴承支承。

(3) 磁力联轴器:磁力泵的磁块是高质量的稀土永磁材料,其最高不可退温度可达 350~400℃,充分保证了磁力联轴器具有可靠的性能。正常工作时,磁力联轴器与三相异步电动机同步运转,性能稳定。而且永久磁铁具有很高的稳定性,能防止

在组装和拆卸转子时或泵在最大传递扭矩下工作时产生的不良影响。

(4) 滑动轴承的润滑与磁力联轴器的冷却:由泵所输送的介质进行润滑和冷却,无需外加润滑油和冷却水系统。

(5) 轴向力平衡:在工作时,磁力泵的轴向力由水力自动平衡,推动盘只在启动和停车时承受瞬时的轴向推力作用。

## 3 海密梯克磁力泵常见故障分析

(1) 泵运行工况波动大而导致的问题:磁力泵的轴向力是通过液压均衡方式自动平衡的。在实际运行中如果运行参数(入口压力、出口压力)波动大,很容易破坏海密梯克磁力泵的液力平衡,使滑动轴承承受大的径向和轴向力而导致轴承损坏。

(2) 泵因汽蚀而导致的问题:泵产生气蚀的原因主要有泵入口管阻大、输送介质气相较多、灌泵不充分、泵入口压头不够等原因。汽蚀对泵的危害最大,发生汽蚀时泵剧烈振动,液力平衡严重破坏,将导致泵轴承、转子或叶轮损坏。这是海密梯克磁力泵故障发生的常见原因。

(3) 无介质或输送介质流量小:海密梯克磁力泵是由输送介质给滑动轴承提供润滑和冷却的,在没有开入口阀或出口阀的情况下,滑动轴承因无输送介质润滑和冷却而导致损坏。

(4) 隔离套损坏:磁力联轴器是由泵所输送介质冷却的,如果介质中有硬质颗粒,很容易造成隔离套划伤或划穿,有时如果维护方法不当也有可能造成隔离套的损坏。

## 4 提高磁力泵运行可靠性的办法和途径

#### 4.1 设备及管路安装要求

(1) 泵的入口管路及出口管路应有支撑,以防止传递给泵额外的载荷,泵不能作为管路中的受力点,要保证管路系统有热膨胀补偿措施。

(2) 当正吸入压头较低时,入口管路应尽可能短,以防止发生汽蚀。入口管路应有适当的尺寸以保证流体流速不超过  $3\text{m/s}$ ;在输送易汽化的流体或液化气时,保证流速不超过  $3\text{m/s}$ 。

