中水设计规范”规定不应小于 2h)。采用活性污泥法时,曝气池中不加浮动型生物载体,BOD_5 容积负荷按 0.4 kg/(m^3·d)计算,曝气池有效容积应为 54m^3,水力停留时间约 3.6h。根据丰联广场中水处理系统的实践经验,在曝气池中投加池有效容积 3%的悬浮填料,水力停留时间可缩短到 2.5h。因此建筑中水处理系统采用悬浮填料可节省投资及占地面积。

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稳压泵的压力设定和扬程确定

黄国元 陆仲达 姜文源

提要 稳压泵的压力设定值决定于稳压泵扬程,稳压泵的扬程一般不另行计算,而是采用消防主泵的扬程,其原因在于设置稳压泵的目的是使消防给水管网的水压稳定。而在集中稳高压给水系统中,这样确定的稳压泵扬程及设定压力值,往往使消防给水管网始终处于较高压力工况,因而使管网内水压与管道及其接口的承压能力这一对矛盾趋于突出。从保证最不利处灭火设施水压要求这一基本前提出发,提出确定稳压泵扬程和设定压力的新思路,并按 3 种情况分别作出说明。

关键词 稳高压给水系统 稳压泵 扬程 压力设定 气压水罐

在稳高压消防给水系统这个大题目下,有许多文章要做,需要作进一步深入探讨。我们已经就稳高压给水系统与高压、临时高压给水系统的区别、特点、稳压泵的流量等方面谈了些看法,本文想着重说明稳压泵的扬程确定和压力设定,供同行们探讨。

稳压泵的扬程和压力设定值的确定,要区分 3 种情况:(1) 稳高压消防给水系统中,稳压泵与消防主泵共用气压水罐;(2) 稳高压消防给水系统中,稳压泵设气压水罐;(3) 稳高压消防给水系统中,有稳压泵而无气压水罐。

至于消防给水系统中设置用以替代消防水箱的气压水罐,而其水调节容量不论为 18m^3,12m^3,6m^3,还是《自动喷水灭火系统设计规范》(GBJ45-85)修订本送审稿中规定的 2.4m^3,都不在本文讨论范围,文章所涉及的气压水罐指水调节容量为 450L 及以下的气压水罐。

1 第一种情况

当稳压泵和消防主泵共用气压水罐,且气压水罐不用于替代消防水箱,只起满足消防主泵启动前消防所需水量和水压;以及通过水位和压力传感器以控制稳压泵启停和消防主泵启动时,在该气压水罐内主要有 3 个压力设定值,如图 1 所示。

P_2 为消防主泵启动压力,P_3 为稳压泵启动压力,P_4 为稳压泵停泵压力,按我国有关设计院的经验 $P_3-P_2 \doteq 0.02$MPa,$P_4-P_3 \doteq 0.05$MPa。相应于 P_2、P_3 和 P_4 压力值的水位为 h_2、h_3 和 h_4。h_2 水位线下的水调节容积,按《高层民用建筑设计防火规范》的规定为 450L,$h_2 \sim h_3$ 区段的水容积为缓冲水容积,$h_3 \sim h_4$ 区段的水容积为稳压水容积。

这种情况,稳压泵的压力设定值为 P_3 和 P_4,P_3 为稳压泵压力设定下限值,即稳压泵启动压力;P_4 为稳压泵压力设定上限值,即稳压泵停泵压力。

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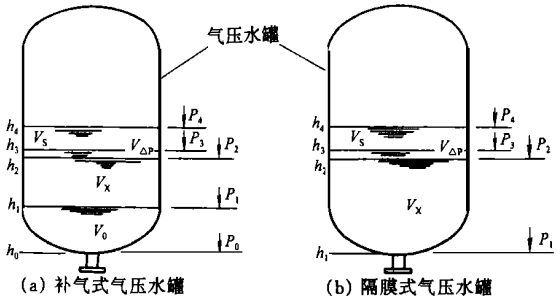

图 1

V_X ——贮水容积;

V_S ——稳压水容积;

$V_{\Delta P}$ ——缓冲水容积;

V_0 ——不动水容积;

P_0 ——起始压力;

P_1 ——最低工作压力;

P_2 ——最高工作压力,灭火消防主泵启动压力;

P_3 ——稳压水容积下限压力,稳压消防水泵启动压力;

P_4 ——稳压水容积上限压力,稳压消防水泵停止压力;

h_0 ——起始水位;

h_1 ——消防贮水容积下限水位;

h_2 ——消防贮水容积上限水位;

h_3 ——稳压水容积下限水位;

h_4 ——稳压水容积上限水位。

P_3 和 P_4 均大于 P_2,大于消防主泵的扬程。对以上压力设定值的相对关系,国内技术界意见是一致的,并已将有关要求纳入推荐性规范《气压给水设计规范》(CECS76:95)的有关条文(见规范条文 4.3.4)。如果说要探讨,也只限于 P_3 和 P_4 压力设定值高于 P_2 多少的问题。

