

# 消防泵房设计及其设备选型探讨

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**摘 要:** 油库消防系统是油库的重要组成部分, 而消防泵房布置设计及设备选型是消防系统设计的关键之一。文章总结了消防给水系统和泡沫灭火系统的设计原则, 同时指出了消防泵房布置设计和消防水池设置的基本要求。着重分析了消防泵房备用泵的设置原则, 内燃机消防泵组的合理性以及正压式泡沫比例混合工艺在消防系统设计中的必然趋势, 对油库消防系统设计具有指导意义。

**关键词:** 油库; 消防系统; 设计; 设备

**中图分类号:** TE974. 9; TU892 **文献标识码:** A

## 1 油库消防系统

### 1. 1 消防给水系统

油库消防给水系统用于冷却油罐、保护消防人员及配置灭火泡沫。消防给水系统有高压系统、低压系统和临时高压系统, 油库常采用临时高压给水系统。根据油库等级及地理条件, 给水管道可采用环状或枝状敷设。

油罐消防冷却水系统型式由单罐容量和罐壁高度确定, 可采用固定式、移动式或两者结合的型式。消防给水设计流量应根据油库规模、油罐类型、消防冷却型式、冷却水供给范围及供给强度确定, 并应用

所选泵进行校核。消防冷却水的供给时间由油罐直径确定, 直径大于 20 m 的地上固定顶油罐为 6 h, 其余为 4 h; 地上卧式油罐为 1 h。

### 1. 2 泡沫灭火系统

油罐消防泡沫灭火系统的设置型式及设置方式应根据《石油库设计规范》<sup>[1]</sup> 确定。系统的型式宜采用低倍数、中倍数泡沫灭火系统, 系统的设置方式尚应考虑单罐容量及油罐类型, 有固定式、半固定式或移动式泡沫灭火系统。泡沫灭火系统应根据《低倍数泡沫灭火系统设计规范》<sup>[2]</sup> 及《高倍数、中倍数泡沫灭火系统设计规范》<sup>[3]</sup> 设计, 对于单罐容量等于或大于 100 000 m<sup>3</sup> 的浮顶油罐, 泡沫灭火系统应

## 4 结论

a) 本文提出天然气管线设计方案 AHP—MCZ 优选法, 能有效应用于方案的评价和可行性研究, 对管线设计、生产管理具有重要指导意义。

b) 实例计算表明, 评价体系的确定和优选方法的选择是获得最优方案的前提。

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## 2 消防泵房

### 2.1 消防泵房布置

油库消防泵房的消防冷却水泵和泡沫混合液泵宜合建在同一泵房内。消防冷却水泵与泡沫混合液泵应采用正压启动或自吸启动,当采用自吸取水时(水环泵或滑片泵),自吸时间不宜大于 45 s。消防泵房与最近保护对象的距离不宜小于 30 m,并应满足泡沫混合液泵启动后 5 min 内,将泡沫混合液或泡沫输送到油库的最远保护目标。

消防冷却水泵、泡沫混合液泵应各设 1 台备用泵。当消防冷却水泵与泡沫混合液泵的流量、扬程接近时,宜共用 1 台备用泵。备用泵的流量、扬程不应小于最大工作泵的能力。

### 2.2 消防水池

当消防水源由消防水池提供时,常在靠消防泵房一侧修建消防水池。仅用于油罐消防的消防水池的容量应包括油罐冷却用水、保护用水、配制泡沫用水及充满管道用水,并按 1.2 倍系数确定。当消防水池的容量大于 1 000 m<sup>3</sup> 时,应分隔为 2 个水池,并由带阀门的连通管连通。消防水池的储水液面高度,通常高于消防泵轴中线,实现自灌引水启泵。消防水池的补水时间不应超过 96 h。

## 3 消防泵组

消防泵按照配电方式有两种形式,一种是由市电或其它备用电源(如自备发电机)提供电能,大多为电动机消防泵或消防泵组;另一种是自备发电功能的消防泵组,如内燃机消防泵组。

