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中华人民共和国国家标准

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煤化工工程设计防火标准

Standard for fire protection design of
coal chemical engineering

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煤化工工程设计防火标准

Standard for fire protection design of
coal chemical engineering

GB 51428 - 2021

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中华人民共和国住房和城乡建设部公告

2021 年 第 57 号

住房和城乡建设部关于发布国家标准 《煤化工工程设计防火标准》的公告

现批准《煤化工工程设计防火标准》为国家标准，编号为 GB 51428-2021，自 2021 年 10 月 1 日起实施。其中，第 4.1.5、4.1.6、4.2.5、5.1.1、6.3.8、7.1.6、7.2.2、7.2.3、7.2.18、8.0.1、8.0.6、8.0.7、8.0.8、9.7.1、10.1.3、10.2.3、10.3.5(5)条(款)为强制性条文，必须严格执行。

本标准在住房和城乡建设部门户网站(www.mohurd.gov.cn)公开，并由住房和城乡建设部标准定额研究所组织中国计划出版社有限公司出版发行。

中华人民共和国住房和城乡建设部

2021 年 4 月 9 日

前　　言

本标准是根据住房和城乡建设部《关于印发<2008年工程建设标准规范制订、修订计划(第二批)>的通知》(建标〔2008〕105号)的要求,标准编制组经广泛调查研究,认真总结工程实践经验,参考有关国际标准和国外先进标准,并在广泛征求意见的基础上,编制了本标准。

本标准的主要技术内容是:总则,术语,基本规定,区域规划与总平面布置,建筑防火,装置和系统单元,储运设施,管道布置,消防给水排水、灭火设施和消防站,电气等。

本标准正文中以黑体字标志的条文为强制性条文,必须严格执行。

本标准由住房和城乡建设部负责管理和对强制性条文的解释,应急管理部消防救援局负责日常管理,应急管理部天津消防研究所负责标准条文具体技术内容的解释。请各单位在执行本标准过程中,认真总结经验,注意积累资料,执行过程中如有意见或建议,请寄送应急管理部天津消防研究所(地址:天津市南开区卫津南路110号,邮编:300381)。

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1 总 则

- 1.0.1** 为了规范煤化工工程的防火设计,减少火灾危害,保护人身和财产安全,制定本标准。
- 1.0.2** 本标准适用于以煤为原料,经过煤气化或煤直接液化过程制取燃料和化工产品的新建、扩建和改建工程的防火设计。
- 1.0.3** 煤化工工程的防火设计,应遵循国家的有关方针政策,做到安全可靠、技术先进、经济合理。
- 1.0.4** 煤化工工程的防火设计,除应执行本标准外,尚应符合国家现行有关标准的规定。

2 术 语

2.0.1 煤化工工厂 coal chemical factory

以煤为原料,采用煤气化或煤直接液化技术生产和储运燃料及化工产品的工厂。

2.0.2 煤储运系统 coal storage and transportation system

原料煤的储运和处理系统,包括上煤、卸煤、运煤、储存、破碎等设施。

2.0.3 煤粉制备系统 pulverized coal preparation system

将原料煤加工成煤粉的处理系统,包括给料计量、研磨、干燥、输送、收集、储存等设施。

2.0.4 防爆墙 explosion-proof wall

用于抵抗爆炸冲击波的墙体。

3 基本规定

3.0.1 液化烃和可燃液体的火灾危险性分类应符合表 3.0.1 的规定。

表 3.0.1 液化烃和可燃液体的火灾危险性分类

类别		特征
甲	甲 _A	37.8℃时蒸气压力>200kPa 的烃类液体及其他类似液体
	甲 _B	甲 _A 类以外,闪点<28℃的液体
乙	乙 _A	28℃≤闪点≤45℃的液体
	乙 _B	45℃<闪点<60℃的液体
丙	丙 _A	60℃≤闪点≤120℃的液体
	丙 _B	闪点>120℃的液体

- 注:1 操作温度超过其闪点的乙类液体,应划分为甲_B类液体;
2 操作温度超过其闪点的丙_A类液体,应划分为乙_A类液体;
3 操作温度超过其闪点的丙_B类液体,应划分为乙_B类液体;操作温度超过其沸点的丙_B类液体,应划分为乙_A类液体;
4 煤直接液化装置中的油煤浆,应划分为甲_B类可燃液体。

3.0.2 气体和固体的火灾危险性类别划分应符合现行国家标准《建筑设计防火规范》GB 50016 的有关规定。

3.0.3 设备的火灾危险性类别应根据其处理、储存或输送介质的火灾危险性类别确定。

3.0.4 建筑物内一个防火分区的火灾危险性类别应按其中火灾危险性类别较高的物质或设备确定;当较高火灾危险性类别的物质或设备占该防火分区面积的比例小于 5%,且发生火灾事故不足以蔓延到其他部位或采取防火措施能防止火灾蔓延时,可按其

中火灾危险性类别较低的物质或设备确定。

同一座建筑物的火灾危险性类别应按其中较高火灾危险性类别的防火分区确定。

4 区域规划与总平面布置

4.1 区域规划

4.1.1 煤化工工厂的区域规划应符合当地城乡(镇)总体规划和防火防爆的安全要求,并应根据煤化工工厂及其相邻工厂或设施的特点和火灾危险性,结合地形、风向、交通、水源等条件,合理确定。

4.1.2 煤化工工厂应远离城市居住、商业、重要交通枢纽等人员密集的地区和饮用水源地;其生产区宜位于邻近城镇和居住区全年最小频率风向的上风侧,并宜避开窝风地段。

4.1.3 煤化工工厂邻近煤矿矿井时,厂内明火或散发火花地点宜位于矿井井口全年最小频率风向的下风侧,高架火炬与井口的距离应根据人或设备允许的辐射热强度计算确定,且不应小于200m,厂内的其他明火或散发火花地点与井口的距离不应小于100m。

4.1.4 煤化工工厂应采取防止厂内可燃液体和受污染的消防废水排出厂区外的措施。

区域性排洪沟不宜通过厂区;当受条件限制确需通过时,应符合现行国家标准《石油化工工厂布置设计规范》GB 50984的有关规定。

4.1.5 地区架空电力线路、其他工厂或设施的架空电力线路、公路、地区输油(输气)管道、其他工厂或设施的输油(输气)管道、运煤栈桥不应穿越厂区。

4.1.6 煤化工工厂与相邻居民区、工厂或设施的防火间距不应小于表4.1.6的规定,其防火间距起止点应符合本标准附录B的规定。

高架火炬与相邻建筑、设施的防火间距应根据人或设备允许的辐射热强度计算确定;对于可能携带可燃液体的高架火炬,不应小于表4.1.6的规定。

表 4.1.6 煤化工工厂与相邻居住区、工厂或设施的防火间距(m)

项 目		液化 烃罐组	液氧 (氧气) 储罐	甲、乙类 液体罐组	可能携带 可燃液体的 高架火炬	甲、乙类 装置或 设施	全厂性或 区域性 重要设施	储煤场区
居住区、村镇及公共福利设施		300	60	100	120	100	25	50
相邻工厂围墙或用地红线		120	50	70	120	50	70	40
厂外铁路(铁路 中心线或建筑物)	厂外铁路和铁路编组站	55	35	45	80	35	25	35
	厂外企业铁路专用线	50	30	40	80	30	20	30
厂外公路 (路边)	高速公路、一级公路	40	30	40(35)	80	35	—	30
	其他公路	35	20	35(30)	60	30	—	20
变配电站(围墙)		80	30	50	120	40	25	30
架空电力线路(中心线)		1.5 倍杆塔 高度且不 小于 40m	1.5 倍杆塔 高度	1.5 倍杆塔 高度且不 小于 35m	1.5 倍杆塔 高度且不 小于 80m	1.5 倍杆塔 高度且不 小于 30m	—	30
I、II 级国家架空通信线路(中心线)		50	30	40	80	40	—	30
通航江、河、海岸边		30	25	30	80	25	—	20

续表 4.1.6

项 目			液化 烃罐组	液氧 (氧气) 储罐	甲、乙类 液体罐组	可能携带 可燃液体的 高架火炬	甲、乙类 装置或 设施	全厂性或 区域性 重要设施	储煤场区
地区管道 (管道中心线)	埋地 管道	原油及成品油	35	30	35	60	30	30	30
		液化烃	60	55	60	80	60	60	55
		输气管道	35	30	35	60	30	30	30
	地面 敷设 管道	原油及成品油	40	40	40	90	40	40	30
		液化烃	90	80	90	120	90	90	90
		输气管道	40	40	40	90	40	40	40
装卸油品码头(码头前沿)			70	60	60	120	60	60	55

- 注:1 当相邻设施为港区陆域、重要物品仓库和堆场、军事设施、机场、爆炸作业场所等对安全有特殊要求时,应按两者的较大值执行;
- 2 可燃气体罐组与周边相邻设施的防火间距应按甲、乙类装置或设施的规定确定;
- 3 丙类可燃液体罐组与周边相邻设施的防火间距不应小于甲、乙类可燃液体罐组规定的 75%;储罐容积大于 1000m³的甲_B、乙类固定顶罐,容积大于 20000m³的浮顶、内浮顶或丙_A类固定顶罐,与厂外其他公路和通航江、河、海岸边的防火间距不应小于 40m;
- 4 丙类装置或设施与周边相邻设施的防火间距不应小于甲、乙类装置或设施规定的 75%;
- 5 对于转运站、筛分破碎室、卸煤装置、运煤栈桥,其防火间距不应小于储煤场区规定的 50%,且不得低于 20m;

- 6 全厂性或区域性重要设施与相邻工厂丁、戊类设施的防火间距不应小于 25m；
- 7 煤化工工厂内各类设施与相邻工厂内专供煤化工工厂使用的储煤场的防火间距应按本标准表 4.2.5 有关储煤场区的规定值增加 25%，且不应小于 30m；
- 8 液氯罐组与周边相邻设施的防火间距应按相应的甲、乙类液体罐组的规定确定；
- 9 储罐容积不大于 1000m³的甲_B、乙类固定顶罐和储罐容积不大于 5000m³的浮顶、内浮顶、丙_A类固定顶罐，与厂外公路的防火间距不应小于表中括号内数值；
- 10 液化烃罐组与 330kV~1000kV 架空电力线路的防火间距不应小于 1.5 倍杆塔高度且不应小于 100m；
- 11 表中“—”表示无规定。

4.1.7 煤化工工厂与化工园区公用设施等的防火间距,应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

4.2 总平面布置

4.2.1 煤化工工厂应根据自身的生产流程、特点及各组成部分的功能要求和火灾危险性,结合地形、风向、交通等条件,按功能分区进行总平面布置,并应符合下列规定:

1 可能散发可燃气体的装置、罐组、装卸区和全厂性污水处理场等设施,宜位于人员密集场所及明火和散发火花地点的全年最小频率风向的上风侧;

2 空分装置应布置在空气清洁地段,并宜位于散发可燃气体和可燃粉尘场所的全年最小频率风向的下风侧;

3 采用架空电力线路进出厂区的总变电站应布置在厂区边缘;

4 储煤场区应布置在厂区边缘,且宜位于厂区全年最小频率风向的上风侧;

5 可燃液体汽车装卸设施应布置在厂区面向厂外公路的一侧,宜设置围墙与其他设施隔开;厂内铁路宜集中布置在厂区边缘;

6 全厂性的危险化学品仓库应布置在厂区边缘;

7 全厂性的高架火炬宜位于厂区全年最小频率风向的上风侧;

8 中央控制室应远离装置(区)、储罐(区),且宜设置在生产管理区;

9 液化烃罐组、可燃液体罐组不应毗邻布置在高于装置、全厂性重要设施或人员集中场所的台地上;当受条件限制或有工艺要求时,可燃液体原料储罐可毗邻布置在高于装置的台地上,但应采取防止泄漏的可燃液体流入装置、全厂性重要设施或人员集中场所的措施;