2 第二种情况

当系统设有气压水罐,而气压水罐不贮存消防主泵启动前消防所需的水量,气压水罐的设置,其目的只在于:(1) 控制稳压泵的启停;(2) 缓解稳压泵启停过于频繁;(3) 缓冲因停泵水锤原因而造成的对系统的压力冲击。

对这种情况,常规做法是将稳压泵启动压力,即压力下限值略高于消防主泵扬程,稳压泵的停泵压力,即压力上限值按气压水罐工作压力比,即气压水罐调节容积确定,也有按经验系数值确定的,其方法与第一种情况相仿,以图示表示见图 2。相应于 P_3 和 P_4 的水位为 h_3 和 h_4,h_3 与 h_4 之间区域的水容

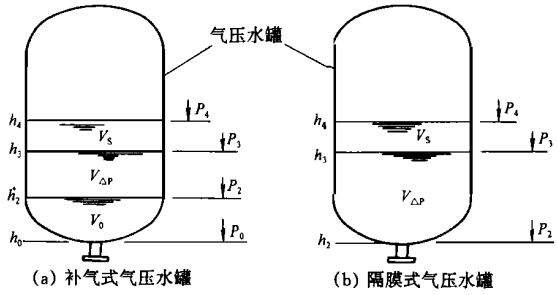

图 2

注:图 2 中,字母意义同图 1。

积为缓冲水容积。也有将消防主泵的启动压力值设置在气压水罐内的,如果这样则图 2 就转换成图 1 形式。

这种做法长期以来未被质疑而得到许可,是基于以下原因:(1) 对稳压泵的功能是为了使消防给水管网水压稳定的理解存在片面性和表面化。(2) 认为消防泵,包括消防主泵和稳压泵,不必要象生活泵那样要计及效率和能耗。同时为稳妥起见,认为水泵扬程高,管网压力高不会有坏处,于消防灭火有利。(3) 按消防设计流量计算消防主泵扬程,再据此以计算稳压泵设定压力值和扬程,较为简便。(4) 对消防方面的技术问题没有深究。

但情况正在起变化,随着稳高压给水系统日益得到重视,由于集中稳高压给水系统的应用,对某些问题有了新的认识:(1) 水泵扬程高、管网压力高在有些情况不是好事。管网长期处于高压状态下运行,容易加剧渗漏、引起管道配件移位等问题发生。(2) 消防主泵启动次数少,可以不必要象生活泵那样计及效率及能耗,而稳压泵情况不同,启停频繁,完全不考虑稳压泵的效率和能耗是不妥当的。

因此,有必要在满足最不利处灭火设施消防用水水压和水量要求的前提下,确定稳压泵的扬程和压力设定值。

当消防主泵工作时:消防设计流量为 Q_s;最不利处灭火设施在消防时要求的水压为 H_x;最不利处灭火设施与消防主泵的标高差为 ΔH;管网为通过消防设计流量所需的沿程水头损失为 H_y;管网为通过消防设计流量所需的局部水头损失为 H_j,则消防主泵的扬程为:

$$H = H_x + \Delta H + H_y + H_j \qquad (1)$$

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当稳压泵工作时:稳压泵的流量为 1L/s 或 5L/s;最不利处灭火设施在消防时要求的水压仍为 H_x;最不利处灭火设施与稳压泵的标高差为 $\Delta H'$,当稳压泵为低位敷设,与消防主泵同在消防水泵房时,$\Delta H'$ 与 ΔH 数值相当接近;管网为通过稳压流量所需的沿程水头损失为 H_y';管网为通过稳压流量所需的局部水头损失为 H_j';则稳压泵的扬程为:

$$H' = H_x + \Delta H' + H_y' + H_j' \qquad (2)$$

比较公式(1)和(2),$H_x = H_x$,$\Delta H \doteq \Delta H'$。沿程水头损失和局部水头损失都决定于流量,稳压泵的流量远远小于消防主泵流量,因此 $H_y' \ll H_y$,$H_j' \ll H_j$,即 $H' \ll H$。结论是 $H' \neq H$,在满足最不利处灭火设施消防水压要求的前提下,稳压泵的扬程可以不等于消防主泵的扬程,稳压泵的扬程可以低于消防主泵的扬程。这个结论会带来设计人员的几重顾虑:

