

流量控制阀在自动喷水灭火系统中的应用探讨

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提要 自动喷水灭火系统由于喷头位置所处的高程不同,存在着流量不均衡问题。《自动喷水灭火系统设计规范》(GB50084-2001)采用的办法是压力控制方式,即限制报警阀组供水的最高与最低位置喷头的高程差和控制配水管入口的压力值,而实际应用时压力控制会受到条件的限制。介绍了另一种控制方式,即流量控制方式。在配水管入口处设置流量控制阀直接控制流量,以达到既保证灭火时喷水强度和系统设计流量的需要,又达到均衡流量的目的。

关键词 流量控制阀 定流量阀 流量阀 流量均衡 自动喷水灭火系统 配水管 孔板

《自动喷水灭火系统设计规范》(GB50084—2001)(以下简称“喷规”)6.2.4条规定:“每个报警阀组供水的最高与最低位置喷头,其高程差不宜大于50 m。”

按条文要求做到每个报警阀组供水的最高与最低位置喷头高程差不大于50 m是可行的。但当有两个或两个以上的报警阀组时,一组报警阀组最高位置的喷头与另一组报警阀组最低位置的喷头,其高程差会大于50 m,乃至达到100 m或以上,见图1。为了防止最低位置喷头的压力过高、流量过大,“喷规”在8.0.5条强调:“轻危险级、中危险级场所中各配水管入口的压力均不宜大于0.4 MPa。”

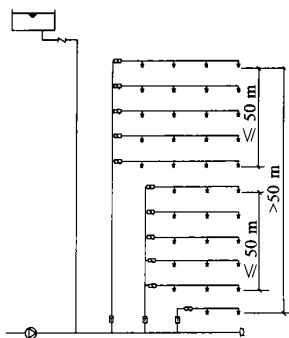


图1 自动喷水灭火系统示意

这两条条是互相配套,互为补充的,目的在于均衡流量。但条文在具体实施时存在以下问题:

(1) 6.2.4条和8.0.5条,规范用词都用“宜”,表示允许稍有选择,在条件许可时首先应这样做。但“宜”毕竟和表示严格,非这样做不可的“必须”和在正常情况下均应这样做的“应”有区别。只要工程设计人员认为条件不许可时,即可不按条文要求执

行。规范用词为“宜”的条文性质属于推荐性条文,而非强制性条文。

(2) 8.0.5条只对轻危险级和中危险级场所的配水管入口压力提出要求,而未对严重危险级和仓库危险级提出限制要求,造成对严重危险级和仓库危险级场所的配水管入口压力实际上处于失控状态。

(3) 如果8.0.5条的“宜”改为“应”在实施时也有一定难度,因为配水管的不同布置,喷头数量不同,管径的选用和管道长度的不同都影响管道水力计算,影响压力值。对配水管入口压力值强制作出规定存在一定难度,这已在许多论文中得到证实。

但在高层建筑中不同楼层,不同高度的喷头,其流量失去均衡的情况又是客观存在的。仍以图1为例,如顶层最不利点处的喷头流量在工作压力为0.1 MPa时为1.33 L/s(计算结果见表1),与其高程差50 m处的同样位置的下层喷头,当配水管入口压力未按“喷规”8.0.5条作出相应控制时,此时该喷头的工作压力为0.6 MPa(0.1 MPa加50 m高程差),流量值为3.27 L/s。该流量为顶层喷头流量值的2.45倍,按此流量值出水,消防水池1 h贮水量在24.5 min就被用完。

图1中第二个报警阀组最低位置的喷头与第一个报警阀组最高位置(顶层)的喷头的高程可相差100 m。当其配水管入口压力未作控制时,最低位置喷头的工作压力为1.1 MPa,喷头的流量为4.42 L/s,其值为顶层喷头流量的3.32倍,消防水池1 h贮水量在18 min就被用完。极限情况是第三个报警阀组最低位置喷头,如果该处喷头的压力为1.2 MPa,