(3) 出口管路应安装一调节阀,以调节泵的流量和扬程。在使用较长的出口管路或两台泵并联使用时,建议安装一附加的单向止逆阀。

(4) 整个管路系统以及辅助管路均应仔细清洗,以防止铁屑、焊渣或其它异物进入海密梯克磁力泵中。对于新建的管路系统,入口管路应装有过滤器。

(5) 管路设计应考虑到泵的排气。

(6) 为实现泵的连续运转,建议安装一回流管路,安装最小流量孔板,以保证连续运转时滑动轴承有足够的润滑和冷却。

如图1所示,回流管路应从出口阀或单向止逆阀之前引出,通过最小流量孔板返回储液罐中。这种安装可实现泵的自动排气。

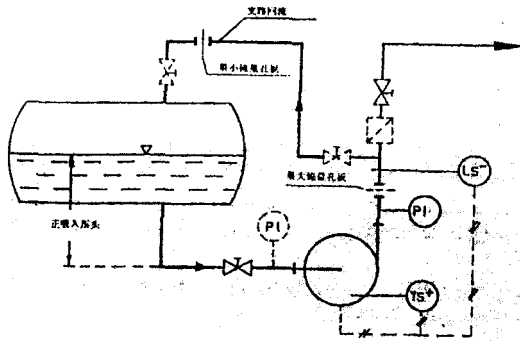


图1 工艺配管及监控示意图

(7) 海密梯克磁力泵必须在指定的范围内工作。为控制最大流量,建议在出口管路上安装一合适的最大流量孔板(如图1所示)。

#### 4.2 工艺监控

由于海密梯克磁力泵的设计特点,一般勿需维修,但是为保证其正常运转及安全工作,应使用工艺监测装置,严格管理。

(1) 入口罐液位保护控制是必要的,入口罐应装有液位变送器或液位开关,在入口罐液位降低到一

定程度时,自动停止泵的运行以保护泵。

(2) 泵体应装有温度传感器,监测磁力定子和泵轴承温度,保护轴承和磁力定子。

(3) 泵出口应装有液位调节阀,根据入口罐的液位调节输送介质的排量。

(4) 应安装差压传感器和开关,测量泵出口和入口差压,在差压低于设定值时自动停泵,起到保护泵的作用。

(5) 泵的振动,较大的振动及噪音说明发生故障。

(6) 为保证正常工作,应保证泵在图2所示的流量及扬程范围内工作,最小及最大工作流量、扬程在性能曲线上均有说明。

(7) 为避免产生汽蚀,海密梯克磁力泵在输送易汽化流体时所需要的最小吸入压头( $e_{\min}$ )由下式计算: $(e_{\min})\text{ (m)} = \text{NPSH}_{\text{泵}}\text{ (m)} + \text{入口管磨擦损失 (m)} + \text{安全余量 (m)}$ ,安全余量通常为  $0.5\text{m}$ 。

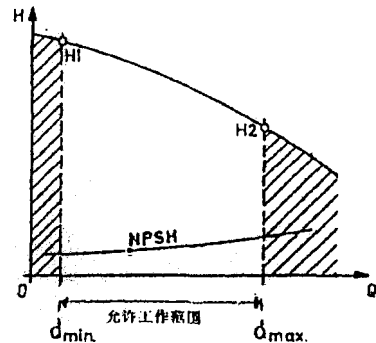


图2

#### 4.3 操作要点

##### (1) 灌注与排气

为使海密梯克磁力泵能正常运转,必须充分地灌注与排气。将泵入口管路和回流管路、出口管路中的阀门完全打开,即可实现密梯克磁力泵的自动排气。当输送液化气或易汽化的液体时,要反复几次排气,直至保证泵中充满液体为止。若输送低温液体,要等到泵的过流部件冷却至液体的温度时方可启动,这样可以保证流体已到达泵的各部。

##### (2) 启动程序

磁力联轴器的型号是根据驱动电机选择的,从而实现正常运转,但是在不适的情况下启动,(例如电机功率过大,出口阀门开启过大或较高的电压等),将超过磁力联轴器的最大转矩,使泵无法正常

运转,所以注意一定要正确启动。

完全打开入口管路的阀门;

关闭出口管路的阀门;

启动电机;

缓慢打开出口管路中的阀门;

调节出口阀直至达到正常工作压力;

为使泵正常运转,应使泵在其允许的范围內工作。

## 5 运行及维护注意事项

(1) 海密梯克磁力泵绝对不允许在干摩擦状态下以及在出口管路阀门关闭时工作,否则将导致滑动轴承损坏。

(2) 必须与电动机同步工作,如果泵失效(扬程很小),则表明已超过了磁力联轴器的最大扭矩,应避免在不良工况下长时间工作。

(3) 正常工作情况下发生振动、较大的噪音及功率增长,说明轴承发生磨损(润滑不足)应立即检查。

(4) 磁力泵滚动轴承为深沟球轴承,靠其自身

的润滑脂进行永久性润滑,但亦应定期检查,定期更换。

(5) 磁力联轴器的失效并不意味着永久磁铁的损坏。但如果在失效状态下长时间地工作,因其转速较低,滑动轴承润滑不良,会导致滑动轴承的损坏。

(6) 转子组件及驱动组件有较高的磁性,在组装和拆卸磁力泵时,应当考虑磁力范围,它可能对电力及电子装置产生一定的影响,注意保持一定的距离。

(7) 长时间放置时,若所输送的液体会产生结晶或凝固,应用合适的液体来冲洗泵。

## 6 结束语

综上所述,可知合理的工艺设计安装和监控保护是保证海密梯克磁力泵长周期无故障运行的必要条件,而正确的操作维护可延长泵的使用寿命;必须加强对磁力泵科学严密的精确操作与精心呵护,为确保新装置的安全、平稳、可靠运行提供保证。

