

真空保冷在 CSY 磁浮色标液位计上的应用

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摘要: 针对目前磁浮子液位计在低温液体环境应用中存在的液位计在某些部位出现冷凝冰块, 降低仪器测量精度、影响其使用寿命的问题, 根据真空保温原理, 对液位计的结构进行改进, 在测量筒和上下平衡管增加真空保温层, 防止出现冷凝冰块, 保证了在深冷环境下磁浮子液位计的正常使用和显示, 提高了仪器的性能。

关键词: 真空保温层; 磁浮子; 液位计

目前, 低温液体液位的测量方法有很多种, 各有其优缺点。其中由于磁浮子液位计结构密封性可靠, 观察清晰明了, 已在部分市场上得到了应用^[1]。但在低温液体所要求的工况下, 这些仪表还有待进一步的完善。

1 普通磁浮色标液位计结构特点

1.1 工作原理及用途^[2]

磁浮色标式液位计是以磁性浮子为感应元件, 并通过磁性浮子与显示色条中磁性体的耦合作用, 反映被测液位或界面的测量仪表。磁浮色标液位计和被测容器形成连通器, 保证被测量容器与测量管体间的液位相等。当液位计测量管中的浮子随被测液位变化时, 浮子中的磁性体与显示条上显示色标中的磁性体作用, 使其翻转, 红色 (或者绿色) 表示有液, 白色 (或者红色) 表示无液, 以达到准确显示液位的目的。

就地显示磁浮色标液位计具有显示直观醒目、无需电源、安装方便可靠、维护量小、维修费用低的优点, 是玻璃管、玻璃板液位计的升级换代产品, 可广泛应用于石油、化工、电站、制药、冶金、船舶工业、污水处理等行业的罐、槽、箱等容器的液位观察监测。

根据工程实际需要, 配合远方传输设施, 磁浮色标液位计不仅可以就地显示液位, 也可在主控

室通过计算机或者数字显示仪表来实现远程观测。根据工业过程控制的需要, 对液位报警或进行控制。

1.2 结构

图 1 为普通磁浮色标液位计结构示意。与液体容器连通的一个测量筒, 置于测量筒中的磁浮子, 以及固定在测量筒外由多个翻板或翻柱组成的液位显示器。其中, 翻板或翻柱上安装有磁性材料, 磁浮子在测量筒中随液位的高低上下浮动, 与磁浮子位于相同高度的翻板或翻柱由于两个

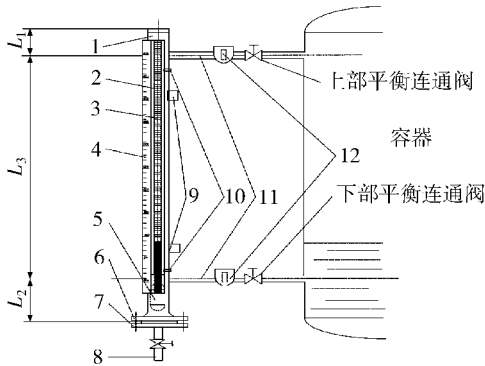


图 1 普通磁浮色标液位计结构

- 1 测量筒; 2 外部显示器; 3 磁性色标板; 4 标尺; 5 磁浮子;
6 法兰; 7 法兰堵盖; 8 排液阀门; 9 磁式液位开关组;
10 紧固夹; 11 平衡连通管; 12 磁滤清装置

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元件上磁性材料的作用而发生翻转。翻板或翻柱上涂有两种视觉区分较大的颜色,观看液位显示器中翻板或翻柱的颜色分界线就可知容器中液位的情况。测量筒垂直方向的上下两端安装有阀门,其中上阀门用于平衡气压,下阀门用于放走残留液体。