消防泵组是指采用单元式组装,将电动机或内燃机、泵、控制电器及其它相关设备有机地组合在同一机座上,形成一个整体件。根据驱动机种类,消防泵组可分为电动机消防泵组和内燃机(柴油机、汽油机)消防泵组两类。

电动机消防泵组以电动机为驱动机,电源由市电或备用发电机提供。内燃机消防泵组直接以柴油机或汽油机为驱动机,油库不需配置消防电源。

根据实际需要,消防泵组可组装用于自吸引水灌泵的叶片泵(水环泵或滑片泵)及泡沫比例混合

器。

目前,油库消防系统设计中,从技术、经济及安全等因素出发,考虑到油库消防系统的必要性及消防作业的不确定性,为减小油库供电配置容量,大多趋向于采用内燃机消防泵组,其中尤以柴油机消防泵组安全、可靠而首选。

## 4 泡沫比例混合工艺

### 4.1 负压式泡沫比例混合工艺

负压式泡沫比例混合工艺因其依靠负压吸液(泡沫液)而命名。这种工艺中,泡沫比例混合器安装于泵的进出口之间,其进口与泵的出口连接,出口与泵的进口连接。其工作原理是,依靠泡沫比例混合器的节流造成负压,抽吸泡沫储罐中的泡沫液,泡沫液与泵进口的水流混合,形成符合比例要求(3%或6%)的泡沫混合液,并由泵输出。

负压式泡沫比例混合工艺要求泡沫比例混合器的吸液高度不大于 1 m,其出口背压也即泵吸入口的进液压力应不大于 0.03 MPa,否则易造成吸液困难以及泡沫液罐发生倒灌现象。另外,负压式泡沫比例混合工艺存在的最大问题是,由于管网的压力、流量变化及取水水池的水位变化,使需要的混合比难以得到保证,并且这种工艺不易实现自动化。

根据规范要求,泵流量的选定应考虑泡沫比例混合器的过流流量。由于泡沫比例混合器的过流流量随泵出口压力及泡沫比例混合器规格型号的不同而不同,国内生产厂家尚缺乏泡沫比例混合器过流流量参数的计算方法。由于过流流量与特定的设计方案有关,科学的方法是,应对设计方案进行现场测定以确定过流流量,并验证泵流量是否符合油库消防系统的要求。有关文献指出,泡沫比例混合器的过流流量在 8~12 L/s 之间,对于消防系统工作压力较高及泡沫比例混合器流量较大时,宜选用较大的过流流量值。

### 4.2 正压式泡沫比例混合工艺

正压式泡沫比例混合工艺的主要设备是正压式泡沫比例混合装置,由泡沫比例混合器、泡沫液罐及附件等组成。其工作原理是,泵仅提供压力水源,当压力水源进入正压式泡沫比例混合装置时,部分压力水进入泡沫液罐,压迫泡沫液经吸液管挤出;另一方面,压力水源流经泡沫比例混合器时产生节流效

应并形成负压,起到抽吸泡沫液的作用。利用泡沫比例混合器“挤压”和“抽吸”的双重作用,使水与泡沫按一定比例(3%或6%)混合,形成泡沫混合液并直接输出。

正压式泡沫比例混合工艺对泵进口压力不作限制,也没有过流流量的水量消耗,可以适应高差、压力和流量的变化,并且为单元式组装,只要保证进入泡沫比例混合器的水源压力满足要求(0.6~1.2 MPa),则可获得稳定的混合比。

泡沫液罐有带隔膜和不带隔膜两种。不带隔膜的泡沫液罐,压力水与泡沫液直接接触,泡沫液为一次性使用。带隔膜的泡沫液罐,压力水与泡沫液由隔膜隔开,保证泡沫液的质量,泡沫液可多次使用,因而得到广泛使用。

#### 4.3 工艺比较及发展趋势

泡沫比例混合工艺是消防泵房工艺的关键组成部分。负压式泡沫比例混合工艺在我国消防系统设计中曾得到广泛使用,但其存在着进口压力限制,过流流量水量消耗及自控配套困难等本身无法克服的弱点。随着油库消防自动控制技术的发展,正压式泡沫比例混合工艺将得到普遍推广使用。