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此密封体结构使用效果理想。其优点如下:

(1) 结构简单,改造容易。原密封体不变,只加工一个  $\phi 75 \times \phi 65 \times 105\text{mm}$  的铸铁套压进即可。膨胀石墨环可以定点加工,隔环在车床上加工即可完成。

(2) 安装、检修方便。如图 1 所示,100R-37 热水循环泵共用  $\phi 65 \times \phi 45 \times 10\text{mm}$  膨胀石墨环 10 个, $\phi 65 \times \phi 45 \times 5\text{mm}$  隔环 6 个,从泵的两端都可安装和拆卸。石墨密封环和隔环间隔安装,口端三根不要隔环。正常情况下,一组填料运行一年,口端三根视情况,一般四个月左右更换一次(因压力,温度不稳造成)。整体组装时,膨胀石墨密封环不切口。第二次更换口端三根时,要把口端内部清理干净,把备好更换的三根切成一个或对称切开二个 45° 切口,三根缺口错开安装。

(3) 密封效果好,无泄漏。

(4) 使用寿命长。整组填料一年更换一次。口端三根一般六个月更换一次。密封体可使用三年,填料套从原来三个月提高到二年左右。

(5) 经济效益好。原浮动环结构,100R-37 热水

循环泵需三组浮动环和一个泄压环,一套价值 700 元,改用膨胀石墨环后,每年只需 60 元。改装后,没有再发生事故停车现象。因去掉了泄压环,泄压孔被堵死,每小时可节约热水 1~2 吨。

使用中应注意的事项:

(1) 膨胀石墨温胀系数较大,新装填料必须空负荷试车。试车前不可预压过紧。每次预紧时,不仅要用力均匀,而且需要停车预紧。最后预紧,必须在工作温度下进行,不然会因高温膨胀将轴抱死。

(2) 操作压力,温度必须稳定。压力不稳,影响填料使用。温度突然升高,石墨填料温升膨胀把轴抱死,轴向膨胀会把填料压盖崩坏,高压蒸汽向外冲出而发生事故。

(3) 发现泄漏时将口边三根填料进行更换,不然,内部填料会因泄漏而被冲坏,轴套也会被高速旋转的涡流冲刷坏。

(4) 80R-60 导热油循环泵的改造同 100R-37 热水循环泵。

**Abstract:** It was mainly introduced in this paper that the feasibility, implementation and good results of the technical modification through diameter expanding of the cylinders in the 190 m<sup>3</sup> / min nitrogen / hydrogen gas compressors used in the ammonia synthesis plant. In this modification, the discharge pressures of some stages in the compressors were changed in order to meet the requirements of the changed operation conditions in the production through the diameter expanding of the corresponding cylinders in the compressors

**Key words:** nitrogen / hydrogen gas compressor, expanding diameter of cylinder, good results

#### Analysis on Causes about Leakage of Mechanical Seals in Ammonia Compressor and Modification

Shang Yangfeng, Guan Zepel, Wang Jianhui  
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**Abstract:** The causes of the abrasion, leakage and short service life of the original mechanical seals were analyzed in this paper. Modified by using the non-contact type of spiral chute end-face seals with fluid dynamic pressure, the seals were basically in a good state of minor abrasion, non leakage, high reliability and long service life. This modification ensured the normal operation of the ammonia compressor unit with remarkable economic results.

**Key words:** ammonia compressor, mechanical seal, spring specific pressure, leakage, spiral chute

#### Improvement of Sealing Structure in R-Model Circulating Pumps

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**Abstract:** In this paper the causes of leakage from the original sealing in R-model circulating pumps were described. The improvement of the sealing structure and the advantages of the modified seal as well as the corresponding points for attention in service were introduced.

**Key words:** R-model circulating pump, sealing leakage, sealing structure, improvement

#### Measures and Approach to Raise Operational Reliability of Hermetic Magnetic Pumps

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**Abstract:** In this paper, the characteristics of the Hermitic pumps were briefly introduced and the causes of common troubles during the routine operation were analyzed. The relevant measures and approach to ensure and promote the reliability in smooth operation of the pumps were presented.