1.3 磁浮色标液位计在低温液体环境使用中的问题

当此液位计用于部分特殊用途时,上述结构将出现问题。例如当容器中储装的是被压缩和液化了的气体或其它低温液体时,由于容器内液体温度非常低,导致液位计的测量筒与低温压力容器连接的上下平衡连通管的温度也非常之低。在此情况下,测量筒中的低温液体将使外部的空气冷凝,致使测量筒的外部极易凝结大量的冰块,尤其严重的是液位计上的显示器也会结冰,而这些冰体卡涩了显示器翻板,使其无法正常显示其应有的色标,失去了液位计应有的功能。

2 改进磁浮色标液位计的结构

2.1 真空保温原理^[3]

根据温度传播的 3 种途径:传导、对流、辐射。基于杜瓦原理,在两个温度不同的环境中间用一真空层来隔离将阻断上述温度传播,使得各自的温度对另一个环境温度不发生影响。传导和对流均需要传热介质。由于真空中无介质(工程上不可能绝对真空)阻止了传导和对流的发生,因此可保温或者保冷(但仍有辐射传热,如真空的暖瓶内壁涂水银就是为了阻止辐射传热)。基于此物理概念,技术人员改进了液位计的结构。

2.2 改进的 CSY 双层保冷磁浮色标液位计^[4]

在原有的液位计结构基础上,在测量筒外增加一真空保温层。由于测量筒中的液体跟容器中的液体是相同的,故测量筒外的真空保温层阻隔了测量筒内的低温液体与外界空气的温度影响。实践证明,此项改进确实起到了良好的隔温作用。但此结构在实际装置运行中,平衡连通管周围会凝结出大量冰块。通过分析,由于测量筒与容器间是通过上下两根平衡管相连接的,在液位计可

正常指示时,下平衡管中始终充满低温液体。因在测量筒外增加的真空保温层不能阻隔平衡管与外界的直接接触,故在平衡管四周还是会出现大量的冰块。

基于上述情况,再次改进了结构—即在平衡连通管外也增加一真空保温层。

具体实施方案见图 2。

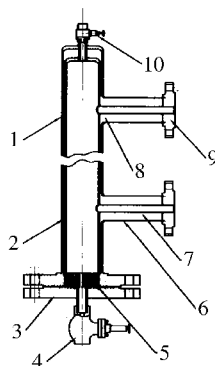


图 2 加真空保温层的 CSY 磁浮色标液位计结构示意图

1 测量筒外增加的外管; 2 测量筒(耐压管); 3 法兰;

4 下排污阀门; 5 密封垫; 6 平衡管外制作的外管;

7 平衡连通管; 8 真空保冷层;

9 与容器连接的法兰; 10 上排污阀门

在原有的液位计管体结构上在测量筒外增加一个外管,同时在平衡管外制作一个外管。将外管 1 和外管 6 分别与测量筒 2 和平衡管 7 中间的空间抽成真空作为真空保温层 8。上排污阀用于排出残留气体并平衡气压,且温度相对较高,所以所用阀门的手柄较短尺寸也较小。直接用一个金属导管连接测量筒和上排污阀门,此处测量筒与外界可通过导管和阀门与外界发生热量的传导,但由于接触面积小,且导管要经过中间的真空保温层,所以低温传递不明显,不会出现上排污阀门处产生冷凝结冰的情况;下排污阀门用于排放残留液体,所接触液体的温度较低,所以采用阀门的手柄较长尺寸也较大。用法兰 3 连接下排污阀门 4 和测量筒,由于法兰与测量筒的低温液体接触面积比较大,热量的传导将很多,且法兰与金属筒体相连接,连接的密封可靠性不能保证,长期使用液体可能从法兰的连接处渗出,所以在法兰的连接处和测量筒的底部加装了一个“T”形的聚四氟乙烯材料的密封垫 5,避免了低温液体与法兰的直