(1) 不好理解。一般都认为消防主泵的扬程就是消防所需的压力,但不理解不同的设计流量允许有不同的消防所需压力。因此从表面上看,稳压泵的扬程低于消防主泵的扬程似乎不好理解,但实质上,这两者都是以满足最不利处灭火设施消防用水水压要求为前提的。区别在于消防主泵流量大,稳压泵流量小,即使都为了满足同一地点、同一目的、同一用途的水压要求,而由于消防设计流量和稳压流量数值的差别,使两种泵的扬程有所不同。但即使两种泵的扬程不同,从保证消防水压要求方面,不会存在问题。

(2) 对管网运行存在疑虑,在实际运行时,当气压水罐为压力 P_4、最高水位 h_4 时,稳压泵停泵;当管网存在渗漏,而水位下降至 h_3 时,稳压泵启动;稳压泵一经启动,气压水罐水位上升,当上升至 h_4 时,稳压泵停泵;当消防给水管网灭火设施开始出水用于火灾扑救时,气压水罐内水位下降至 h_3,即使稳压泵启动,而水位继续下降至 h_2 或压力下降至 P_2 时,消防主泵启动,并以消防设计流量供水,此时消防主泵扬程高于稳压泵扬程 P_4,稳压泵自然在消防主泵工作时不起作用,因此稳压泵的扬程高低与否,不会影响消防给水管网的正常运行。

将稳压泵的扬程确定与消防主泵的扬程计算区别开来存在的缺点在于:

(1) 两番计算,以消防设计流量计算消防主泵扬程,以稳压流量计算稳压泵扬程,就比只计算消防主泵的扬程要繁复,往往不被设计部门所接受。

(2) 稳压装置定型产品已问世。这类产品中的稳压泵规格、性能由于不可能具体知道消防给水工程最不利处灭火设施的高程,管网形式,管道长度和管径大小,因此稳压泵的扬程都按消防主泵扬程而定。要精确确定稳压泵的扬程和压力设定值只在具体工程中才能做到。区别稳压泵与消防主泵的扬程在一般工程中是可以忽略的,当管网小,压力值低时更是如此。而在另一些情况下是可予以重视,也是十分必要的,如:集中稳高压给水系统其管网大、管道长、水压高,当消防给水管网长期处于高压状态下运行,对管网是不利的,而使其在足够的、而又不致于过高的压力工况下运行,应该说是更安全些,尤其对于某些工程环境条件不够如意,如土质差,支座和支墩不完全到位,接口方式不理想,管道在施工时避让过多,管线段存在较多的弯头承受内水压力的薄弱环节,降低稳压泵扬程,使之低于消防主泵的扬程,以缓解消防给水管网压力偏高问题,应当说是一种十分有效的措施,唯一不足之处是设计部门需两次计算,分别计算消防主泵和稳压泵的流量。但这种做法即使如此,也可推行,因为就保证最不利处灭火设施的水压要求是可靠的,就保证灭火设施的流量要求(消防时的消防设计流量、稳压时的稳压流量)也是合理的。从理论上也是有依据,也更准确。

3 第三种情况

当消防给水系统只设稳压泵而不设气压水罐时,情况和第二种情况基本相同,稳压泵的扬程和压力设定值按稳压流量计算,仍以满足最不利处灭火设施消防用水压力要求为前提。区别在于:有气压水罐时,压力传感和水位传感装置设置在气压水罐内,无气压水罐时,压力传感装置设置在管道上。此时稳压泵的扬程仍可低于消防主泵的扬程值。

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Analysis on Using Duckbill Valve in Sea Outfalls ····· *Liu Cheng et al* (19)

Abstract: The advantages and disadvantages of using duckbill valve in sea outfalls are discussed in this paper, and the suitable conditions to use duckbill valve in outfall are put forward. Comparing the usage of duckbill valve with multi-port heads in Fengpu outfall in Shanghai it is concluded that whether or not duckbill valves shall be used in a sea outfall depends on the comprehensive analysis of the specific engineering conditions.

Full Scale Research on Enhancement of Turbidity and Colority Removal of Composite Permanganate Agent ····· *Xu Guoren et al* (22)

BIOFOR: Application and Efficiency in Wastewater Treatment ····· *Niu Xueyi* (26)

Abstract: Bio-Filtration Oxygenated Reactor (BIOFOR) is a new-improved bio-membrane wastewater treatment facility based on the conventional biological filtration tank. It can be used together with the bio-activated sludge process to deeply treat municipal sewage and industrial wastewater. In this paper the character, application range and treatment efficiency of BIOFOR are discussed so that it will be applied more widely in the future.

Bio-Membrane and Chemical Flocculation Process to Treat Paper Making Wastewater ····· *Zhang Bosheng et al* (30)

Abstract: Taking the WTP of Jinlin Pulp-Paper Plant as an example a combined process of bio-membrane (contact oxidation) and chemical flocculation to treat the medium stage paper making wastewater was presented. The COD_{Cr} level in the raw wastewater is high to 1000 mg/l, the COD_{Cr} removal ratio of 30 % by bio-membrane process alone was gained formerly. Now by combined process of bio-membrane and chemical flocculation much better COD_{Cr} removal of 65 % has been obtained and the effluent is quite good to meet the requirement of national wastewater discharge standard. The persistent problem for years of medium pulp and paper making wastewater has been solved.