**Key words:** magnetic pump, trouble, reliable operation, measure, approach

#### Properties and Selection of Non-Asbestos Gaskets in Engineering Design

Ling Yuan Jia  
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**Abstract:** In this paper, the varieties and technical parameters of non-asbestos gaskets were more comprehensively introduced. Meanwhile, how to select the non-asbestos gaskets in engineering design was described.

**Key words:** non-asbestos gasket, variety, technical parameter, selection

#### Characteristics of Polypropylene Material and its application in Conversion System of Potassium Chloride

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**Abstract:** The characteristics and properties of polypropylene material were shown in this paper. Its application in the conversion system that is used in the production of S-based NPK compound fertilizer by the method of conversion of potassium chloride under low temperature was introduced.

**Key words:** polypropylene, characteristics, compound fertilizer, conversion system, application.

#### Analysis on Causes of Corrosion in Ammonia Stripper and Countermeasures

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**Abstract:** In this paper, the state of corrosion in the ammonia stripper was introduced, the causes of corrosion were analyzed and the countermeasures to solve the problem of corrosion were put forward.

**Key Words:** ammonia stripper, cause of corrosion, countermeasures

#### Analysis on Causes of Cracks in Polymerizing Vessels and Treatment Measures

Wang Qing  
Hunan Institute of Science & Technology  
Yueyang 414000

**Abstract:** In this paper it was described that the analysis on the causes of the cracks located in the region of the thermal couple nozzles in the polymerizing vessels was carried out via testing and examination, and effective treatment measures to prevent the corrosion cracks were taken.

**Key words:** polymerizing vessel, corrosion, crack

#### Analysis on Causes of Failure for Partial Condenser of Ammonia Stripper

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**Abstract:** The causes of failure of the partial condenser of the ammonia stripper were analyzed in this paper. Through the macroscopic examination, the analysis of chemical composition of the tubes and the testing for quality of the water, it was shown that the main causes of failure of the equipment were the eroding corrosion, but the corrosion could be under the influence of the heat exchanging way and accelerated with the raise of the PH value of the media. However, the local corrosion in the outside wall of the tubes resulted from the unacceptable content of the chloride ion and the impurities in the circulating water.

**Key words:** partial condenser, failure, corrosion

#### A Study on Connection of Pro/E with ANSYS

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**Abstract:** The modeling of a complex structure in the finite element analysis software ANSYS is a time-consuming work. By comparing many kinds of methods to import CAD files to ANSYS, the method for ANSYS modeling has been put forward in this paper. In the ANSYS modeling, CAD software is used to build the CAD model and then the model can be accurately imported to ANSYS by utilizing the connection of Pro/E with ANSYS.

**Key words:** ANSYS, Pro/E, Modeling

#### Method of Finding out Friction Factor of Pipe Based on CAGD

Li Jin, Sun Tie, Zhang Shuxiang, Shi Chengjiang  
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**Abstract:** By adopting the method of Computer Aided Geometrical Design (CAGD), the curves of friction factors for pipes are converted and precisely plotted in computer. The program, which is worked out with Visual Basic calculating foreground and AutoCAD dealing with curves background, can imitate a man to search for the curves and then the friction factor of the pipe under the given conditions will be determined accurately.

**Key words:** CAGD, pipe, friction factor,

#### Mechanics Analysis on Swaging Process of Hose Assembly

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**Abstract:** The swaging quantum influences the connecting performance of the hose assembly directly. A hydraulic high-pressure hose is composed of the steel wire reinforced layer, inner and outer rubber layer, and presents orthogonal anisotropy. By adopting the theory of rubbery composite materials, regarding the hose as an anisotropic cylindrical shell, considering the swaging force and studying the method of analysis of stress-strain for the lamination cylinder composed by multi-materials, the mechanics model of the compounded tube was established. The deformation regularity of the hose was obtained and the relationship between swaging force and swaging quantum was derived theoretically. Meanwhile, simulated analysis was carried out by using the ANSYS finite element method and the results were finally proved with the experiments.

**Key words:** swaging quantum, hose assembly, mechanics model, ANSYS finite element method