接接触,并且防止了液体的渗出。

3 使用效果

图 3 图 4 为未全部保冷和全面真空保冷液位计使用效果。

从图 3 和图 4 可见,平衡连通管无真空保温层的液位计,有冷凝冰块出现。加了之后,冷凝冰块全部消失。



图 3 未全部保冷的液位计

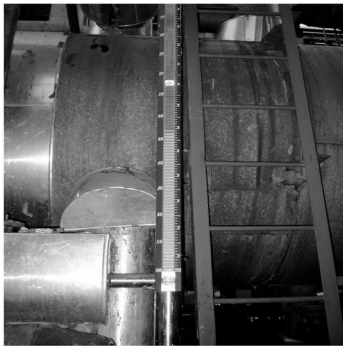


图 4 全面真空保冷的 CSY 低温液压计

4 实际使用情况

上海赛科石油化工有限公司(以下简称赛科)乙烯装置共有约 30 台低温磁浮色标液位计,最低设计温度达 - 171 ℃。原先采用的是普通

结构的浮色标液位计,在投用过程中发现,虽然液位计的平衡连通管、测量筒处有冷保温层,但外部显示器、磁性色标板、标尺处还结有厚厚的冰块,无法辨认出测量筒内浮子的真实位置。

从 2006 年 2 月始,赛科逐步将普通磁浮色标液位计更换为真空双层保冷的 CSY 磁浮色标液位计,所视部位无任何结冰迹象,并无需冷保温,实际液位指示准确、清晰,反应灵敏,使用寿命长,无需维护。

在 2009 年 5 月赛科乙烯装置改扩建项目中,新增了 18 台低温 CSY 磁浮色标液位计,实际使用情况良好。

5 结语

采用真空保温层对低温液位计测量筒和上下平衡管进行保温,可有效地消除液位计结冰现象。

低温液体液位测量的方法多种多样,但在实际应用中应根据容器内的介质、工作压力和温度,结合实际情况合理选择液位测量方法或组合,以达到既安全又经济的目的。

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· 乙烯在线 ·

卡塔尔建成全球最大乙烷裂解装置

由拉斯拉凡烯烃公司负责运营的全球最大乙烷裂解装置已在卡塔尔拉斯拉凡举行了正式的落成仪式。该裂解装置预计的乙烯产能为 1 300 kt/a,投资成本估计为 10 亿美元。卡塔尔石油公司、雪佛龙菲利普斯化学以及道达尔均为拉斯拉凡烯烃公司的股东。该裂解装置所需的乙烷原料来自卡塔尔北方海洋气田。该装置将通过管道运输的方式向法国的道达尔与卡塔尔石化公司合资建设的一套线型低密度聚乙烯装置供应乙烯原料(该装置已于 2009 年 11 月试运行)。同时还将向卡塔尔化工公司二公司正在建设的高密度聚乙烯和烯烃装置供应乙烯,这些装置预计在今年下半年投产。

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PROGRESS OF STUDY ON FREE-RADICAL MECHANISM MODEL IN CRACKING FURNACE TUBE

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Abstract In this paper, the progress of study on free-radical mechanism model in cracking furnace tubes was reviewed through the generation of free-radical mechanism reaction networks, the calculation of reaction thermodynamics parameters, and the construction of dynamic model in tubes. As well, increased requirements of analysis of the components in petroleum hydrocarbon feeds from the development of this model were proposed.

Keywords Free-radical mechanism model, Reaction dynamics, Pyrolysis reaction, Thermo pyrolysis

PRACTICE AND EXPLORATION OF CLEANER PRODUCTION OF YPC ETHYLENE PLANT

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Abstract This article introduces the operation of the Ethylene Complex at SINOPEC Yangzi Petrochemical Co., Ltd. Effective measures had been taken from aspects of technical innovation, operation optimization, recovery and utilization, on-site treatment and management reinforcement, so as to realize cleaner production, minimize pollutants, reduce material consumption and energy consumption, and improve its competitiveness in international and domestic markets and its sustainable development ability.