10 装置外独立设置的控制室、机柜室和外操室所在场地的地坪高度不宜低于甲、乙类生产设备区的地坪高度；

11 消防站宜设置在生产管理区，且应远离装置（区）、储罐（区）；消防站至甲、乙、丙类火灾危险场所最远点行车路程不宜大于 2.5km，且接到火警后消防车到达火场的时间不宜超过 5min，至丁、戊类火灾危险的局部场所最远点行车路程不宜大于 4.0km。

4.2.2 输送煤、灰渣的输送机栈桥宜布置在爆炸性环境区域范围外，且不应跨越与其无关的生产单元。当位于爆炸性环境区域范围内时，应采取相应的防爆措施。

4.2.3 为不同装置、自备热电站（锅炉房）等输入（出）物料的 2 座及以上的封闭式输送机栈桥之间的防火间距不应小于 6m。当相邻 2 座栈桥，其中任一座的相邻侧外墙采用耐火极限不低于 2.00h 的实体墙和乙级防火窗分隔，且相邻 2 座栈桥外侧沿其长度方向至少一侧设置消防车道时，其防火间距可不限。

4.2.4 生产区与厂外之间宜设置高度不低于 2.2m 的不燃烧实体围墙。

4.2.5 煤化工工厂内装置或设施之间的防火间距除本标准另有规定外，不应小于表 4.2.5 的规定（见书后插页）。装置或设施（罐组除外）之间的防火间距应按相邻最近的设备、建筑物确定，其防火间距起止点应符合本标准附录 B 的规定。

高架火炬与其他建筑、设施的防火间距应根据人或设备允许的安全辐射热强度计算确定；对于可能携带可燃液体的高架火炬，不应小于表 4.2.5 的规定。

4.2.6 液化烃、可燃液体罐车装卸线中心线至厂内铁路卸煤线中心线的防火间距应符合下列规定：

- 1 对于液化烃装卸线，不应小于 25m；
- 2 对于甲_B、乙类液体装卸线，不应小于 20m；
- 3 对于丙类液体装卸线，不应小于 15m。

4.2.7 在液化烃、可燃液体的铁路装卸区内,两相邻栈台铁路装卸线中心线之间及内燃机车与另一栈台铁路装卸线中心线之间的防火间距应符合下列规定:

1 对于甲、乙类液体,两相邻栈台铁路装卸线中心线之间的防火间距不应小于10m,内燃机车与另一栈台铁路装卸线中心线之间的防火间距不应小于12m;甲_B、乙类液体采用密闭装卸时,其防火间距可减少25%;

2 对于丙类液体,两相邻栈台铁路装卸线中心线之间的防火间距不应小于7m,内燃机车与另一栈台铁路装卸线中心线之间的防火间距不应小于8m。

4.2.8 厂内铁路等其他布置和厂区绿化应符合现行国家标准《石油化工企业设计防火标准》GB 50160的有关规定。

4.3 厂内消防车道

4.3.1 煤化工工厂通向厂外公路的车辆出入口不应少于2个,且宜位于不同方位。

4.3.2 下列场所周围应设置环形消防车道,且至少应有2处与其他车道连通:

1 装置或联合装置;

2 可燃气体储罐区、可燃液体储罐区;

3 总容积不小于120000m³的可燃液体储罐单个罐组或多个罐组;

4 液化烃储罐组;

5 危险化学品仓库区;

6 占地面积大于10000m²的露天储煤场、筒仓、储煤库;

7 液化烃、可燃液体铁路装卸区。

对于本条第2、5、6、7款的场所,当受地形条件限制设置环形消防车道确有困难时,也可设置带有回车场的尽头式消防车道,回车场不宜小于20.0m×20.0m(含路面),且第2、5、6款场所的消

防车道应沿其 2 个长边设置,第 7 款场所的消防车道应平行铁路装卸线方向单侧设置,消防车道与铁路装卸线的距离不应大于 80m。

4.3.3 装置内应设置与装置周边环形消防车道相通的中间消防车道,且应符合下列规定:

1 应用消防车道分割成为占地面积不大于 10000m^2 的设备、建筑物组成的区块;消防车道宽度不应小于 6.0m,路面上的净空高度不应小于 4.5m,路面内缘转弯半径不应小于 7.0m;

2 当装置的设备、建筑物组成的区块占地面积大于 10000m^2 且不超过 20000m^2 时,在该区块四周应形成环形消防车道,区块宽度不应大于 120m,且相邻设备、建筑物组成的区块之间的防火间距不应小于 15m;

3 当装置的设备、建筑物组成的区块占地面积大于 40000m^2 时,应用消防车道分割成占地面积不大于 40000m^2 的设备、建筑物组成的消防分区,消防分区四周应形成环形消防车道,且该消防分区与相邻消防分区或区块之间的防火间距不应小于 25m;

4 当装置外两侧消防车道间距不大于 120m 时,装置内可不设中间消防车道。

4.3.4 液化烃、可燃液体、可燃气体的罐区内的储罐中心与至少 2 条消防车道的距离均不应大于 120m;当不能满足此要求时,任何储罐中心与最近的消防车道之间的距离不应大于 80m,且最近消防车道的路面宽度不应小于 9m。

4.3.5 占地面积大于 30000m^2 的露天煤堆场应设置与周边消防车道相通的中间消防车道,且道路间距不宜大于 150m。

4.3.6 液化烃、可燃液体铁路装卸区内,当与铁路线路平行的消防车道间距大于 200m 时,应设置与周边消防车道相通的中间消防车道,若增设的消防车道与铁路平面相交,平交的角度宜为 90° ,确有困难时,平交的角度不应小于 45° 。

4.3.7 生产区的消防车道两个路口间的长度大于 300m 时,应在

该消防车道的中段设置回车场,回车场不宜小于 $20.0\text{m} \times 20.0\text{m}$ (含路面)。

4.3.8 厂内消防车道的路面宽度和转弯半径等应满足下列要求:

1 占地面积不小于 40000m^2 的装置区、装置或联合装置设备和建筑物组成的区块,大型、中型煤化工工厂的煤气化装置,其周边环形消防车道的路面宽度不应小于 9m ,路面内缘转弯半径不宜小于 15m ;

2 大型、中型煤化工工厂的储罐区、单罐容积大于 50000m^3 的可燃液体罐组,其周边消防车道的路面宽度不应小于 9m ,路面内缘转弯半径不宜小于 15m ;

3 尽头式消防车道的路面宽度不应小于 9m ;

4 除第 1 款~第 3 款及本标准第 4.3.3 条第 1 款外的消防车道路面宽度不应小于 6m ,路面内缘转弯半径不宜小于 12m ;

5 消防车道路面上的净空高度不应小于 5.0m ,道路的纵向坡度不宜大于 6% 。

4.3.9 厂内消防车道与储罐组防火堤外堤脚线的距离不应小于 3.0m ,与围墙(栏)的距离不应小于 1.5m 。

4.3.10 消防车道防护设施的设置及其路面边缘与管架支柱的距离,应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

5 建筑防火

5.1 耐火等级、耐火极限

5.1.1 煤粉制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备厂房的耐火等级应为一级。水煤浆制备厂房的耐火等级不应低于二级。

5.1.2 厂房(仓库)柱间支撑的耐火极限应按该厂房(仓库)柱的耐火极限要求确定;次梁和水平支撑的耐火极限可按该厂房(仓库)梁的耐火极限要求降低 0.50h 确定。

不直接承受和传递设备管线的水平荷载与设备荷载等的构件、钢格栅及不作为楼层防火分隔构件的钢楼板,可不采取防火保护措施。

5.1.3 厂房内可燃介质设备裙座的耐火极限不应低于该厂房柱的耐火极限。

当厂房的楼层采用钢板进行防火分隔时,该钢板应采取防火保护措施,且耐火极限不应低于相应耐火等级楼板的耐火极限。

5.1.4 储煤库的挡煤墙应采用钢筋混凝土结构,且与堆煤接触的部位应采取隔热措施。钢结构储煤库内与煤堆垛边缘水平距离小于或等于 3m 范围内的钢结构承重构件应采取防火保护措施,且耐火极限不应低于 2.50h。

5.1.5 封闭式运煤栈桥、转运站、筛分破碎楼等运煤建筑和运煤输送机通廊的围护结构应采用不燃材料,当未设置自动灭火系统时,其钢结构构件应采取防火保护措施。

5.1.6 除本标准第 5.1.4 条、第 5.1.5 条规定外,煤储运系统建筑构件的耐火极限应按不低于二级的厂房(仓库)确定。

5.1.7 液化烃、可燃液体、可燃气体和助燃气体球罐从地面到钢

结构支腿与球体交叉处以下 0.2m 的部位,应采取防火保护措施,且耐火极限不应低于 2.00h。

5.1.8 设备构架的钢结构和管廊钢结构的防火保护措施,应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

5.2 建筑高度、层数和面积

5.2.1 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备的厂房,其层数和高度可按工艺流程及设备布置要求确定。

5.2.2 煤粉制备、煤气化、煤气化工艺水处理、油煤浆制备、煤直接液化催化剂制备的高层厂房和粉煤气化单元与煤粉制备单元合建的高层厂房,每层及每个防火分区的建筑面积不应大于 3500m^2 。

煤气化水煤浆制备厂房,其煤储斗部分与磨煤机部分之间应采用防火墙分隔,煤储斗部分每层及每个防火分区的建筑面积不应大于 4000m^2 ,磨煤机部分每层及每个防火分区的建筑面积不应大于 8000m^2 。确需在防火墙上设置观察窗或开设设备孔洞时,应分别采用甲级防火窗或防火分隔水幕分隔。

5.2.3 甲、乙类构架除工艺流程及设备布置要求外,其层数不宜超过 4 层。

5.2.4 厂房内按工艺及管道布置需设置钢格栅板的楼面,其面积可不计人所在防火分区的建筑面积内。

5.2.5 储煤库应采用独立的单层建筑,其最大允许占地面积不应大于 50000m^2 ,每个防火分区的建筑面积不宜大于 12000m^2 ,当防火分区建筑面积大于 12000m^2 时,防火分区之间应采用宽度不小于 10m 的通道或防火墙分隔。圆形煤库的直径不宜大于 120m。

卸煤装置地下室防火分区的建筑面积不应大于 3000m^2 。

5.3 建筑防爆

5.3.1 甲、乙类厂房宜采用敞开或半敞开形式，其承重结构宜采用钢筋混凝土或钢框架、排架结构。

5.3.2 受条件限制需封闭的液化烃泵、可燃液体泵、可燃气体压缩机等动设备厂房和煤气化的工艺水处理厂房，以及因检修和操作条件限制需局部场所封闭的煤气化厂房，应符合下列规定：

1 任一层可开窗面积不应小于该层外墙表面积(不含屋顶面积)的8%，且宜均匀布置在不同朝向的外墙上；

2 甲类厂房泄压比值C不宜小于 $0.16(m^2/m^3)$ ，乙类厂房泄压比值C不宜小于 $0.11(m^2/m^3)$ ，泄压面积应按现行国家标准《建筑设计防火规范》GB 50016的有关规定计算，并宜分层计算；

3 封闭厂房及场所的通风应符合现行国家标准《工业建筑供暖通风与空气调节设计规范》GB 50019和《石油化工采暖通风与空气调节设计规范》SH/T 3004的规定。

5.3.3 当中央控制室、区域性控制室、仪表机柜间与有爆炸危险的建筑、设备、储罐等邻近布置时，应根据爆炸风险评估确定是否需要抗爆要求；当需进行抗爆设计时，应按现行国家标准《石油化工控制室抗爆设计规范》GB 50779的规定进行设计。