表 1 不同标高最不利点处的喷头流量

喷头所在标高	喷头工作 压力 P / MPa	$K(10P)^{0.5}$ / L/min	q / L/s	与顶层喷头 流量的比值
顶层	0.1	80.00	1.33	1.00
顶层下 10 m 处	0.2	113.13	1.89	1.41
顶层下 20 m 处	0.3	138.56	2.31	1.73
顶层下 30 m 处	0.4	160.00	2.67	2.00
顶层下 40 m 处	0.5	178.89	2.98	2.23
顶层下 50 m 处	0.6	195.96	3.27	2.45
顶层下 60 m 处	0.7	211.66	3.53	2.65
顶层下 70 m 处	0.8	226.27	3.77	2.83
顶层下 80 m 处	0.9	240.00	4.00	3.00
顶层下 90 m 处	1.0	252.98	4.22	3.16
顶层下 100 m 处	1.1	265.33	4.42	3.32
顶层下 110 m 处	1.2	277.13	4.62	3.46

流量则为 4.62 L/s,为顶层喷头流量的 3.46 倍,消防水池 1 h 的贮水量在 17.3 min 可被用完(以上均未考虑同层喷头的不同工作压力)。对这种既无规范条文强制控制,又客观存在流量不均衡的现象人们认为确实应予解决。“喷规”对这种问题采取的解决办法未能完全奏效的情况,必然会引起人们对于配水管入口采用压力控制是否可行,是否有效的疑问。再进一步提出配水管入口是否只有压力控制一种方式?有没有别的方式可供选择?对此,我们认为可以采用流量控制方式。采用流量控制要比采用压力控制有效而且合理,流量控制方式的主要装置是流量控制阀。

流量控制阀又名定量阀或称流量阀,见图 2。是水力控制阀中的一种,其主要功能是在进口压力变化时,流量基本保持不变;在进口压力无变化时,流量也保持基本不变。而流量可根据需要在一定范围内调节,以满足设计要求。主阀是流量控制阀的主要部件,采用膜片式驱动结构,控制精度为 5%~

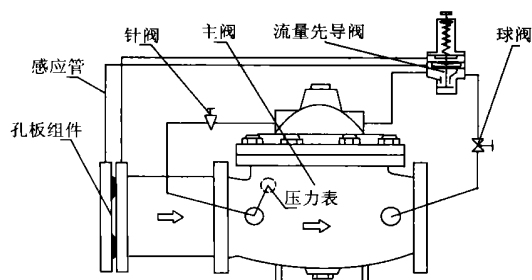


图 2 流量控制阀示意

表 2 可控流量范围

公称直径 DN/mm	可调最大流量		可调最小流量		最大流量与最 小流量比值
	/ m^3/h	/ L/s	/ m^3/h	/ L/s	
50	21	5.83	4	1.11	5.25
65	36	10.00	6	1.67	5.99
80	54	15.00	9	2.50	6.00
100	85	23.61	14	3.89	6.07
125	132	36.67	22	6.11	6.00
150	190	52.78	32	9.89	5.94
200	340	94.44	56	15.56	6.07
250	530	147.22	87	24.17	6.09
300	763	211.94	125	34.72	6.10
400	1 357	376.94	222	61.67	6.11
500	2 121	589.17	345	95.83	6.15

10%,流量控制阀的可控流量范围见表 2。

将流量控制阀用于自动喷水灭火系统是完全可以的,因为自动喷水灭火系统不同于消火栓系统的流量会出现超流量现象和流量失控现象。自动喷水灭火系统在一定作用面积内,其流量值是可以计算得到的。包括在同一防火分区、同一楼层不同位置的喷头由于工作压力不同而递增的流量值,也可以通过计算求得。而实际喷头开放数又小于计算喷头开放数,实际喷头出流量小于喷头设计流量,因此对喷淋系统实施流量控制是合理的、可行的。

工程设计时,按“喷规”进行水力计算,计算系统设计流量。按系统设计流量选用流量控制阀(按流量控制阀的可调最大流量值的 75%~80%核定)和确定流量控制阀的公称直径。

流量控制阀在其阀前和阀后应设控制阀(闸阀或蝶阀),自动喷水灭火系统的控制阀还应有信号装置,流量控制阀前的信号阀距流量控制阀孔板距离不应小于 5 倍公称直径,以保证控制阀的精度要求。当流量控制阀设置在水流指示器附近,流量控制阀前的信号阀可与水流指示器前的信号阀共用。自动喷水灭火系统设置流量控制阀时,还应在阀前设置过滤器,过滤器距孔板的距离不应小于 3 倍公称直径。流量控制阀的工作压力有 1 MPa 和 1.6 MPa,应与管网系统的压力值配套。

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Degradation of Refinery Wastewater by Mixed Culture Bacteria *Li Weiguang et al* (42)

Abstract : 39 petroleum removable strains were isolated and screened from the aeration tank in wastewater treatment plant of Harbin Refinery factory. Four groups of experiments of single strain, twin strains, multi-strains and mixed strains were carried out to invest the influent factors such as pH, temperature, DO, degrading time, oil and nutrient contents on pollutant removal and to find the best operation condition. The results show that in condition of pH 7.0, temperature 30 °C, oil less than 100 mg/L and adequate nutrients, the removal rates of each group are maximum, meanwhile the rate of the mixed strains are the highest. It can be deduced that co-metabolism of mixed strains microorganism make the degradation of refinery wastewater more efficiently.

