

高层建筑消防给水的超压和泄压问题

姜文源

提要 超压问题在高层建筑消防给水中客观存在,给消防给水系统带来损害。分析了造成超压的成因,以及采取的防超压措施,并对泄压阀的应用提出具体意见。

关键词 超压 防超压 泄压 泄压阀 泄流量

1 消防给水系统超压原因

《高层民用建筑设计防火规范》(GB50045-95)第7.5.6条规定:“高层建筑给水系统应采取防超压措施”。这是我国第一次将超压和防超压措施列入规范条文。消防给水系统的超压是指系统内的水压超过其工作压力限值,造成管道、配件、附件、器材和设备的损坏,影响消防给水系统正常运行的现象。超压问题在高层建筑消防给水中客观存在,应引起注意,并采取防治对策。

消防给水系统超压的原因大致有以下情况:

(1)按设计流量选消防水泵,而水泵的流量~扬程曲线较陡直,当消防水泵在小流量运行时会出现超压。小流量运行指火灾初期和消防水泵自检时的情况。此时,灭火设施出水量较小,消火栓的水枪为1~2支,自动喷水灭火系统的喷头数为1~3个。

(2)消防水泵从给水管网直接吸水,水泵扬程按给水管网的最低水压计算。水泵运行时如正逢给水管网的最高水压,而给水管网的最低水压与最高水压相差较大时,就会出现超压。

(3)消防给水管网按最低位置的室内消火栓静水压力0.80MPa进行竖向分区,管网未采取完善的减压措施,当消防水泵启动时,管网下部的消火栓会由于动压值大于静压值而出现超压。

(4)消防水泵因故障或停电而突然停转,停泵水锤造成超压。

(5)消防给水竖向分区采用减压阀分区给水方式,当减压阀因故障而关闭不严、或旁通管上阀门失控时,会造成下区给水管网的超压。

(6)消防给水采用水泵对口抽给水方式,即下区的水泵出水管与上区水泵吸水管直接连接,当止回阀不严密时,下区的水泵会因静水压力大于其工作

压力而超压。

(7)稳压泵低位设置,其吸水管若引自高位水箱,当静水压力大于其工作压力时会出现超压。

(8)消防给水竖向分区的上区和下区共用水泵接合器,当防止串压的止回阀不严密时,下区会出现超压。

(9)集中或区域的,设有稳压泵或气压水罐的临时高压给水系统,由于管道较长,水头损失值较大,消防给水管网的稳压值对消火栓等灭火设施会造成超压。

(10)消防车车用消防泵串联运行向水泵接合器供水造成室内消防给水管网超压。

(11)消防水泵的实际扬程和产品样本不符,而且偏差较大,造成超压。

(12)给水管网排气阀设置位置不当或未设置排气阀,管网内存有的气体在外力的作用下处于压缩状态造成超压。

2 防超压措施

在12个超压成因中,与水泵有关的占了8个。目前国内采取的防超压措施,大致如下:

2.1 采取技术措施,防止超压产生

(1)选用流量~扬程曲线平缓的水泵,其中值得推荐的是:建筑消防特种泵(原名切线泵),流量~扬程曲线特别平缓,呈恒压状态。

(2)采用多台水泵,小流量时小泵运行或单泵运行,大流量时大泵运行或多泵并联运行。

(3)消防给水管网竖向分区时,不按最低位置的室内消火栓静水压力0.80MPa进行分区,适当留有余地;或按0.80MPa值进行竖向分区,但采取相应的有效的减压措施。

(4)采用恒压变流量变频调速水泵供水,使水泵

供水压力在流量变化时保持恒定。

(5) 消防水泵从给水管网直接吸水时,以给水管网的最高水压对水泵的工作情况进行校核,防止超压。

(6) 对采用减压阀分区的给水方式,当有可能因减压阀故障或旁通管阀门失控而造成超压时,不设旁通管,同时减压阀采用串联设置方式。

(7) 水泵对口抽给水方式的给水管网,或上下区共用水泵接合器时采用优质水密性能好的止回阀。

(8) 稳压泵低位置设时,其吸水管从消防水池引来可以防止超压。

(9) 水泵出口处设置速闭止回阀等装置,可以有效防止停泵水锤。

2.2 提高整个消防给水系统的承压能力

使之在一般情况下出现的超压,在提高承压能力后在允许工作压力范围之内。

2.3 采取相应泄压和稳压设施,使超压值不致造成损害

泄压和稳压设施有回流管、安全阀、泄压阀、稳压阀、气压罐等。正在修订的《自动喷水灭火系统设计规范》的有关条文中对泄压阀的设置作出规定。

实践证明泄压阀反应灵敏、准确、可靠,可以有效防止因超压而造成的损害。泄压阀在应用时,应注意以下两个问题:

2.3.1 设置位置

泄压阀设置在消防水泵出口处,或在止回阀前(沿水流方向)或在止回阀后,或前或后都可有效防止因(1)、(2)、(6)等原因而造成的超压。但停泵水锤或因管网内存气而造成的超压,当泄压阀位于止回阀后才能有效防止。因此,泄压阀的最佳位置应在水泵出口处的止回阀后。

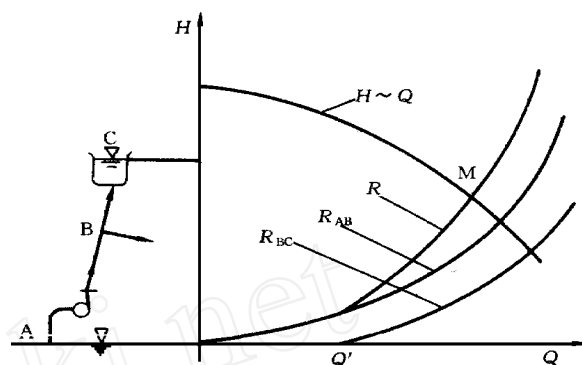


图1 从管中分出部分流量的供水曲线

2.3.2 泄压阀口径

泄压阀口径直接影响水泵运行工作点及其实际扬程和流量。

图1中的 $H \sim Q$ 为水泵流量~扬程曲线, R_{AB} 为AB管段的阻力曲线,B点为泄压阀设置点,泄流量为 Q 。从 Q 起作BC管段的阻力曲线 R_{BC} ,将 R_{AB} 和 R_{BC} 串联合成阻力曲线 R , R 和 $H \sim Q$ 曲线交点M为水泵的工况点。

由图1可知,泄压阀口径越大, Q 值越大, R_{BC} 的位置就越偏右侧,串联后的 R 曲线位置就会越低,M点的位置也就相应降低。因此,泄压阀的口径直接决定水泵的工况点,直接决定水泵的扬程和流量,一般情况泄压阀的口径可与水泵出水管同径或小一级。由于 R 曲线高于 R_{AB} ,是 R_{AB} 和 R_{BC} 的串联组合曲线,因此无需担心M工况点会低于无泄压阀时的水泵原工况点。

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