

# 软水补水屏蔽泵的分析及改进

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摘要 分析软水补水屏蔽泵不能稳定出力及易损坏的原因, 并提出了改进办法。

关键字 软水 屏蔽泵 分析 改进

## 1 前言

屏蔽泵是以输入介质为润滑液, 无动密封, 高度机泵一体化的产品, 由于设计先进, 结构紧凑、高效、节能、噪声小、无泄漏、耐高温、寿命长、维护少等而广泛用于石油、化工行业。由于屏蔽泵配合间隙小, 要求条件较高, 在实际使用中必须注重泵本身设计的合理性, 管路设计、安装的科学性, 操作人员操作的正确性等, 这样才能保证屏蔽泵长、满、安、稳、优地运行, 发挥屏蔽泵的真正优势。我车间 2000 年安装了 1 台无锡安化屏蔽电泵厂的补水屏蔽泵, 用以把软水补充到软水包中去, 在使用初期状况并不理想, 经整改后此泵运行良好。

## 2 工艺及使用概况

补水泵是把低压蒸汽冷凝水从软水罐增压 1.0MPa 变成供系统使用的高温软水的屏蔽泵, 进口、出口管路均为 1 英寸管, 软水液位至泵口中心高 0~1.5 m, 进口管弯头 3 只、三叉头 1 只, 泵为单级离心泵, 技术参数为流量  $Q=2.0\text{m}^3/\text{h}$ 、扬程  $H=100\text{m}$ 、汽蚀余量  $NPSH_r=2.0\text{m}$ 、功率  $P=5.5\text{kW}$ 、转速  $n=3000\text{r}/\text{min}$ 。工艺要求泵的扬程要大于 80m, 流量大于  $1.5\text{m}^3/\text{h}$ 。

现场使用时, 按屏蔽泵的操作规程启动, 表压达 0.8MPa, 但一开出口阀, 表压迅速下降到 0.7~0.8MPa, 经反复操作出口压力均不能稳定达到工艺要求, 出力低, 当时环境温度为 20~30℃, 软水温度 80~90℃, 后经过一段时间操作使用发现补水泵有以下问题:

(1) 运行不够平稳, 有一定的噪声及振动。

(2) 出水压力达不到技术参数, 出水流量小, 甚至会断流, 出力低。现场未装过滤器。

(3) 轴承损耗大, 使用寿命短, 定子套使用不长时间后即磨损。

(4) 操作工未严格按照操作规程操作和检查。

## 3 存在问题和分析

### (1) 汽蚀

工艺要求流量  $Q>1.5\text{m}^3/\text{h}$ , 压头  $H>0.8\text{MPa}$ , 从表面上看所选的泵的性能指标满足了工艺要求, 但根据现场使用情况来看, 现场工艺条件并未完全满足泵的工艺要求。泵在正常运转时, 装置汽蚀余量必须大于泵的必需汽蚀余量, 否则会汽蚀。

补水泵在使用时发生汽蚀, 而汽蚀主要原因是 ①现场软水罐位置偏低; ②进口软水温度过高易于在泵口汽化; ③吸入管过细管道损失大。

### (2) 运行不平稳, 振动

此泵在工作时常有轻微振动和响声, 并且使用时间不长轴承就已磨损。

此外, 由于屏蔽泵轴承与轴套的间隙只有 0.1~0.4mm, 吸入管路未装过滤器, 不时会有杂质进入泵体内, 一旦有杂质进入泵体内会干扰转子转动, 引起转子不规则窜动, 从而引起整个泵的振动并损坏定子套。

### (3) 水流量小, 出水压力低

出水流量、压力与泵的结构设计有关。一般小流量, 高扬程泵, 泵内各配合间隙都较小, 以利于密封, 减少压头损失及涡流等形成的机械损失, 另外泵的叶轮直径越大扬程就越高, 此屏蔽泵的第一次启动, 表压只达 0.8MPa, 并未达到泵的性能指标, 因此可能泵的叶轮切削过多, 直径偏小。