## 5 结论

a)油库消防系统型式应根据《石油库设计规范》确定,而消防系统设计应遵循《低倍数泡沫灭火系统设计规范》及其它相应规范。

b)在消防系统设计中,备用泵的选取应综合考虑,在满足流量和扬程要求的前提下,消防泵宜选用相同的规格型号,消防泵房工艺具有互为备用的功能。

c)在电力紧张地区或油库电力增容等成本费用不经济时,采用内燃机消防泵组在经济上是合理的,同时也解决了消防配电双电源或双回路供电的要求。

d)在技术、经济及自动控制等方面,正压式泡沫比例混合工艺优于负压式泡沫比例混合工艺,是消防系统设计的必然趋势。

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- [2] GB50151-92 低倍数泡沫灭火系统设计规范[S].
- [3] GB50196-93 高倍数、中倍数泡沫灭火系统设计规范[S].

## 世界天然气需求预测

世界能源专家一致认为,21世纪是天然气的世纪。天然气资源比石油资源更为丰富,据预测可满足世界需求120年以上。第16届世界石油大会的报告认为,全球天然气需求将从目前 $2.5 \times 10^{12} \text{ m}^3$ 增加到2020年 $4.9 \times 10^{12} \text{ m}^3$ 。石油、天然气在总能源中的比例将从1999年64%上升到2010年69%,约在2040年,世界天然气供应量将超过石油和煤炭,天然气所占比例将达到51.1%。全球发电市场天然气所占份额将从1999年27.9%增加到2005年35.2%、2010年41.7%、2015年51%、2020年59.7%。世界天然气消费量将从2001年 $2.4 \times 10^{12} \text{ m}^3$ 增加到2005年 $2.9 \times 10^{12} \text{ m}^3$ 、2010年 $3.5 \times 10^{12} \text{ m}^3$ 、2015年 $3.9 \times 10^{12} \text{ m}^3$ 和2020年 $4.9 \times 10^{12} \text{ m}^3$ 。

据2003年6月初在日本东京召开的第22届世界天然气会议报道,在今后30年中,亚洲天然气需求量预计每年增长4%左右。国际天然气联合会的研究显示,亚洲天然气需求的增长速度远远超过世界同期的平均数,预计2030年亚洲天然气需求量将达到全球的19%。日本在LNG贸易份额中约占世界贸易总量的一半。中国将减少对燃煤的依赖,今后20年中天然气消费量将增加7倍。北美和欧洲的天然气产量增速已开始减慢,而俄罗斯和中东将成为补偿其现有气田产量降低的主要天然气产地。据预测,2030年前,天然气将成为能源结构中的主要燃料,其需求增长量远远超过石油和煤炭。新型发电站中40%以上将建立燃气热力装置。今后30年中,发电将成为天然气需求的主要动力。从长远看,大量使用天然气可以减少二氧化碳的排放。到2100年,天然气将占全球能源总产量的40%。在今后的100年中,天然气将代替煤作为基本的热电燃料。

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### SPECIAL SUBJECT

#### Reliability and Interruption of Power Supply and Self-contained Power Supply

Zheng Shitong, Li Xingming(China Petroleum Engineering Co., Ltd. Southwest Company, Chengdu, Sichuan, 610017, China) **NGO**, 2004, 22(3): 1~5

**ABSTRACT:** Combined with advanced design ideas at home and abroad, analyses are made on such issues as reliability and interruption of power supply and self-contained power supply and some suggestions are provided to further designs.

**KEY WORDS:** Power supply reliability; Rate of power supply reliability; Interruption of power supply; Self-contained power supply

#### Harmonic Suppression of Power Source Frequency Converter and Improvement of Power Factor

He Limei, Lei Ying(China Petroleum Engineering Co., Ltd. Southwest Company, Chengdu, Sichuan, 610017, China) **NGO**, 2004, 22(3): 6~11

**ABSTRACT:** In view of preliminary design plans on compressor units in "West-to-East Gas Pipeline Project" and according to power supply system, analyses are made on harmonic effect and reactive power developed when matched Frequency-Converting and speed-regulating units operate, appropriate suppression methods and compensatory measures are provided in order to meet corresponding demand.