Fire Control Design of Baiyun Airport in Guangzhou *Fu Peiyong* (52)

Abstract : As a big airport in this country, the buildings in Baiyun Airport in Guangzhou are big space and distributed dispersedly in wide area. Loop network was adopted as common fire-water supplying line for buildings in the terminal area, and this could improve the safety of fire water supply and easy to maintenance. The automatic sprinkling system is not suitable for buildings with height exceeding 8 m, so quick response nozzles were applied. All the fire control water was lifted by automatically started pumping system.

Water System Design for Zhonghai Fuyuan Residential Building in Beijing *Shang Cheng* (56)

Abstract : This is a high-rise residential building of slab structure. The construction document stage of water system design, including the water supply, hot water supply, sewer, rainwater drainage, air condition condensation, fire control water and automatic sprinkling system are presented. Attentions in design of automatic sprinkling system and hot water supply system are discussed in detail.

Problems on Operation of Urban Wastewater Reuse Units in Beijing *Zhang Yajun et al* (63)

Abstract : 22 Wastewater reuse units in Beijing were investigated. Most of them are bathing and washing discharges and reused for lavatory flushing, water scenery, garden greening and car washing. Now the combined biological and physico-chemical process seems the best. However a lot of facilities are not fully used and expensive. So the size of each unit and the capacity of structures must be determined properly, the water price should be regulated according to the so-called market rule to active the economical measure. Also reasonable water price must be issued to create a perfect market for wastewater reuse.

Application of Sedimentation and Air-Floatation for Kitchen Wastewater Treatment *Guan Guanglin* (67)

Abstract : The combined process of lamellar sedimentation with inclined tubes and air floatation treating oil and grease containing wastewater discharged from a big restaurant in Guangzhou runs with operating expenses of RMB 2.7/m³. This facility performances well. In case the inlet levels of COD, BOD, SS and oil are 480 mg/L, 270 mg/L, 413 mg/L and 19.6 mg/L respectively, effluent with levels of the same indicators of 70 mg/L, 36 mg/L, 23 mg/L and 1.97 mg/L respectively was obtained. All are good enough to meet the requirement of discharge standard.

Problems on Application of Memorable Alloy Junction of Pipeline *Ma Guanbao* (72)

Abstract : Pipes or accessories are connected by iron based memorable alloy junction (MAJ) by ways of low temperature heating to the MAJ capsule in which the connected objects were inserted, and thermal shrinking of the capsule made the junction closed in tight. The junction quality is depended on the diameter allowance of the pipes or accessories and the junction capsule, excess difference causes poor tightness and low reliability. New designed die assemblies and manipulate skills can guarantee the allowance less than 0.06 mm.

Operation and Management of Long Distance Water Transportation Line in Pingshan *Hou Lin et al* (76)

Abstract : 28.5 km of glass fiber-reinforced plastic and 37.37 km of PRC pipes have been constructed and put into operation since April 2001 for Pingshan water transporting engineering in Liaoning Province. Up to now the pipeline has run for three years without any accident of burst. In this paper some protection countermeasures applied in construction stage and the maintenance of valves in operation are described. In case when pipeline across the river or highway a jacket caisson is used to protect the pipe and stone cage or culvert shall be built over or around the caisson.

On Application of Flow Control Valve in Automatic Sprinkling System *Jiang Wenyan* (92)

Abstract : Due to different installation elevation of each nozzle there was unbalanced flow distribution through the whole service area of automatic sprinkling system (ASS). In the national design norm of ASS (GB50084-2001) a measure called water pressure control was recommended against this shortage. By this way the elevation difference of the highest and lowest nozzles for alarm water supply and the water pressure at the inlet of the water distribution pipe have to be restricted, these were not convenient in practices. In this paper the author presents a new operation called flow control. A flow control valve will be set in the inlet of water distribution pipe for two targets: to guarantee the sprinkling intensity at preset level and to regulate the overall flow balance.