### (4) 轴承损耗大

由于补水泵轴承冷却、润滑是通过由泵出口引

出的循环管接到泵尾进行对轴承冷却、润滑的,在实际中由于泵打出的高压软水温度可达 150~160℃,因此当高温软水未经冷却直接进入泵尾时,由于温度高实际未起冷却作用。另外当高温软水通过轴套与轴承间隙流向泵头时,会由于腔室大小的变化而汽化,同时由于汽蚀的影响,泵出口无稳定出水,循环管得不到稳定的润滑液,而使循环液未起到润滑的作用,使轴承、轴套、推力盘间发生干磨,加快轴承及推力盘的损坏。

#### (5) 操作不严格

有部分操作工开泵前未严格按照操作规程操作,开泵时未打开泵尾的排气阀排气,或汽未排干

冷却后润滑冲洗轴承及轴套,减少轴承与轴套磨损;增加定子冷却夹套,并降低定子及循环液温度,保护定子线圈不超温,使其在安全温度下工作。

②改变循环液管路进口,结构如图 1,使其进口改在泵前轴承前,尽量与泵出口高温软水隔离,转子后部加一副叶轮,后轴打穿孔,以便循环液流动,这样泵体内的液体通过副叶轮的旋转使循环液形成从前轴承—循环管—后轴承—后轴中心—副叶轮—定、转子间隙—前轴承的循环,并与泵腔内的高温软水相对隔离,形成一个相对隔离,但可循环的低温循环液,从而真正起到保护、润滑、冷却轴承的作用,可大大延长轴承寿命。

## 4 目的

### (1) 汽蚀

针对以上可能造成汽蚀的情况,采取以下措施:

①适当提高软水罐位置 1.5m,使用时软水罐液位不低于 50%,保证泵口最小静压头在 2m 以上。

②软水收集管路上增加冷凝器,软水罐增加冷却盘管以降低软水温度,软水罐加温度计,以把水温控制在 60℃以下。

③改大吸入管路直径为 2 英寸管,减少吸入管路弯头,减少吸入管路阻力。

### (2) 运行不平稳,振动,以及流量小,扬程低

如前所述,减少汽蚀,减少循环液的汽化,重而减少整个泵的振动。避免汽蚀的发生和减少循环液的汽化是减少泵运行不平稳和振动的最关键因素。

建议厂家重新核算泵轴,适当加大泵轴头直径,加大叶轮强度,以减少因泵机械强度弱而引起的振动。另外,重新核算叶轮直径,适当加大叶轮直径以增加泵的流量和扬程,并考虑好电机功率与泵叶轮直径的关系,不能因加大叶轮直径而使功率不足。

### (3) 轴承损耗大

①针对循环液温度高、汽化的问题,建议厂家改进泵的结构,增加循环管路上冷却夹套,并弯成 U 型圈 2 圈,以增加循环管路的换热面积,使循环液充分



图 1

③在泵进水管路上装上 30 目的过滤器,定期清理排除杂质,减少杂质对屏蔽泵的损害。

### (4) 加强职工培训

首先对职工进行安全教育和技术培训,把原理及操作要点交待清楚,特别是屏蔽泵的结构特点、使用方法和故障排除等,以提高职工队伍的操作水平;加强巡回检查,密切注意 TRG 表指针所在区域,一旦发现指针指向黄色区域,立即停泵检查,把故障消灭在萌芽状态。

开泵前要严格按照操作规程反复打开泵本身的排气阀排气,确认排净气体后方可启泵,以免循环液汽蚀引起振动,损坏石墨轴承。

## 5 结束语

通过一系列改进措施和加强管理,补水泵性能参数超过名牌值,至今已连续使用 13 个月,未发生一起屏蔽泵故障,保证了安全生产。

## 参考文献

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factor and dimensionless liquid height) was also presented.