Keywords Ethylene plant, Cleaner production, Pollution source, Technical innovation, Benefit

APPLICATION OF HIGH EFFICIENCY DEMISTER IN ETHYLENE PLANT

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Abstract This paper introduces the construction features of two kinds of demister, analyzes their working principles and their main factors influencing demisting performance. Combining with the application of demister in ethylene plant, it also points out that the demisting effect is essential to the economic operation of ethylene plant. When expansion and modification is made to the plant, one of the most efficient and reliable methods is to use vertical high efficiency angle vane-type demister.

Keywords Demister, Ethylene plant Application

CAUSE ANALYSIS AND COUNTERMEASURES FOR PLUGGING IN OPERATION OF ACETYLENE PLANT

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Abstract Focusing on the plugging problem which affects the long-term operation of acetylene plant, this article analyzes the reasons for plugging in acetylene plant from aspects of feedstock, natural gas pyrolysis, processing and maintenance, identifies the main factors resulting in the plugging, including sulfur in feedstock, by-product carbon black, polymers and rust, and provides solutions for each specific problem.

Keywords Acetylene plant, Plugging, Long term operation

DISCUSSION ON THE OPERATION OF C₂ FRONT-END HYDROGENATION CATALYST IN ETHYLENE PLANT

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Abstract C₂ front-end hydrogenation process is adopted in the new section of the 700 kt/a ethylene plant at SINOPEC Shanghai Petrochemical Co., Ltd., and imported G-83C front-end hydrogenation catalyst and homemade BG-H-21B front-end hydrogenation catalyst was successively used during its 7 years of operation. The imported catalyst was operated continuously and stably for 5 years and 3 months through continuous exploration and improvement of its process performance, and the homemade catalyst also achieved good process performance.

Keywords Ethylene plant, C₂ front-end hydrogenation Catalyst, Industrial operation

STRESSLESS PIPELINE CONNECTION OF COLD BOX IN 1.0 MT/A ETHYLENE PLANT

Fan Ruili, Diao Songtao, Wang Yu, et al. China Petroleum First Construction Corporation, Henan Luoyang P. C. 471023

Abstract Generally stressless pipeline connection starts from the flange of cold box and extends outwards, but it requires subsequent stressless adjustment. The method, in which the final welding seam is close to the flange of cold box, can eliminate subsequent adjustment and achieve first-time success of stressless pipeline connection.

Keywords Cold box, Stressless pipeline connection, Final welding seam, Symmetry welding

APPLICATION OF VACUUM INSULATION IN CSY MAGNETIC LIQUID INDICATOR

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Abstract Magnetic liquid indicator used in cryogenic liquid environment had a problem, i.e. ice condensation was found in some parts of the liquid indicator. This problem not only reduced the accuracy of measurement, but also shortened its service life. Based on vacuum insulation principles, the structure of liquid indicator was improved by adding vacuum insulating layer in the measuring tube and the equalizing pipes to avoid ice condensation, thus ensuring the normal service and display of magnetic liquid indicator in cryogenic environment and improving the performance of the instrument.

Keywords Vacuum insulating layer, Magnetic float, Liquid indicator

ENERGY CONSERVATION AND CONSUMPTION REDUCTION FOR THE 460 KT/A ETHYLENE PLANT AT LANZHOU PETROCHEMICAL COMPANY

Sun Yong. Ethylene Plant of PetroChina Lanzhou Petrochemical Company, Gansu Lanzhou, P. C. 730060

Abstract Since the 460 kt/a ethylene plant at PetroChina Lanzhou Petrochemical Company was put into operation 3 years ago, the energy consumption and material consumption of ethylene plant was reduced by solving problems affecting the stable production of the plant and optimizing process operation based on stable operation. By taking naphtha as materials for all the cracking furnaces, replacing burners to improve the heat efficiency of cracking furnace, carrying out technical innovation projects including fuel gas balance, and