5.3.4 装置的控制室、仪表机柜间、变配电室、办公室和分析化验室不得与甲、乙A类设备的房间布置在同一建筑物内。装置的控制室与甲、乙A类设备房间外的其他建筑物合建时，应设置独立的防火分区。

装置的控制室、办公室和分析化验室宜布置在装置外。当控制室、仪表机柜间、变配电室、办公室和分析化验室布置在装置内时，应符合下列规定：

1 宜布置在爆炸危险区域范围外，当平面布置位于爆炸性气体环境附加2区时，室内地面应高出室外地面不小于0.6m；

2 办公室和分析化验室面向爆炸危险区域范围侧的外墙，宜

采用无门窗洞口且耐火极限不低于3.00h的不燃烧实体墙；当确需设置门、窗时，应采用甲级防火门、窗；

3 控制室宜设置在建筑物的首层，分析化验室不应布置在控制室和变配电室的上方。

5.3.5 当装置的控制室、仪表机柜间与有爆炸危险的建筑、设备邻近布置时，应根据爆炸风险评估确定抗爆要求。抗爆设计应执行现行国家标准《石油化工控制室抗爆设计规范》GB 50779的规定。装置的变配电室面向爆炸危险区域范围侧的外墙，应采用无门窗洞口且耐火极限不低于3.00h的不燃烧实体墙。

装置的控制室或化验室的室内不得设置可燃气体、液化烃和可燃液体的在线分析仪器。

5.3.6 当消防泵房的外墙与可燃液体、可燃气体或液化烃管道法兰的水平距离小于15m时，该外墙应采用无门窗洞口且耐火极限不低于3.00h的不燃烧实体墙。

5.3.7 消防给水增压泵房宜独立布置。当设置在所服务的煤气化、油煤浆制备等高层厂房内时，应布置在首层，且应采用耐火极限不低于3.00h的不燃烧实体墙和耐火极限不低于2.00h的楼板与其他部位隔开，并应设置直通室外的安全出口。

5.3.8 厂房内有爆炸危险的房间与经常有人操作的房间之间，应采用防爆墙分隔。封闭厂房内爆炸危险区域范围内的楼梯间、室外楼梯或有爆炸危险的房间与相邻房间连通处应设置门斗等防护措施，门斗隔墙应采用耐火极限不应低于2.00h的防火隔墙，门应采用甲级防火门并应与楼梯间门错位布置。

有爆炸危险的房间门不宜与其他房间的门正对设置，且不得设置门槛。

5.3.9 设置在爆炸危险区域范围内的疏散门，其开启方向应朝向爆炸危险性较小的区域一侧，疏散门口的外侧应采用防滑坡道，且不应设置台阶。

5.3.10 煤储运系统（栈桥除外）、煤粉制备等易积存煤粉的厂房

或部位，宜采用不易积粉尘的建筑构造做法，其室内墙面、楼地面应采用光滑、易清洗、不积粉尘的饰面材料。

5.3.11 甲、乙类建筑内不宜设置地沟；必须设置时，应采取防止粉尘、可燃液体和比空气重的可燃气体积聚在地沟内的措施，并应封闭盖板的缝隙，地沟与相邻建筑连通处应采用防火封堵材料进行封堵，且防火封堵组件的耐火极限不应低于被贯穿物的耐火极限。

5.4 安全疏散

5.4.1 建筑物内房间疏散门的数量应经计算确定，且不应少于2个；每个房间相邻2个疏散门最近边缘之间的水平距离不应小于5m。当符合下列条件之一时，可设置1个：

- 1 建筑面积小于250m²的仪表机柜间；
- 2 建筑面积小于120m²的控制室；
- 3 长度小于7m的化验室和分析室、变配电室、电缆夹层、电容器室、蓄电池室、发电机室、电气开关室等电气设备房间。

5.4.2 高层甲、乙、丙类厂房通往地面的疏散楼梯不应少于2个，其室内任一点至安全出口的距离应符合下列规定：

- 1 对于甲类厂房，不应大于25m；
- 2 对于乙类厂房，不应大于30m；
- 3 对于丙类厂房，不应大于40m。

5.4.3 设备构架或检修平台安全疏散通道的设计，应符合现行国家标准《石油化工企业设计防火标准》GB 50160的有关规定。

设备构架或检修平台上通往地面的垂直梯可作为第二部疏散梯，但平台上的操作人数不宜超过3人。

5.4.4 厂房的疏散楼梯应符合下列规定：

- 1 宜布置在爆炸危险区域范围以外；
- 2 建筑高度不大于32m或建筑高度大于32m且任一层人数不超过10人时，应采用封闭楼梯间或室外楼梯；建筑高度大于

32m 且任一层人数超过 10 人时,应采用防烟楼梯间、室外楼梯或具有自然通风条件的封闭楼梯间;

3 厂房内局部高出的设备平台,当操作人数不超过 3 人时,可设置 1 部垂直梯作为该平台的疏散梯。

5.4.5 建筑高度大于 32m 且设置电梯的高层厂房,每个防火分区宜设置 1 部消防电梯,符合消防电梯功能要求的载货电梯可兼作消防电梯。

当电梯处于爆炸危险区域范围内时,应采用防爆电梯,其防爆等级应按现行国家标准《爆炸危险环境电力装置设计规范》GB 50058 的有关规定执行。当电梯停靠高度大于 60m 且采用防爆电梯时,防爆电梯的运行时间宜按其最大运行速度 1m/s 计算确定,其他技术性能应符合现行国家标准的有关规定。

5.4.6 煤储运系统建筑的安全出口应符合现行国家标准《火力发电厂与变电站设计防火标准》GB 50229 的有关规定。

5.5 建筑构造

5.5.1 当厂房内上层与下层为不同的防火分区时,上、下层之间楼板上的开口处应采取防火保护措施。

5.5.2 建筑内可能存在可燃液体泄漏和流淌的楼层,应采取防止可燃液体流淌的措施,且楼板的耐火极限不应低于 1.50h。

5.5.3 紧邻设备防爆门上方的围护平台不应设置孔洞。煤粉制备系统中有法兰连接且检修频繁的楼层,宜采用无孔洞的楼面。

5.5.4 变配电室与除甲、乙类设备房间之外的其他房间合建时,应采用耐火极限不低于 2.00h 的不燃烧实体墙隔开。变配电室之间应采用耐火极限不低于 1.50h 的不燃烧实体墙隔开,隔墙上的门可采用不燃材料制作的双向弹簧门。

5.5.5 电缆沟进入变配电室、电缆夹层、控制室等的孔洞及电缆贯穿隔墙和楼板的孔隙,应采用防火封堵材料进行封堵,且防火封堵组件的耐火极限不应低于被贯穿物的耐火极限。

5.5.6 可燃气体和甲、乙、丙类液体的管道不应穿过防火墙。其他管道不宜穿过防火墙；当必须穿过防火墙、楼板或其他防火分隔部位时，应在穿越处加钢套管，并应采取防火封堵措施。

5.5.7 用作安全疏散的室外楼梯应符合下列规定：

- 1** 栏杆扶手的高度不应小于 1.1m；
- 2** 楼梯的净宽度不应小于 0.9m，倾斜角度不应大于 45°；
- 3** 休息平台的宽度不应小于 1.2m；
- 4** 梯段和平台应采用不燃材料，梯段的耐火极限不应低于 0.25h，平台的耐火极限不应低于 1.00h；
- 5** 通往室外楼梯的门应采用乙级防火门，并应向室外开启，不应正对楼梯段；门的设置不应减少楼梯的有效宽度；
- 6** 除疏散门外，室外楼梯周围 2.0m 范围内应设置无门窗洞口的不燃烧实体墙。

5.5.8 甲、乙类建筑物的门、窗应采用金属型材门、窗。

6 装置和系统单元

6.1 一般规定

6.1.1 工艺设备(以下简称设备)、管道和构件的材料应符合下列规定:

1 设备本体(不含衬里)及其基础,管道(不含衬里)及其支架、吊架和基础应采用不燃材料,但储罐底板垫层可采用沥青砂;

2 设备和管道的绝热材料应采用不燃或难燃材料。

6.1.2 设备和管道应根据其内部物料的火灾危险性和工作条件设置相应的安全防护装置。

6.1.3 煤粉制备系统中可能发生煤粉泄漏的煤粉仓等设备部位,宜设置煤粉浓度检测报警系统。

6.1.4 散发可燃粉尘与可燃气体的设备和建筑,宜布置在所在装置全年最小频率风向的上风侧,并应布置在远离人员集中的场所。

6.1.5 散发可燃粉尘的场所应采取防止粉尘扩散、飞扬和积聚的措施。

6.1.6 甲、乙类设备宜露天布置或布置在敞开、半敞开式厂房内。装置和设备的布置,在满足工艺要求的情况下,宜限制和缩小爆炸性环境区域的范围。

6.1.7 使用或产生可燃气体或甲、乙_A类液体的装置和系统单元,应按区域控制和重点控制相结合的原则设置可燃气体检测报警系统。

6.1.8 除本标准另有规定外,装置和系统单元内的其他防火设计应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

6.2 装置及设备布置

6.2.1 当煤气化装置中的水煤浆制备、煤粉制备、煤气化、煤气化工艺水处理设备、油煤浆制备、煤直接液化催化剂制备分别布置在各自建筑物内时,相邻建筑物之间的防火间距不应小于15m。但当煤气化装置内各建筑物占地面积总和不大于 3500m^2 时,相邻建筑物之间的防火间距可不限。

煤粉设备与其他设备、建筑物的防火间距,应按现行国家标准《石油化工企业设计防火标准》GB 50160中有关乙类可燃气体设备与其他设备、建筑物的防火间距确定;当煤粉设备采用惰性气体保护时,与其他工艺设备的防火间距可不限。

重力流输送等有特殊工艺要求的相关设备可靠近布置;油煤浆循环泵与反应器以及其他与主体设备密切相关的设备,可直接连接或靠近布置。

6.2.2 粉尘防爆的电气设备与可燃气体和甲、乙A类可燃液体设备的防火间距不应小于15m;采用耐火极限不低于3.00h的不燃烧实体墙分隔时,可按水平折线计算其距离。当粉尘防爆电气设备的平面布置位于爆炸性气体环境附加2区时,其地面应高出周围地面不小于0.6m。

6.2.3 煤气化炉烧嘴所在楼层宜设置防止烧嘴蹿火的不燃烧实体隔断墙,隔断墙高度宜高于烧嘴顶部不小于0.5m。

6.2.4 热风炉宜布置在厂房的边缘。当与煤粉制备厂房中有防粉尘爆炸要求的设备靠近布置时,应采用耐火极限不低于3.00h的不燃烧实体墙分隔。

6.2.5 高压设备宜布置在装置或厂房的一端或一侧,并宜远离装置储罐。

6.2.6 同一建筑内分隔不同火灾危险性类别房间的墙体,应采用防火墙。有爆炸危险的甲、乙类房间宜布置在建筑的端部,且不宜靠近建筑的主要出入口。人员集中和经常有人工作的房间,应布

置在建筑中火灾危险性较小的一端。

6.2.7 装置内的可燃液体收集罐、排放槽,受工艺条件限制必须布置在地坑内时,应布置在装置的边缘,并应设置明显的警示标志和采取防止可燃气体在坑内积聚的措施。

6.2.8 煤气化循环气压缩机,受工艺条件限制确需与其他甲、乙和丙类设备布置在同一厂房内时,应符合下列规定:

1 宜靠近煤气化厂房一侧布置;

2 除自用的高位润滑油箱外,压缩机的上方不应布置甲、乙、丙类设备;

3 压缩机及设备(设施)上方易泄漏部位和房间内顶部易于积聚可燃气体的部位,应设置可燃气体探测器,并应方便校验和维护;