**Keywords:** horizontal vessel, volume of filled liquid, arc of circle

#### **Revision of Equation for Calculating Area of Mat Used in Equipment Installation**

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After analyzing the shortcomings of the original equation to calculate the area of the mat used in the equipment installation, a new equation that was proved to more fit to the practice was presented in this article.

**Keywords:** mat, equipment, equation

#### **Design of Piping Segment Drawing**

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With the practical examples in the engineering, the method and key points to make the section drawings in the piping design were introduced in this article. Under the condition that the piping is pre-fabricated in the factory, the method can make the material classification more accurate and ensure the procedure of the engineering.

**Keywords:** pre-fabricated in factory, design specification, section drawing, material classification

#### **Current Situation and Trend of Piping Standardization in China**

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In this article, the classification of pressure piping and current standard system in China and abroad were analyzed. To counter the situation that the pressure piping standard in China is relatively backward, the guidance - standard systemization and compromise with international ways - were presented as the directions of the work of pressure piping subcommittee.

**Keywords:** pressure piping, standard, current situation, direction

#### **Finite Element Analysis of Elastic - Plastic Stress Distribution in Extruded Piping Branch Junction**

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By using elastic and plastic finite element analysis, the effects of structural sizes such as  $D/T$  and  $r/D$  on the stress distribution in extruded piping branch junction were systematically studied in this paper. It is indicated by the calculation result that the maximum stress at the transition area of the branch and run pipe will be decreased if the radius at crotch corner increases, however, the stress concentration area will be larger. The stress level can be decreased when the thickness of the pipe is increased. But, the distribution of the stress will not be changed. The research result can be used as the reference for the optimum design of the T branch and the assessment of the structure with flaws.

**Keywords:** extruded T branch, stress distribution, elastic and plastic finite element analysis

#### **Application of PIG in Storage and Transportation in Petrochemical Industry**

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In this article, the essential mechanism, process, device and design method of PIG were introduced. At the same time, the significance of the application of PIG to the piping in the petroleum transportation system was also indicated.

**Keywords:** PIG, petroleum transportation

#### **Test of Seal Reform for Gas Compressor**

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The cause of the gas leakage occurred in the gas compressor used in refinery was analyzed in this article. The improvement measures were proposed and the rational and feasible technological process drawing was made after the onsite test had been carried out. The design scheme presented in this article is significant for the safe production of the gas compressor.

**Keywords:** air compressor, leakage, technological process

#### **Analysis and Improvement of Pure Water Magnetic Pump**

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In this article, the causes of that the pure water magnetic pump cannot work stably and is easy to be out of order were analyzed. Then, the improvement measures were proposed.

**Keywords:** pure water, magnetic pump, analysis, improvement

#### **Failure Analysis of T Branch for Outlet of Waste Water Pump**

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Combined with the operating condition, the failure samples of T branch were analyzed through the chemical and physical tests, such as visual examination and material composition analysis. The analysis results showed that the failure was caused by the combined influences of poor welding quality, pitting corrosion and erosion.

**Keywords:** stainless steel, T branch, failure analysis

#### **Design of 1000m<sup>3</sup> Spherical Tank Made of NK - HITEN610U2 Steel**

**Jiang Ling**  
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Nanjing 210048

In this article, the method of using imported steel plate NK - HITEN610U2 and Chinese standard to design 1000 m<sup>3</sup> acryl spherical tank was stated from the aspects of the requirement of the material, structure and fabrication.

**Keywords:** imported steel plate, Chinese standard, spherical tank, design

#### **Comparison and Evaluation of Chinese and American Titanium Material Standards for Chemical Industry**

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In this article, based on the comparison of the titanium and titanium alloy standards issued by China and USA, some problems in using titanium in chemical industry were stated.

**Keywords:** chemical industry, titanium, anticorrosion titanium alloy