**KEY WORDS:** Frequency converter; Harmonic suppression; Wave filter; Reactive compensation

#### Selection of LA Battery in "West to East Gas Pipeline Project"

Guan Yue, Wang Qiang(China Petroleum Engineering Co., Ltd. Southwest Company, Chengdu, Sichuan, 610017, China) **NGO**, 2004, 22(3): 12~15

**ABSTRACT:** Battery is the critical component of standby power supply system of AC or DC UPS utilized in long-distance natural gas pipeline projects. New techniques, new materials and new production methods of LA battery are highly developed. In accordance with LA battery selected in "West-to-East Gas Pipeline Project", introduced are current situation and the tendency of LA battery technology, analysis is the invalidity of VRLA battery and its working improvement, concluded is the key point of LA battery design and measures are put forward to promote working conditions of LA battery according to system engineering techniques.

**KEY WORDS:** LA battery; Lean liquid VRLA battery; Gel battery; Invalidity; Capacity selection; Intelligent management

### OIL & GAS TRANSPORTATION AND STORAGE

#### Study on "Six-relationship" and Design Idea for Large-diameter Pipeline Construction

Xiang Bo, Chen Jing(China Petroleum Engineering Co., Ltd. Southwest Company, Chengdu, Sichuan, 610017, China) **NGO**, 2004, 22(3): 16~20

**ABSTRACT:** "West-to-East Gas Pipeline Project" has created a new page of long-distance and large-diameter gas pipeline construction. Large-diameter gas pipeline construction has its own characteristics and rules; it is necessary to correctly deal with its corresponding relationships and determine appropriate guiding principles. Summarized are design and construction works completed in "West-to-East Gas Pipeline Project", discussed are characteristics of large-diameter gas pipeline construction and its corresponding "Six-relationship" and put forward are design ideas and guiding principles required to follow in large-diameter gas pipeline design.

**KEY WORDS:** Large-diameter pipeline construction; Six-relationship; Design idea

#### Study on Optimization of Long-distance Natural Gas Transportation Pipeline Design

Liu Wu, Gu Xueqin(Southwest Oil College Transportation & Storage Institute, Chengdu, Sichuan, 610500, China)

Tang Jinsong(Nanchong Natural Gas Company, Nanchong, Sichuan, 637000, China) **NGO**, 2004, 22(3): 21~23

**ABSTRACT:** Based on the laws of engineering design, the optimum long-distance gas pipeline design plan is selected among many preliminary design plans. The design parameters and economic indexes of design plans are characterized by typical hierarchic properties. These properties can be used as important quantitative index(weight) corresponding to the design object, in combination with MCZ method which can calculate the approaching extent by comparing preliminary plans with optimal one, the order of prior selected of multiple plans can be determined. The analysis shows that the optimum plan can be determined by using AHP-MCZ to establish index system and structure model for optimizing the design plans. AHP-MCZ method is effective for designers to select a technically feasible and economically reasonable design plan.

**KEY WORDS:** Gas pipeline; Hierarchic analysis; MCZ method; Design; Optimization

#### Design of Fire-fighting Pump Station and Selection of Equipment

Wang Jianhua, Liu Jinling, Shu Dan(Logistic Engineering College, Chongqing, 400016, China)

Zhang Shu(Unit 78416 of The People's Liberation Army, Chongqing, China) **NGO**, 2004, 22(3): 24~26

# SELECTED ABSTRACTS

## NATURAL GAS AND OIL

(QUARTERLY)

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**ABSTRACT:** Fire-fighting system is an important part of oil depot and fire-fighting pump station design and its equipments are the key of fire-fighting system design. Summarized are the design principles of fire-fighting water system and foam extinguishing system. Pointed out are the basic demands of fire-fighting pump station design and fire-fighting water pool setting. Analysis is made on setting principles of standby pump at fire-fighting pump station, the rationality of internal combustion engine fire-fighting pump set and the necessary trend of positive foam proportion mixing techniques for fire-fighting system in oil depot. There is some guide significance for fire-fighting system in oil depot.