4 受自然条件和工艺条件限制需封闭的压缩机房间,应设置自然通风或机械通风设施;

5 压缩机房间的地面应采用不发火花地面,不宜设置地坑或地沟。

6.2.9 甲类和总储量大于 5t 的乙类物品仓库,不应布置在装置区内。

6.2.10 可能有可燃液体泄漏、漫流的设备区周围应设置高度不低于 150mm 的围堰和导液设施;机泵、压缩机等在检修时易发生泄漏的部位以及低点排放的部位,宜设置满足安全检修所需的排液设施。

6.2.11 空分装置的空压机吸风口处空气中烃类等危险杂质的含量以及吸风口位置、空分装置内设备、建筑的防火间距,应符合现行国家标准《氧气站设计规范》GB 50030 和《深度冷冻法生产氧气及相关气体安全技术规程》GB 16912 的有关规定。

6.3 煤粉制备

6.3.1 碎煤仓的设计应符合下列规定:

- 1 宜采用圆筒形钢仓，仓的内表面应平整、光滑、耐磨，且锥段内壁宜衬光滑、不燃或阻燃型耐磨材料；仓的锥段壁面与水平面的交角不应小于 65° ；对于黏性大、挥发性高或易燃的烟煤和褐煤的碎煤仓，其锥段壁面与水平面的交角不应小于 70° ；
- 2 碎煤仓下出口直径不宜小于 600mm；
- 3 应设置温度检测报警设施和氮气管道接口；
- 4 当碎煤仓内储存褐煤和易自燃的高挥发分煤种时，宜增设一氧化碳检测报警设施，并应采取自动紧急充氮保护；当储存经过预干燥的褐煤时，应采取充氮保护措施；
- 5 在严寒和寒冷地区设置的碎煤仓，应采取防冻保温措施。

6.3.2 煤粉制备系统应在惰性气氛下运行，并应设置氧含量在线监测报警及联锁控制设施。

煤粉制备系统应设置温度、一氧化碳、压力、流量和料位等监测仪表及事故报警及联锁控制设施。

6.3.3 磨煤机出口的气体温度宜高于水蒸气的露点 $20^{\circ}\text{C} \sim 35^{\circ}\text{C}$ ，且煤粉制备系统末端的介质最低温度应高于水蒸气的露点。

6.3.4 煤粉制备系统宜选用漏风率低的中速磨煤机和气密性好的给煤机，其抗爆设计内压不应小于 0.35MPa。

6.3.5 用于煤粉分离收集的袋式过滤器，除应符合现行国家标准《粉尘爆炸危险场所用收尘器防爆导则》GB/T 17919 的规定外，尚应符合下列规定：

- 1 煤粉收集斗的壁面与水平面的交角不应小于 65° ，相邻两壁间交线与水平面交角不应小于 60° ，相邻两壁交角的内侧应成圆弧形，圆弧半径不应小于 200mm；
- 2 过滤器的气体出口管线上应设置一氧化碳监测报警设施；
- 3 过滤器上应设置氮气管道接口，并应采取自动紧急充氮保护措施；
- 4 过滤器箱体及煤粉收集斗表面应采取伴热保温措施；
- 5 过滤器的清粉气源应采用氮气，氮气的气源压力应保持

稳定；

6 煤粉收集斗应设置温度监测及料位监测设施。

6.3.6 对于输送和处理煤粉的机械设备，应选用气密性好的设备，机身上应设置氮气管道接口，其轴封处应采取喷吹氮气的密封措施。

6.3.7 煤粉仓的设计应符合下列规定：

1 宜采用圆筒形金属仓，长径比应小于 5：1，锥段壁面与水平面的交角不应小于 70°；仓体应封闭严密，减少开孔；任何开孔必须有可靠的密封结构；

2 仓的内表面应平整、光滑、耐磨和不积粉，仓的几何形状和结构应使煤粉能够顺畅自流；

3 仓内应设置氮气管道接口，并应采取充氮保护措施；

4 应设置温度及料位监测设施；

5 常压仓的设计内压不应小于 40kPa；

6 仓外壁应采取保温措施，严寒和寒冷地区宜增设伴热措施；

7 仓的煤粉排出口应设置流化助流或破拱清堵设施。

6.3.8 煤粉仓的进粉和出粉装置必须具有锁气功能。

6.3.9 煤粉仓及(加压)给料系统应设置系统停止运行后的放粉系统。

6.3.10 煤粉制备和煤气化厂房宜设置负压吸尘清扫设施，褐煤和易自燃的高挥发分煤种的煤粉制备厂房必须设置负压吸尘清扫设施。严禁采用压缩空气吹扫。

6.3.11 煤粉制备系统的管道设计应符合下列规定：

1 管道及其阀门、管件内壁应光滑、耐磨；

2 除必须用法兰与设备和部件连接外，管道应采用焊接连接；

3 磨煤机出口至煤粉收集袋式过滤器入口的气粉混合物管道与水平面的倾斜角不宜小于 45°，弯管弯曲半径不宜小于管道

公称直径的3倍；

4 利用重力流输送的煤粉管道宜垂直布置，管道与楼地面的交角不应小于70°；管道内壁不得有使煤粉积结的凸台。

6.3.12 煤粉制备系统中设备和管道的保温层，以及与煤粉制备系统同厂房布置的其他设备和管道的保温层，其外表面应光滑、易清扫。

6.3.13 煤粉制备系统中的煤粉收集袋式过滤器和可能超压的煤粉仓，应设置防爆门。防爆门的设计应符合下列规定：

1 对于煤粉收集袋式过滤器，宜采用膜板式并带有自动启闭装置的门；

2 可能超压的煤粉仓的泄压面积和爆破膜的额定动作压力，应按超压时煤粉仓不被破坏确定；

3 防爆门的位置应使其动作时喷射出的气流不危及附近的电缆、油气管道和经常有人通行的部位；

4 防爆门宜直接（无引出管）排放，若必须在防爆门后加引出管时，宜短而直。

6.4 其他

6.4.1 接触油煤浆和可能被其他物料堵塞、腐蚀的安全阀，在安全阀前应设置爆破片或在其出入口管道上采取吹扫、冲洗、加热或保温等防堵措施。

6.4.2 装置和储运设施中重要的泵、风机和压缩机的操作与控制，应能在控制室实现远控操作及现场操作。

6.4.3 装置内应设置软管站设施。

6.4.4 煤气化厂房内的可燃气体探测报警装置，宜设置在气化炉、高压飞灰过滤器等设备可燃气体进出口法兰和气化炉充可燃气体的煤锁斗阀门的附近。

6.4.5 对于粉煤气化炉可燃气体出口法兰、高压飞灰过滤器和旋风过滤器的可燃气体进出口法兰，在法兰片之间宜采用金属环垫

圈焊接在两端法兰面上的密封措施。

6.4.6 可燃气体压缩机、液化烃和可燃液体泵不得使用带传动；在爆炸性环境区域范围内的其他转动设备必须使用传动带时，应采用防静电传动带。

7 储运设施

7.1 煤 储 运

7.1.1 露天储煤场煤堆应按煤种分堆储存,相邻煤堆底边之间的距离不应小于10m。

7.1.2 当采用翻车机、卸车机、斗轮机等机械卸煤时,宜选用在设备本体的落煤点处带有喷雾装置的机型。若设备本体的落煤点处未带喷雾装置,设计应考虑在落煤点设置降尘设施。

7.1.3 储煤库应采取下列措施:

- 1 采用自然通风;
- 2 设置喷水装置或降低煤尘设施;
- 3 设置温度检测报警设施;
- 4 设置电视监视系统;
- 5 地下廊道内电气设备应选用防爆型。

7.1.4 采用筒仓储煤时,应符合下列规定:

1 筒仓的数量及单仓的容积,应根据用煤的煤种类型、煤质、用煤量及煤储运系统出力等条件确定;宜采用通过式先进先出布置;

2 筒仓的排料设备,筒仓排料口的形式、数量、尺寸、漏斗壁倾角和筒仓的高径比等参数,应根据煤种的颗粒组成、流动性和设计的流动形式等条件确定;筒仓下部锥体部分应光滑耐磨,避免有突出或凹陷的部位;必要时可增加耐磨衬板或设置必要的防堵设施;

3 设置性能可靠、能连续测量的料位计,并应具有高位、低位和高高位报警装置,高位信号应与进煤带式输送机联锁;

- 4 设置防爆门;

5 每个筒仓顶部应设置除尘设施,除尘设施如有尾气排出时应引至室外;

6 每个筒仓应设置温度、烟气和可燃气体检测报警设施,其显示器应集中设置在控制室;

7 设置防止筒仓下部空气侵入的设施;

8 储存褐煤或易自燃的高挥发分煤的筒仓,电气设备应选用防爆型;

9 储存褐煤或易自燃的高挥发分煤时,宜采取惰化保护措施;

10 严寒和寒冷地区的筒仓,其漏斗部分应采取防冻保温措施。

7.1.5 煤储运系统应采取下列措施:

1 金属煤斗及各转运点落煤管的连接处应加填料密封,并应采取防撒落和防积聚措施;

2 带式输送机应设置安全防护设施;

3 运输褐煤或易自燃的高挥发分煤种时,应采用难燃输送带,导料槽的防尘密封条应采用难燃材料,落煤管的内衬应采用不燃材料;

4 输送褐煤或易自燃的高挥发分煤种的栈桥内,从储煤设施取煤的第一条带式输送机上,应设置明火煤监测装置;当监测到明火时,应有禁止明火进入后续运煤系统的措施;

5 当转运点落差大于4m时,落煤管出口处宜增设缓冲锁气器、缓冲滚筒或缓冲煤斗;

6 煤的破碎应选用鼓风量较小的破碎机,破碎机应设置风量调节装置;破碎机入料、排料处应设除尘设施;破碎机入料口前应设置除铁器;

7 筒仓顶当采用犁式卸料器卸煤时,其卸料器应设置锁气挡板;

8 当采用移动带式输送机或卸料车卸煤时,应有落煤口的密

封措施。

7.1.6 煤储运系统应设置事故紧急停车装置。

7.1.7 煤储运系统的各转运站、破碎筛分楼、翻车机室、卸煤装置、储煤设施各扬尘点，应设置水喷雾降尘或机械除尘设施。卸煤装置地下室与运煤地下廊道内应设置可燃气体检测报警装置。

7.1.8 运煤栈桥、运煤隧道、地下卸煤沟、转运站、碎煤筛分楼、筒仓上部输煤间等煤储运系统各建筑的地面，应采用水力清扫，且设备布置及有关工艺、建筑的设计应满足冲洗的要求，并应有沉淀回收细煤和冲洗水的设施。

7.1.9 煤储运系统采用电除尘器时，与电除尘器配套的电机应选用防爆型。当煤质干燥无灰基挥发分大于或等于 46% 时，不应采用高压静电除尘器。

7.2 可燃液体、可燃气体地上储罐

7.2.1 可燃气体、助燃气体、液化烃和可燃液体的储罐应采用钢罐，并应符合下列规定：

1 浮顶储罐单罐容积不应大于 150000m^3 ；

2 固定顶和储存甲_B、乙_A类可燃液体的内浮顶储罐直径不应大于 48m；

3 储罐罐壁高度不应超过 24m；

4 容积大于或等于 50000m^3 的浮顶储罐应设置两个上罐的通道并应采用斜梯或盘梯，罐顶应设双平台；

5 储罐的基础、支撑及管架（墩）应采用不燃材料；

6 液化烃、可燃液体储罐的外保温层应采用不燃材料。

7.2.2 储存沸点低于 45°C 或真实蒸气压不小于 76.6kPa 的甲_B类液体，应选用压力储罐、低压储罐或降温常压储罐，并应符合下列规定：

1 选用压力储罐或低压储罐时，应设置氮气密封保护系统，并应密闭回收处理罐内排出的气体；

2 选用降温常压储罐时,应控制储存温度低于液体闪点5℃及以下,并应设置氮气密封保护系统。

7.2.3 储存沸点不低于45℃或真实蒸气压小于76.6kPa的甲_B、乙_A类液体,应选用浮顶罐或内浮顶罐。当甲_B、乙_A类液体因特殊储存要求采用固定顶罐、低压储罐和容积大于50m³的卧式储罐时,应采取下列措施之一:

- 1 设置氮气密封保护系统,密闭回收处理罐内排出的气体;
- 2 控制储存温度低于液体闪点5℃及以下;
- 3 其他安全措施。

7.2.4 储存乙_B和丙类液体可选用浮顶罐、内浮顶罐或固定顶罐。

7.2.5 容量不大于100m³的储罐可选用卧式储罐。

7.2.6 浮顶储罐和内浮顶储罐的浮顶选用应符合下列规定:

1 单罐容积大于或等于50000m³的浮顶储罐应采用钢制双盘式浮顶;

2 当单罐容积大于5000m³的内浮顶储罐储存甲_B、乙_A类液体时,应采用钢质单盘或双盘式浮顶;

3 当单罐容积小于或等于5000m³的内浮顶储罐储存甲_B、乙_A类液体且采用易熔材料制作的浮盘时,应采取氮气密封保护等安全措施。

7.2.7 储存毒性为高度和极度危害的甲_B、乙_A类液体的内浮顶储罐,储存温度超过120℃的重油固定顶罐应设置氮气密封保护系统。

7.2.8 多雷和强雷地区单罐容积大于或等于50000m³的浮顶储罐的一次、二次密封之间应采取下列措施之一:

- 1 设置氮气密封保护系统;
- 2 向一次、二次密封之间的空间充填软体不燃或难燃材料。

7.2.9 罐组的总容积应符合下列规定:

- 1 浮顶罐组的总容积不应大于600000m³;
- 2 采用钢制单盘或双盘的内浮顶罐组总容积不应大

于 360000m^3 ；

3 固定顶罐组的总容积不应大于 120000m^3 ；

4 固定顶罐和浮顶、内浮顶罐的混合罐组的总容积不应大于 120000m^3 ；

5 固定顶罐和浮顶、内浮顶罐的混合罐组中浮顶、内浮顶罐的容积可折半计算。

7.2.10 罐组内储罐的个数应符合下列规定：

1 单罐容积大于 50000m^3 的储罐个数不应多于 4 个；

2 单罐容积大于 10000m^3 且不大于 50000m^3 的储罐个数不应多于 12 个；

3 单罐容积小于 10000m^3 的储罐个数不应多于 16 个；

4 单罐容积均小于 1000m^3 储罐以及丙_B类液体储罐的个数不受限制。

7.2.11 甲_B类液体的压力储罐应独立成组布置，其罐组的总容积不应大于 60000m^3 ，罐组内的储罐数量不应大于 12 座。

7.2.12 可燃液体储罐罐组应设置防火堤，并应符合下列规定：

1 防火堤应能承受所容纳液体的静压及温度变化的影响，且不应渗漏；

2 防火堤应采用不燃材料，其耐火极限不得小于 5.50h；

3 常压罐组、低压罐组、甲_B类液体的压力储罐罐组，其防火堤的有效容积不应小于罐组内 1 个最大储罐的容积；

4 立式储罐防火堤的高度应为计算高度加 0.2m，且不应低于 1.0m(以堤内设计地坪标计)，不宜高于 3.2m(以防火堤外侧设计地坪或消防车道路面较低者计)；卧式储罐防火堤的高度不应低于 0.5m(以堤内设计地坪标计)；

5 高度大于 2.2m 的防火堤应设消防操作平台，操作平台面积不宜小于 $2.0\text{m} \times 2.0\text{m}$ ，操作面宜与防火堤顶面齐平，2 个消防操作平台的间距不宜大于 30m。

7.2.13 设有防火堤的罐组内应按下列要求设置隔堤和围堰：

- 1 单罐容积大于 20000m^3 的储罐,应每个罐一隔;
- 2 单罐容积大于 5000m^3 且不大于 20000m^3 的储罐,隔堤内的储罐不应超过 4 个;对于甲_B、乙_A类可燃液体储罐,储罐之间还应设置高度不低于 300mm 的围堰;
- 3 单罐容积小于或等于 5000m^3 的储罐,隔堤所分隔的储罐容积之和不应大于 20000m^3 ;
- 4 隔堤所分隔的沸溢性液体储罐不应超过 2 个;
- 5 卧式储罐组内隔堤高度不应低于 0.3m,其他储罐组内隔堤高度不应低于 0.5m,隔堤和围堰应采用不燃烧实体墙;
- 6 围堰与雨水排放明沟交叉处,可设置常开截断装置,该装置在罐组地面发生火灾情况下应能自动关闭。

7.2.14 工艺流程设置应避免甲类和乙_A类液体(如轻污油)进入丙类液体储罐。

7.2.15 储存温度高于 90℃ 的储罐宜单独布置。当与储存温度低于或等于 90℃ 的储罐同组布置时,两者之间应设置隔堤,隔堤顶面标高应比防火堤顶面的标高低 0.2m~0.3m。

7.2.16 立式储罐至防火堤内堤脚线的距离不应小于罐壁高度的一半,卧式储罐和储存甲_B类液体的压力储罐至防火堤内堤脚线的距离不应小于 3m。

7.2.17 当相邻罐组之间不设置消防车道时,相邻罐组防火堤的外堤脚线之间应设置宽度不小于 7m 的消防空地。

7.2.18 甲_B、乙类液体的固定顶罐通向大气的通气管上应设置阻火器和呼吸阀,采用氮气或其他惰性气体密封保护的储罐应增设泄压装置。

7.2.19 常压固定顶罐应采取泄压措施,罐顶与罐壁之间应采用弱连接结构。

7.2.20 可燃液体的设计储存温度应符合下列规定:

- 1 甲_B、乙_A类液体的储存温度不应高于 40℃;
- 2 乙_B和丙类液体的储存温度宜低于其闪点 5℃ 及以下;

3 沸溢性液体的储存温度应避免位于 91℃~119℃区间。

7.2.21 固定顶罐内的乙_B和丙类液体的储存温度,高于本标准第 7.2.20 条第 1、2 款规定的设计储存温度时,应采取氮封保护措施,且应密闭回收处理罐内排出的气体。

7.2.22 设置蒸汽加热器的储罐应采取温度控制措施。

7.2.23 可燃液体的储罐应设置温度计、液位计和高液位报警器。温度计和液位计的测量参数信号应远传至控制室。

7.2.24 可燃液体地上储罐的其他防火要求及液化烃和液氨及其他可燃、助燃气体的储存、装卸、灌装设施的设计,应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

8 管道布置

8.0.1 蒸气和热水管道不得与可燃液体、可燃气体、液化烃的管道敷设在同一条管沟内。

8.0.2 埋地敷设的蒸气和热水管道,与埋地敷设的甲、乙类液体管道、可燃气体管道的净距,平行敷设时,不应小于1.0m;交叉敷设时,不应小于0.25m。

8.0.3 输送可燃介质的埋地管道不宜穿越电缆沟,如必须穿越时,热管道应设在电缆之上,其他管道均应设置在电缆之下,同时应设置套管。当管道介质温度超过60℃时,在套管内应充填隔热材料,使套管外壁温度不超过60℃。套管伸出电缆沟外壁的距离不应小于0.5m。

8.0.4 输送油煤浆、水煤浆、液态油渣等含固体物料管道的布置应符合下列规定:

- 1 管道应尽可能短、少拐弯、不出现死角;
- 2 支管与主管的连接应顺应物料流向斜接,夹角不宜大于45°;
- 3 管道上弯管的弯曲半径宜大于或等于管道公称直径的4倍;
- 4 管道中间不宜有低点;管道上的低点倒淋管管径不宜小于DN50,宜水平(最好切线)接出,且根部阀宜靠近主管布置;
- 5 管道宜选择耐磨材料或采取耐磨措施;
- 6 管道上的冲洗点宜靠近被冲洗的装置,且根部阀宜靠近主管布置。

8.0.5 加热炉燃料气管道应采取下列保护措施之一:

- 1 设置低压自动保护仪表,低压自动保护仪表应具有当压力降到0.1MPa(g)时能发出声光报警,当压力降到0.05MPa(g)时能自动关闭燃料气管道阀门的功能;

2 在每个燃料气调节阀与加热炉之间设置管道阻火器，管道阻火器的选用和安装应符合现行行业标准《石油化工石油气管道阻火器选用、检验及验收标准》SH/T 3413 的规定。

8.0.6 与甲_B和乙_A类可燃液体立式储罐连接的液体管道上设置的阀门应符合下列规定：

1 阀门数量不应少于 2 个；

2 储罐进出料管道应设 1 个可远控操作的切断阀，进料管道上的该切断阀应与储罐高高液位报警装置自动联锁关闭；

3 当罐根阀设置为可远控操作的切断阀时，该切断阀与工艺操作阀之间的管道上不宜设置金属软管。

8.0.7 与液化烃储罐连接的液体管道上设置的阀门不应少于 2 个，并应符合下列规定：

1 液化烃进出料管道距储罐最近的阀门应设置为紧急切断阀，其执行机构应有故障安全保障措施，该阀应与储罐高高液位报警装置自动联锁关闭；

2 液化烃储罐不设二次自动脱水罐时，脱水管道上的最后一道阀门应采用弹簧快关阀；

3 液化烃储罐底部的进出料管道应采用柔性连接方式，并应满足抗震和防止储罐沉降的要求，柔性连接不宜采用金属软管。

8.0.8 除可燃气体放空管道外，进、出装置和储罐区的可燃液体、液化烃、可燃气体管道，应在装置和储罐区的边界处设置隔断阀与 8 字盲板；储罐区边界处的隔断阀应设置在防火堤外。

8.0.9 可燃液体储罐和设备进出液体物料管道上设置的遥控阀应具有快速手动开关功能。

8.0.10 可燃液体管道洞应采用不燃材料填实。

8.0.11 厂区管线综合、工艺管道、公用工程管道和含可燃液体的生产污水管道的布置，除本标准另有规定外，应符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定。

9 消防给水排水、灭火设施和消防站

9.1 一般规定

9.1.1 煤化工工厂的消防给水系统应统一规划,消防水源应有可靠保证。

煤化工工厂的装置区、储运区、动力及公用工程设施区、辅助设施区应设置独立的高压或稳高压消防给水系统。稳高压消防给水系统宜采用稳压泵维持系统压力大于或等于0.7MPa。

丁、戊类辅助设施区和生产管理区可采用低压消防给水系统,消防给水压力应确保灭火时最不利点室外消火栓的水压不低于0.25MPa。低压消防给水系统可与煤化工工厂生产给水系统合并。

9.1.2 除本标准另有规定外,消防给水系统的设计应执行现行国家标准《消防给水及消火栓系统技术规范》GB 50974的有关规定。

9.1.3 本标准未做规定的室内外灭火、冷却设施的设计,应按现行国家标准《石油化工企业设计防火标准》GB 50160的有关规定执行。

9.1.4 煤化工工厂内各类建筑和设施的灭火器配置,应符合现行国家标准《石油化工企业设计防火标准》GB 50160和《建筑灭火器配置设计规范》GB 50140等标准的有关规定。

9.2 消防设计流量和用水量

9.2.1 煤化工工厂的高压和稳高压消防给水系统的设计用水量应按装置区、储罐区一次火灾消防用水量最大者与动力及公用工程设施区、辅助设施区一次火灾消防用水量最大者之和计算确定。符合本标准第9.1.1条的低压消防给水系统的设计用水量应按其