On the Design of Waste Potato Fermentation Distillers Treatment ····· *Zhang Deqing* (34)

Abstract: Waste potato fermentation distillers is classified into high concentrated organic wastewater. In this paper the experience in practice is summarized and the key technical problems of potato fermentation wastewater treatment are discussed deeply.

Experiment and Research on the Nitrous Nitrification ····· *Xu Dongmei et al* (37)

Abstract: The feasibility and stability of Nitrous Nitrification (NN) are studied experimentally from both the influence factors (IF) and the toxic effects of free ammonia (FA) using the gas generation wastewater and the result shows that certain feasibility of NN could be controlled by IF and FA. The NN process can work at pH > 7.4 and alkalinity > 350mg/l, And under this condition an effluent with concentration of ammonia nitrogen > 20mg/l and FA > 0.4mg/l was obtained. The nitrite percentage will be > 90 % in the total nitric nitrogen.

Shallow Air-Flotation-Biological Contact Oxidation Process To Treat Wastewater of Meat Processing ··· *Zhai Sujun et al* (40)

Electro-Chemical Treatment of Printing and Dyeing Wastewater ····· *Li Yaxin* (42)

Abstract: Advances in theory, research and engineering practices of electro-chemical treatment of printing and dyeing wastewater abroad are reviewed in this paper..

Application of Suspended Biological Carrier in Building Water Treatment System ····· *Fan Maogong* (45)

Pressure Setup and Head Decision of Pressure Stabilizing Pumps ····· *Huang Guoyuan et al* (47)

Abstract: The pressure of pressure stabilizing pump will be settled on the basis of its delivery head which is not calculated but determined by the delivery head of main fire pump as the function of it is to stabilize the pressure inside the

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fire water system. By this way, however, the working pressure of the fire water system will be at higher level in case of the central stabilizing high pressure system and undesirable consequences related to the pressure-acceptance of the pipe and the joints shall come forth. A new concept to determine the delivery head of the pump and to set up the pressure of the system is proposed in this paper, based on the precondition to ensure the water head demand of any fire appliance at the most unfavorable point.

Hydraulic Calculation of Copper Pipeline for Cold and Hot Water System ····· *Xiao Ruishu et al* (50)

Application of Clasp Cast Iron Pipe in Building Drainege System ····· *Zhao Lijun et al* (52)

Abstract: The basic feature of a new material clasp cast iron pipe are presented and some personal impressions in application are added.

100 m Revolving Spring Fountain in Daminghu Lake in Jinan ····· *Li Chuanqi et al* (57)

Abstract: The first revolting spring fountain with a jet-height of 100m has been constructed in Jinan, the capital city of Shandong province. The general situation and the design categories such as the selection of jet-pumps, the structure of nozzles and the driving and the sealing arrangements of the revolving fountain are presented.

ClO_2 Desinfection for Drinking Water ····· *Zhang Hongwei et al* (59)

Abstract: ClO_2 is an effective and safe disinfectant for drinking water. By comparing the currently available ClO_2 generation methods, the authors think that saltwater electrolyzing is suitable way for drinking water disinfection. And a new electrolyzing based ClO_2 generator has been successfully developed on the basis of proper choosing of electrode and diaphragm material and increased OH^- concentration around the anode by recycling the outflow of cathode area.

nfluence of Pump-Pipe Layout on the Separation Pattern and Collapsing Pressure during Transients Flow Process ····· *Ding Feng et al* (62)

Design of Marine Outfall Pipeline of Floor Pull Type ····· *Huang Liangjue* (65)

Abstract: The design norm of big diameter floor pull pipeline for marine outfall is still absent. The criteria related to design are explored and calculated in practice and useful results have been obtained.

Cathodic Protection of Steel Pipeline in Coastal Area ····· *Zhan Guangshen et al* (69)

Abstract: The physico-chemical properties of the soil in the coastal area of Dalian where the Biliu River water diverting line is laid in have been examined by means of field investigation and electro-chemical analysis. The findings show that the soil has a low resistance and high Cl^- concentration. The corrosion rate of carbon steel in the coastal soil is lower than that in sea water but far higher than that in soil outside the coastal area and in tap water. Through a field experiment of simulation, the parameters of engineering design of sacrificial anode protection of buried steel pipelines have been defined. By the measured results of pipe to soil polarization potential after one year, it is shown that the design is reasonable and the technical targets fulfil the design requirements.

Influence of Scale on Water Metering ····· *Xie Jianliang et al* (73)

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