**KEY WORDS:** Oil depot; Fire-fighting system; Design; Equipment

### Construction of Natural Gas Transportation Pipeline from Hangzhou to Huzhou

Wang Luobiao(Zhejiang Natural Gas Development Co., Ltd. Hangzhou, Zhejiang, 310009, China) **NGO**, 2004, 22(3): 27~29

**ABSTRACT:** The natural gas pipeline from Hangzhou to Huzhou is a large branch of "West-to-East Gas Pipeline", and the first long-distance gas pipeline in Zhejiang Province. The Project started in the late of 2002 and completed near a year later. Summarized are some successful experiences of project construction and put forward are issues to be improved. Some suggestions and considerations are put forward for construction of long-distance and large-diameter gas pipeline in water net areas.

**KEY WORDS:** Long-distance gas pipeline; Water net area; Project construction

### Study on Breather Loss Mechanism of Oil Tank

Kang Yong(Xi'an Oil University, Xi'an, Shanxi, 710065, China) **NGO**, 2004, 22(3): 32~35

**ABSTRACT:** Except the volatility of oil, there are many reasons which cause oil losses, such as the environment where the tank is, the state of the tank used, the geometrical shape of the tank, the heat preservation measures of the tank, the tank's configuration intensity and route of heat transmission etc. Beginning with the calculation methods of breather loss, all factors are analyzed such as temperature, pressure. Put forward are the variety of rules that influence the primary and second status for breather loss. If these reasons are considered, it will be a great help to understand more about the breather loss mechanism and a beneficial guidance for oil tank design and to reduce breather loss and improve the management of oil storage.

**KEY WORDS:** Oil tank; Breather loss; Configuration; Geometrical shape

## OIL & GAS TREATING AND PROCESSING

### Analysis on Clinsulf-SDP Process Features and Problems Existing in The Unit

Tan Zhiqiang, Xi Ningkai(PetroChina Southwest Oil and Gas Field Branch Chongqing General Gas Purification Plant, Changshou, Chongqing, 410259, China)

Chen Xiaobo(PetroChina Southwest Oil and Gas Field Branch Chongqing General Gas Purification Plant Dianjiang Branch, Dianjiang, Chongqing, 408323, China) **NGO**, 2004, 22(3): 40~43

**ABSTRACT:** Clinsulf-SDP sulfur recovery technology is one of the extended advanced CLAUSE technologies at present. Its process is simple and clear. Introduced are the technical process and its features, analyzed are the existing problems and put forward is the tentative plan for solving these problems.

**KEY WORDS:** Process feature; Existing problem; Solution plan

### Application of the On-line Cleaning System Technique in Cold Machine in Water

Lu Liling(China Qingjiang Petro Chemical Co., Ltd. Huai'an, Jiangsu, 223002, China) **NGO**, 2004, 22(3): 44~45

**ABSTRACT:** The usage of this kind of on-line cleaning system technique in cold machine in water is introduced in steamer machine condenser of FRCC in the company's refinery. It reduced consumption and operational expenses and solved technical problems, which effected the operation of the device for long period at the same time. The benefit of economy is very remarkable.

**KEY WORDS:** On-line cleaning; Cold machine in water; Energy-saving; Long period

## COMPUTER & COMMUNICATION

### Network Transmission of Reported Information from Dispatching Center

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**ABSTRACT:** Adopting the Microsoft Visual FoxPro 6.0 data base language, developed is the data management system(the network edition)software of the dispatching center. Its function is relatively complete and operating interfaces are simple and easy to use. With this software, data transmission and integrity of report forms can be carried out faster between the dispatching center and dispatchers of oil transportation offices. It can help dispatchers to manage most data information from the oil transportation dispatching system more conveniently.

**KEY WORDS:** Dispatch; Data management; Network transmission