保护范围内需水量最大的建筑确定。

9.2.2 大型煤化工工厂应设置不少于2套独立分区供水的高压或稳高压消防给水系统,且应符合下列规定:

1 每套消防给水系统的最大保护半径不宜超过1200m;

2 每套消防给水系统应根据其保护范围及保护对象,按本标准第9.2.1条的规定确定消防用水量;

3 分区独立设置的相邻消防给水系统管网之间应设不少于2根带切断阀的连通管,并应满足当其中一个分区发生故障时,相邻分区能够提供100%消防供水量。

9.2.3 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备、煤直接液化催化剂制备的厂房和煤储运系统建筑的消防设计流量,应按室内外消防设施的设计流量之和计算确定。室外消火栓系统的设计流量不应小于表9.2.3的规定,火灾延续时间不应小于3.00h。

表9.2.3 室外消火栓系统的设计流量

名称		备煤		设计流量(L/s)	
煤直接液化	煤粉制备	原煤处理量 (t/d)	≤ 3000	20	
			$3000 < V \leq 6000$	30	
			> 6000	60	
			≤ 3000	25	
	油煤浆制备		$3000 < V \leq 6000$	35	
			> 6000	70	
			≤ 3000	20	
			$3000 < V \leq 6000$	30	
	煤直接液化 催化剂制备		> 6000	60	
			≤ 3000	25	
			$3000 < V \leq 6000$	35	
			> 6000	70	
水煤浆气化	煤气化		≤ 3000	25	
			$3000 < V \leq 6000$	35	
			> 6000	70	

续表 9.2.3

名称		备煤		设计流量(L/s)	
水煤浆气化	水煤浆制备	原煤处理量 (t/d)	≤ 3000	15	
			$3000 < V \leq 6000$	25	
			> 6000	50	
			≤ 6000	10	
			> 6000	20	
	工艺水处理		≤ 3000	25	
			$3000 < V \leq 6000$	35	
			> 6000	70	
			≤ 3000	25	
			$3000 < V \leq 6000$	30	
碎煤气化	煤气化		> 6000	70	
			≤ 6000	10	
			> 6000	20	
			≤ 3000	15	
	工艺水处理、 煤锁气压缩		$3000 < V \leq 10000$	20	
			$10000 < V \leq 30000$	25	
			> 30000	30	
			≤ 80	30	
筒仓(单座)、干煤棚、 露天储煤场、储煤库 (不含圆形煤库)		直径 D(m)	$80 < D \leq 120$	40	
圆形煤库(单座)			15		
运煤栈桥、转运站、 筛分破碎室、翻车机房					

注：当煤粉制备厂房与煤直接液化或粉煤气化厂房合建时，其室外消火栓系统设计流量应叠加计算。

9.2.4 装置区、储运区、公用工程设施区、辅助设施区的消防设计流量，应按照现行国家标准《石油化工企业设计防火标准》GB 50160

的有关规定确定。

9.2.5 自备热电站、变电站的消防设计流量,应按现行国家标准《火力发电厂与变电站设计防火标准》GB 50229 的有关规定确定。

9.2.6 生产管理区的消防设计流量,应按现行国家标准《消防给水及消火栓系统技术规范》GB 50974 的有关规定确定。

9.2.7 大型、中型煤化工工厂消防储水量,在满足本标准要求的消防设计用水量的基础上,尚应增加不小于 10000m^3 的用于消防车取水的备用消防储水量。符合下列条件时,备用消防储水量可减去相应的有效储水量:

1 当工厂设有 3 套及以上高压或稳高压消防给水系统,且给水系统之间消防管网互联互通时;

2 当临近天然水源或工厂之间消防管网互联互通时。

9.3 消防水源和消防泵

9.3.1 当消防给水由煤化工工厂水源直接供给时,工厂生产给水管网的进水管不应少于 2 条,且每条均应能满足火灾延续时间内 100% 的消防给水设计流量和 70% 的生产给水设计流量的要求。生产给水设计流量应按最大小时用水量计算,消防给水设计流量应按最大秒流量计算。

9.3.2 当煤化工工厂水源直接供给不能满足消防用水量、水压和火灾延续时间内消防用水总量要求时,应建消防水池(罐),并应符合下列规定:

1 水池(罐)的容量应满足火灾延续时间内消防用水总量的要求;当发生火灾能保证向水池(罐)连续补水时,其容量可减去火灾延续时间内的补充水量;

2 水池(罐)的总容量大于 1000m^3 时,应设置能独立使用的 2 座(格)消防水池(罐),并设带切断阀的连通管;

3 水池(罐)的补水时间,不宜大于 48h,当水池(罐)有效总容积大于 2000m^3 时,不应大于 96h;

4 当消防水池(罐)与生活或生产水池(罐)合建时,应有消防用水不作他用的措施;

5 严寒和寒冷地区应设防冻措施;

6 消防水池(罐)应设液位检测、高低液位报警及自动补水设施。

9.3.3 消防水泵应远离爆炸危险源,并宜布置在地上;消防水池(罐)最低液位应满足水泵自灌引水要求。

9.3.4 消防水泵的吸水管、出水管应符合下列规定:

1 每台消防水泵宜有独立的吸水管;2台以上成组布置时,其吸水管不应少于2条,当其中1条检修时,其余吸水管应能确保吸取全部消防用水量;

2 成组布置的水泵,至少应有2条出水管与环状消防管道连接,两连接点间应设阀门;当1条出水管检修时,其余出水管应能输送全部消防用水量;

3 泵的吸水管上不应设置管道过滤器,出水管道应设防止超压的安全设施;

4 直径大于300mm的出水管道不应选用手动阀门;

5 进出口阀门的启闭应有明显标志;

6 埋地管道外防腐等级不应低于加强级,并应符合现行国家标准《给水排水管道工程施工及验收规范》GB 50268的有关规定。

9.3.5 消防水泵组的性能应满足消防给水系统所需流量和压力的要求,同一泵组的消防水泵型号宜一致,并应以室内外消防给水的最高水压校核消防水泵的工作工况。消防水泵的主泵应采用电动泵,备用泵应采用柴油机消防泵,且备用泵应按100%供水能力设置。

9.3.6 当全厂消防给水系统供水压力不能满足粉煤气化、油煤浆制备等高层厂房内消防系统最不利点消防设备的供水压力时,应设置区域消防给水增压泵,并应符合下列规定:

1 增压泵的供水能力应满足室内消防用水总量及压力要求;

增压泵的启动宜在火灾确认后远距离手动启动，并应具有现场启动功能，且泵、控制阀等工作状态及报警信号应能在消防控制室显示；

2 宜设置独立吸水池（罐），其容积应满足消防供水增压泵10min的供水水量；

3 消防补水应可靠，补水能力不应小于增压泵供水能力；系统应设置防水倒流的措施；

4 消防给水增压泵的主泵应采用电动泵，备用泵应采用柴油机泵，且备用泵应按100%供水能力设置；

5 不同消防系统的增压泵可合并设置，增压泵及系统控制阀均应布置在泵房内。

9.3.7 稳压泵的设计流量不应小于消防给水系统管网的正常泄漏量和系统自动启动流量。稳压泵的设计压力应满足煤气化等高层厂房室内消火栓系统最不利点消火栓的静水压力不低于0.15MPa。稳压泵应采用电动泵，并应设置备用泵；备用泵的供水能力应与主泵一致。

9.3.8 稳高压消防给水系统，其消防水泵应在接到报警后2min以内投入运行。消防水泵应依管网压降信号自动启动，多台消防泵应根据系统压力按程序依次启动，且应具备就地手动启动和远程手动启动功能。

9.3.9 煤化工工厂消防水泵站可采用安全可编程序控制器（PLC）独立控制，系统压力、水位及报警信号、水泵运行及控制阀启闭状态信号应实时显示并记录。

9.4 室外冷却、灭火设施

9.4.1 煤化工工厂生产区、公用和辅助生产设施区、生产管理区应设置室外消火栓。

9.4.2 室外消防给水管道的布置应符合下列规定：

1 装置区四周，高层厂房和高架仓库四周，可燃液体罐（组）、

液化烃罐(组)、液氨罐(组)、可燃(助燃)气体储罐(组)四周,占地面积大于 10000m^2 的露天储煤场、筒仓、储煤库和干煤棚,应沿消防车道边设置环状消防给水管道;其他厂房、仓库、煤储运系统建筑可沿消防车道边设置枝状消防给水管道;装置区内沿消防车道及检修道路设置的消防给水管道,应与其四周设置的消防给水管道连通,构成环状管网;

2 可燃液体、液化烃的火车和汽车装卸栈台,火炬区的消防给水管道可采用枝状管网;

3 独立设置的高压和稳高压消防给水环状管道应用阀门分成若干独立管段,每段内的消火栓数量不宜超过5个;与生产给水合用的低压消防给水管道上的每个消火栓前应设置切断阀;

4 消防给水干管的管径应经计算确定;对于独立消防给水管道,宜采用钢制管道,管道内的流速不宜大于 3.5m/s ,管径不应小于 200mm ;

5 消防给水管道应保持充水状态,地下的独立消防给水管道应埋设在冰冻线以下,严寒和寒冷地区管顶距冰冻线不应小于 150mm 。

9.4.3 室外消火栓的设置应符合下列规定:

1 消火栓距路面边不宜大于 5.0m ,距建筑物外墙不宜小于 2.0m ,距城市型道路路边不宜小于 1.0m ,距公路型双车道路肩边不宜小于 1.0m ;

2 宜采用地上式消火栓,其大口径出水口应面向道路;当采用地下式消火栓时应有明显标志;

3 可能受到车辆冲撞的地上式消火栓,应在其周围设置防护设施并应采用防撞型消防栓;

4 生产区、公用和辅助生产设施区内消火栓的间距不应大于 60m ;对于生产管理区,不应大于 120m ;

5 可燃液体、液化烃的火车和汽车装卸栈台,除沿消防车道边设置消火栓外,设有二层平台的火车装卸栈台,还宜在二层平台

设置消防软管卷盘；

6 大型煤化工工厂的主要装置区、罐区环形消防道路或救援场地宜设置工业专用的大流量消火栓。

9.4.4 煤化工工厂室外消防炮、水喷雾、泡沫等灭火设施的设置部位及选用的系统类型应符合表 9.4.4 的规定。

表 9.4.4 室外灭火设施的设置部位及选用的系统类型

设置部位	设置要求	选用的系统类型及要求
甲、乙类可燃气体、可燃液体设备的高大构架和设备群周围	应	固定消防水炮
甲、乙类可燃气体、可燃液体设备的高大构架和设备群周围消防水炮不能保护的特殊危险设备及场所	宜	水喷雾灭火系统
甲、乙类设备的构架平台	应	半固定式消防给水竖管，且沿梯子敷设
大型空分装置高压氧设备进出口法兰密封面及阀组区周围	宜	固定消防水炮
装置内加热炉、甲类气体压缩机、介质温度超过自燃点的泵及换热设备、长度小于 30m 的油泵房附近等位置	应	消防软管卷盘，其保护半径宜为 20m
液化烃泵、操作温度不低于自燃点的可燃液体泵	应	水喷雾灭火系统或固定消防水炮
煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备的高层厂房周围	应	固定消防水炮，且同时作用的消防水炮不应少于 2 门
单罐容积等于或大于 1000m ³ 的液化烃罐	应	水喷雾灭火系统和远控消防水炮，且同时作用的消防水炮不应少于 2 门

续表 9.4.4

设置部位	设置要求	选用的系统类型及要求
厂区单台容量在 $40\text{MV}\cdot\text{A}$ 及以上的油浸电力变压器及独立变电站单台容量在 $125\text{MV}\cdot\text{A}$ 及以上的总降压变电站油浸电力变压器	应	水喷雾灭火系统或泡沫喷雾灭火系统

注:沸点低于 45°C 的甲B类液体压力罐,其消防冷却水系统的设置应按液化烃全压力式储罐的要求设置,且罐区应配置用于扑救液体流散火灾的辅助泡沫枪,泡沫枪配置不应少于 3 支,每支泡沫混合液供给流量不应少于 $480\text{L}/\text{min}$ 。

9.4.5 固定消防水炮的设计应符合下列规定:

- 1 应具有直流和水雾两种喷射方式,出水量宜为 $30\text{L}/\text{s} \sim 50\text{L}/\text{s}$;
- 2 当地面消防炮的射流受到较高大障碍物的阻挡时,应设置消防炮塔或消防炮平台,并宜选用远控消防水炮;
- 3 地面安装的手动消防水炮设置位置距保护对象不应小于 15m ,远控消防水炮的控制阀设置位置距保护对象不宜小于 15m ;
- 4 远控消防水炮同一根供水立管上布置的水炮不应超过 2 门;
- 5 单罐容积等于或大于 1000m^3 的液化烃罐区设置的消防水炮,每门消防水炮的设计流量不应小于 $40\text{L}/\text{s}$ 。

9.4.6 采用独立的稳高压消防给水系统供水的煤化工工厂,其室外设置的水喷雾灭火系统,应在系统控制阀后设置半固定接口,管径不应小于 $\text{DN}80$ 。

9.5 室内冷却、灭火设施

9.5.1 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备高层厂房和煤储运系统建筑应设置室内消火栓。

室内消火栓应配置直流水雾两用枪,系统设计流量不应小于

表 9.5.1 的规定,火灾延续时间不应小于 3.00h。

表 9.5.1 室内消火栓系统的设计流量(L/s)

名 称	原煤处理量(t/d)		
	≤ 3000	$3000 < V \leq 6000$	> 6000
运煤栈桥、转运站、筛分破碎楼、翻车机房	10		
煤粉制备	15	25	50
煤直接液化	油煤浆制备	20	30
	煤直接液化 催化剂制备	20	25
水煤浆气化	煤气化	40	40
	水煤浆制备	15	20
	工艺水处理	10	10
粉煤气化(含渣水处理)	40	40	40
碎煤加压气化	煤气化	40	40
	工艺水处理、 煤锁气压缩	10	10

9.5.2 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备高层厂房,其室内消火栓系统的消防给水竖管宜沿疏散楼梯布置,超过 10 个消火栓时应连成环状,管径不宜小于 150mm。

9.5.3 室内消火栓系统宜采用湿式系统。对于严寒和寒冷地区非采暖的厂房和仓库,冬季可采用干式系统,但应符合下列规定:

- 1 应具有管道快速充水措施,充水时间不应大于 2min;
- 2 应具有管道自动快速放空措施;
- 3 系统控制阀应采取防冻措施;
- 4 室内消火栓附近应设置火灾报警按钮,可联动启动系统控制阀。

9.5.4 室内消火栓的设置应符合下列规定：

- 1 宜采用减压稳压型消火栓；
- 2 室内消火栓栓口处静压大于 1.2MPa 时应分区供水；
- 3 宜采用直流水雾水枪，直流水枪充实水柱不宜小于 13m；
- 4 应按自然楼层设置消火栓，布置间距不应大于 30m。

9.5.5 室内其他冷却、灭火设施的设置部位及选用的系统类型应符合表 9.5.5 的规定。

表 9.5.5 室内其他冷却、灭火设施的设置部位及选用的系统类型

设置部位	设置要求	选用的系统类型
无耐火保护的封闭式钢结构运煤栈桥，输送褐煤和易自燃的高挥发分煤的封闭式运煤栈桥	应	自动喷水灭火系统或水喷雾灭火系统
筒仓顶部运煤输送机通廊，褐煤和易自燃的高挥发分煤的磨煤工段顶部输送机通廊	宜	雨淋灭火系统或水喷雾灭火系统
输送褐煤和易自燃的高挥发分煤的运煤地下廊道的封闭段	应	防火分隔水幕系统
输送褐煤和易自燃的高挥发分煤的下述部位：封闭式运煤栈桥与运煤地下廊道、转运站、筒仓、圆形煤库、筛分破碎室、煤气化、煤粉制备、水煤浆制备厂房连接处的洞口，厂外长距离的运煤栈桥在进入厂区处，超过 3000m ² 卸煤装置地下室与运煤地下廊道之间	应	
输送褐煤和易自燃的高挥发分煤的下述部位：敞开或半封闭的运煤栈桥与运煤地下廊道、筒仓、圆形煤库、筛分破碎室、煤气化、煤粉制备、水煤浆制备厂房连接处的洞口	宜	

续表 9.5.5

设置部位	设置要求	选用的系统类型
储煤库	应	固定消防水炮系统
粉煤气化厂房磨煤机	应	雨淋灭火系统或固定消防水炮系统
粉煤气化厂房循环压缩机、室内液化烃泵、操作温度不低于自燃点的可燃液体泵	应	水喷雾灭火系统或固定消防水炮系统
煤粉仓周围煤粉泄放区	应	雨淋灭火系统或远控消防水炮系统
总装机容量 $> 400 \text{ kV} \cdot \text{A}$ 的柴油发电机房	应	水喷雾、细水雾灭火系统，气体灭火系统或泡沫喷雾灭火系统
单台容量在 $40 \text{ MV} \cdot \text{A}$ 及以上的油浸电力变压器	应	水喷雾、细水雾灭火系统或泡沫喷雾灭火系统

- 注:1 煤储运系统建筑设置的自动喷水灭火系统,其设计火灾危险等级应按不低于中Ⅱ级确定;当采用闭式自动喷水灭火系统时,宜采用快速响应喷头;
- 2 固定消防水炮应具有水雾喷射功能,并应有效覆盖被保护对象。煤粉仓周围煤粉泄放区设置的固定消防水炮系统的设计流量不宜小于 20 L/s ,火灾延续时间不应小于 1.0 h ;储煤库内设置的固定消防水炮系统的设计流量不宜小于 30 L/s ,火灾延续时间不应小于 2.0 h ;粉煤气化厂房磨煤机和循环压缩机、室内液化烃泵、操作温度不低于自燃点的可燃液体泵场所设置的固定消防水炮系统设计流量不宜小于 40 L/s ,火灾延续时间不应小于 2.0 h ;
- 3 水喷雾灭火系统用于煤粉固体火灾时,设计喷雾强度不应小于 $15 \text{ L}/(\text{min} \cdot \text{m}^2)$;用于防护冷却,设计喷雾强度不应小于 $9 \text{ L}/(\text{min} \cdot \text{m}^2)$;
- 4 当粉煤气化厂房室外固定消防水炮的射流不受障碍物阻挡且能有效覆盖厂房内的磨煤机和循环压缩机时,其室内可不设置固定灭火系统。

9.5.6 大型、中型煤化工工厂生产区无人值守的仪表控制机柜间,宜设置自动气体灭火设施。

9.5.7 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备高层厂房和煤储运系统建筑设置的室内消火栓系统、自动喷水灭火系统、水喷雾灭火系统、固定消防水炮系

统,均应在系统控制阀后设置半固定接口,管径不应小于 DN80。

9.5.8 煤化工工厂内采用独立的稳高压消防给水系统供水的建筑物,可不设高位消防水箱。

9.6 消防站

9.6.1 大型、中型煤化工工厂应设置消防站。

9.6.2 消防站的等级应根据煤化工工厂的规模、火灾危险性、灭火剂用量、固定消防设施的设置情况、灭火时需要的装备类型,以及邻近单位消防协作条件等综合确定,并应符合下列规定:

1 消防车辆配置数量,对于大型煤化工工厂,不应低于表 9.6.2 中一级站的要求;对于中型煤化工工厂,不应低于表 9.6.2 中二级站的要求;

2 当消防站的服务范围不能满足本标准第 4.2.1 条第 11 款的规定时,应增设消防分站;厂区占地面积不小于 300hm^2 时,消防分站的消防车辆配置数量不应低于表 9.6.2 中二级站的要求;厂区占地面积小于 300hm^2 时,消防分站的消防车辆配置数量不应低于表 9.6.2 中三级站的要求;

3 消防站宜设置向消防车快速灌装泡沫液的设施;

4 消防站的消防通信指挥室应设置与全厂消防监控中心直通的电话机;

5 消防站应设置具有独立通信功能的无线通信系统。各类型消防车辆可配置无线通信车载台。

表 9.6.2 消防车辆配置要求

消防站等级		一级站	二级站	三级站
消防车配备数量(辆)		7~10	4~6	2~4
消防车种类	抢险救援消防车	1	1	
	供气消防车	1*	1*	
	供液消防车	1*	1*	1*
	泡沫消防车	1*	1*	1*

续表 9.6.2

消防站等级		一级站	二级站	三级站
消防车种类	干粉-泡沫联用消防车	1	1	1*
	举高喷射消防车($\geq 70m$)	1*	1*	
	举高喷射消防车(55m~65m)	1	1*	
	举高喷射消防车(18m~25m)	4	2+2*	2*

注:1 表中“*”表示可选配的车辆品种;

- 2 一级站宜配备不少于4门,二级站宜配备不少于2门,且流量不小于40L/s的远程遥控移动消防炮;
- 3 一级站的供液消防车泡沫液罐载液量不应低于18000kg,二级站不应低于12000kg;
- 4 抢险救援消防车宜选配石化型;大型煤化工工厂的二级消防分站,可将抢险救援消防车改配为其他类型消防车;
- 5 泡沫消防车载液量不应小于12000kg,其中泡沫罐载液量不应小于6000kg,水罐载水量不应小于6000kg,且应具备输转泡沫原液功能;当已建一级站的泡沫消防车数量为2辆~3辆时,18m~25m举高喷射消防车数量可相应减少1辆~2辆,但不应低于2辆;
- 6 干粉-泡沫联用消防车干粉罐载剂量不应低于3000kg,干粉炮喷射强度不应小于40kg/s,泡沫液罐载液量不应低于2000kg,泡沫炮喷射流量不应小于48L/s;
- 7 车载泡沫比例混合器应采用自动泡沫比例混合器,运输蛋白、氟蛋白泡沫原液的供液消防车应具备泡沫液搅拌功能,防止沉降;
- 8 举高喷射消防车配备的消防泵额定流量不应小于100L/s,臂架上配备的消防炮额定流量不应小于80L/s;
- 9 大型工厂一级站、中型工厂二级站的18m~25m举高喷射消防车泡沫罐载液量,应按工厂最大储罐全液面火灾、连续供液不低于30min所需泡沫液用量的25%~50%确定,泡沫罐载液量应按最大10000kg计,水罐载液量不应低于泡沫罐载液量;
- 10 煤制天然气和合成氨工厂可根据需要将供液消防车或泡沫消防车改配为总载液量不小于12000kg的水罐消防车。储存液化天然气的工厂,水罐消防车还应配备桶装高倍数泡沫灭火剂;
- 11 根据煤化工工厂所在地区的自然条件及煤化工工厂特点,可在本表基础上增减和选配车辆类型。

9.6.3 消防站主要消防车辆的技术性能及灭火器材配备应符合下列规定：

1 一级站不应低于《城市消防站建设标准》建标 152 有关特勤站的要求；

2 二级站不应低于《城市消防站建设标准》建标 152 有关一级普通消防站的要求。

9.6.4 消防站配备的个人防护装备、器材应满足现场灭火、有毒有害气体防护、侦检、破拆、堵漏、供气、医疗救护、环境监测等实际需求。个人防护用品宜按现行行业标准《消防员个人防护装备配备标准》GA 621 的相关标准配备。

9.6.5 消防站应配备防火勘察检查器材和火灾原因调查专用器材，配备照相机、摄像机等火场影像摄录器材。

9.6.6 消防站灭火剂的储量宜按照不低于车载泡沫灭火剂总量 1:1 的比例储存。大型、中型煤制油工厂固定泡沫灭火系统和消防站的泡沫灭火剂总储存量不应少于 100m^3 ；当区域有依托条件时，工厂内的泡沫储存量与区域可依托的泡沫量之和不应小于 100m^3 。泡沫灭火剂总储存量应同时考虑抗溶性和非抗溶性泡沫灭火剂储备比例。

9.7 消 防 排 水

9.7.1 煤化工工厂应设置消防排水收集设施。

9.7.2 消防排水宜利用煤化工工厂生产污水系统、雨水系统收集，并应符合下列规定：

1 当利用煤化工工厂生产污水系统、雨水系统收集消防排水时，应按最大设计消防水量校核排水系统收集能力；

2 含有可燃液体的消防排水收集管道应在装置或单元出口设置水封，其水封高度不应小于 250mm 。

9.7.3 设有水消防设施的卸煤装置地下室和运煤地下廊道应设置消防排水设施。

9.7.4 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备高层厂房应设置消防排水收集设施。

10 电 气

10.1 消防电源及配电

10.1.1 大型、中型煤化工工厂的消防用电,应按一级负荷供电。消防电源的负荷分级应符合现行国家标准《供配电系统设计规范》GB 50052 的有关规定。

10.1.2 煤化工工厂消防配电线应具有满足火灾时连续输电的可靠性设计。

全厂消防监控中心、区域消防控制室、消防水泵和泡沫消防水泵、防烟与排烟风机、消防电梯等重要的低压用电消防设备的配电线,应在其最末一级配电箱处设置自动切换装置。

10.1.3 消防用电设备应采用专用的供电回路,其配电设备应有明显标志。当生产、生活用电被切断时,应仍能保证消防用电。

10.1.4 设置在爆炸性环境区域范围内的火灾报警、消防应急照明、疏散指示标志等消防设施,应满足现行国家标准《爆炸危险环境电力装置设计规范》GB 50058 的规定。

10.1.5 腐蚀性介质场所的消防配电线及其配管,应采取相应的防腐蚀措施。

10.2 电 气 装 置

10.2.1 煤粉仓泄爆口的外部区域,宜按爆炸性粉尘环境 22 区划分,其范围宜按泄爆口周围 3m 的距离且垂直向下延至地面或楼板水平面确定。

10.2.2 在爆炸性气体和爆炸性粉尘同时存在的环境,电气装置的设计应同时符合爆炸性气体环境和爆炸性粉尘环境相关标准的规定。

10.2.3 电力电缆、通信线缆等与可燃液体管道、可燃气体管道或煤粉管道不应敷设在同一管沟内。

10.2.4 在可能散发比空气重的可燃气体、可燃粉尘或可燃液体泄漏场所及其周围 30m 范围内的电缆沟、通信线缆沟等，应采取防止可燃气体和可燃粉尘积聚、可燃液体和含可燃液体的污水进入的措施。

10.3 火灾自动报警系统

10.3.1 煤化工工厂应设置火灾自动报警系统，火灾自动报警系统应全厂统一规划。

10.3.2 煤化工工厂应设置全厂消防监控中心。全厂消防监控中心宜与全厂性生产调度中心合并设置。全厂消防监控中心应满足全厂的消防管理、监控和指挥的要求，应设置具有全厂火灾监视、火警受理与通信、消防设施运行状态实时监控、消防通信指挥与消防安全管理信息查询功能的设施。

全厂消防监控中心应设置在建筑物一层或二层靠近安全出口的位置。

10.3.3 煤化工工厂可设置区域消防控制室，区域消防控制室可与其他生产操作岗位用房合建。区域消防控制室应满足本辖区的消防管理、监控和指挥的要求，应设置具有全厂火灾监视和本辖区火警受理、消防设施运行状态实时监控功能的设施。

10.3.4 需要远程控制的固定灭火系统应采用专用线路直接连接至全厂消防监控中心或区域消防控制室的消防联动控制器手动控制盘。直接连接的固定灭火系统远程控制专用线路的电压可采用 DC24V 或 AC220V。

当固定灭火系统由区域消防控制室实施远程手动控制时，宜在全厂消防监控中心设置对应的手动控制装置对其实施控制。

10.3.5 火灾自动报警系统的设计应符合下列规定：

1 煤化工工厂火灾自动报警系统联网方式应采用对等网络

结构；

2 全厂消防监控中心和区域消防控制室应设置接收全厂火灾报警信息的火灾报警控制器和消防信息图形显示设施；消防站通信室、总变配电所及其他与消防管理有关的值班岗位应设置接收全厂火灾报警信息的火灾报警控制器或消防控制中心图形显示装置；

3 区域火灾报警控制器应按装置或单元分区设置在非爆炸危险环境建筑物内，当建筑物内火灾报警触发装置超过 60 点时，宜设置区域火灾报警控制器；

4 控制固定灭火系统的消防联动控制器，应设置在全厂消防监控中心或区域消防控制室，其他消防联动控制器可设置在操作室或值班室等有人职守的房间；

5 火灾自动报警系统应采用专用线路，并应具有线路故障侦测功能；系统的线路应保障所连接设备在工作时段功能正常；

6 不同建筑物内的火灾报警控制器、消防联动控制器、消防控制中心图形显示装置间应采用光纤连接，并应采用环状连接结构；

7 火灾自动报警系统的设置场所及火灾探测器选型应符合附录 A 的规定；

8 系统中各类设备之间的接口和通信协议的兼容性应符合现行国家标准《火灾自动报警系统组件兼容性要求》GB 22134、《消防联动控制系统》GB 16806 的规定；

9 火灾自动报警系统应设置警报装置；当生产区有扩音对讲系统时，可兼作警报装置，未设置扩音对讲系统的区域应设置声光警报器；

10 火灾自动报警系统应具备向电视监视系统发送联动控制信号的功能，火灾报警时联动电视监视系统摄取报警区域的图像，火灾自动报警系统可接收电视监视系统的报警信息；

11 设有火灾自动报警系统的区域和作业人员集中的场所应设置消防应急广播，当使用扩音对讲或公共广播系统用于消防应急广播时，应能在全厂消防监控中心或/及区域消防控制室自动或

手动将其切换至消防应急广播状态。

10.3.6 甲、乙类装置内及装置区周围,甲、乙类储罐组四周的道路边,应设置手动火灾报警按钮。甲、乙类装置区周围和储罐组四周的道路边的手动火灾报警按钮间距不应大于100m;甲、乙类装置内手动火灾报警按钮宜设置在重要设备旁及巡检路线附近,地面设置时,应保证任何位置到最近的手动火灾报警按钮的距离不大于50m,其他场所设置的手动火灾报警按钮距离应符合相关标准的规定。

10.3.7 全厂消防监控中心应设置可燃气体探测报警系统报警和故障信息显示终端,区域消防控制室等与消防管理有关的值班岗位可设置可燃气体探测报警系统的报警和故障信息显示终端。当可燃气体的报警信号需接入火灾自动报警系统时,应由可燃气体探测报警控制器接入火灾自动报警系统,并应由接收全厂火灾报警信息的火灾报警控制器显示。

10.3.8 全厂消防监控中心、区域消防控制室、消防站、总变配电站等需要了解现场情况的消防管理岗位应设置电视监视系统监视终端,并在报警时联动显示报警区域图像。全厂消防监控中心、区域消防控制室、消防站通信室等需要移动通信的消防管理岗位应设置无线通信终端。

10.3.9 消防控制中心图形显示装置等未配套符合相关国家标准要求的备用电源时,应采用不间断型消防设备应急电源供电。消防设备应急电源的备电容量应保证在火灾状态时系统负荷同时工作条件下不间断供电时间大于或等于3.0h。电源的输出功率应大于系统全负荷功率的120%。

10.3.10 煤化工工厂火灾自动报警系统的设置尚应符合现行行业标准《石油化工企业电信设计标准》SH/T 3153的相关要求。

10.4 火灾电话报警系统

10.4.1 煤化工工厂应设置火灾电话报警系统,火灾电话报警系

统应全厂统一规划。火灾电话报警应具有专用号报警和全厂消防监控中心与消防管理岗位间直通联系的功能,火灾电话报警的设计应符合下列规定:

1 全厂消防监控中心应设置可受理不少于2处同时报警的火灾受警录音电话和与当地主管部门联系的电话机;

2 全厂消防监控中心应与区域消防控制室、消防站、消防加压泵站、泡沫站、总变配电所及其他与消防管理有关的值班岗位建立具有录音功能的直通电话联系;当全厂消防监控中心的火灾受警电话与直通电话之和超过4台时,应设置具有录音功能的按键式双手柄消防调度台,消防调度台宜具有多方接听功能;

3 火灾电话报警系统中消防管理岗位间的直通电话应具有线路故障和电话脱机侦测功能;当生产调度电话系统的技术指标满足火灾电话报警系统要求时,火灾电话报警系统可与生产调度电话系统合并设置;

4 工厂的火灾电话报警系统可替代消防专用电话系统用于工厂的电话专用号报警、消防直通电话报警和消防通信指挥;

5 工厂的无线通信系统宜与火灾电话报警系统联网,并应具有无线通信终端向火灾电话报警系统报警的功能。

10.4.2 煤化工工厂火灾电话报警系统的设计尚应符合现行行业标准《石油化工企业电信设计标准》SH/T 3153的相关要求。

10.5 消防应急照明和疏散指示系统

10.5.1 下列场所或部位应设置消防应急灯具:

1 电气控制室、仪表室和液压润滑油站(库);

2 全厂消防监控中心、区域消防控制室、生产调度中心、中央控制室、消防水泵房、变配电室、防排烟机房、自备电源室(包括发电机房、UPS室和蓄电池室等)、通信机房、大中型电子计算机房等发生火灾时仍需正常工作的房间;

3 疏散楼梯(间)、防烟楼梯间前室、消防电梯间的前室或合

用前室,建筑内长度大于 10m 的疏散走道。

10.5.2 火灾发生时需正常工作的房间,其消防应急照明灯具应保证正常照明的照度,连续供电时间应满足火灾时工作的需要,且不应少于 2.0h。

疏散用消防应急照明灯具的地面水平最低照度值不应低于 1.0 lx,消防应急照明灯具和疏散指示标志灯具的蓄电池连续供电时间不应少于 30min。

10.5.3 设置消防疏散指示标志的场所,应采用灯光型疏散指示标志。

10.5.4 消防应急照明和疏散指示系统的设计,除应符合本标准的规定外,还应符合现行国家标准《消防应急照明和疏散指示系统技术标准》GB 51309 的规定。

10.6 防雷和防静电

10.6.1 煤化工装置及其辅助设施的防雷设计,应符合现行国家标准《石油化工装置防雷设计规范》GB 50650 等的规定。

10.6.2 煤化工工厂内存在静电引燃、引爆的危险场所,应采取静电防护措施。

附录 A 火灾自动报警系统的设置场所 及火灾探测器选型

表 A 火灾自动报警系统的设置场所及火灾探测器选型

火灾自动报警系统的设置场所		适用的火灾探测器种类
煤储运系统	转运站,碎煤机室,封闭式运煤栈桥,运煤地下廊道(封闭段),筒仓顶部运煤输送机通廊	缆式线型感温火灾探测器
	电缆夹层	缆式线型感温火灾探测器
	筒仓	可燃气体探测器和感烟火灾探测器
	储煤库	感温火灾探测器
生产装置	磨煤工段顶部输送机通廊、碎煤仓和煤粉仓	缆式线型感温火灾探测器
	煤气化装置:煤粉制备中干法磨煤、煤粉加压输送,煤气化、除渣、湿洗、煤气化的工艺水处理(闪蒸),碎煤气化工艺水处理(烃回收); 气体净化装置:一氧化碳变换、酸性气体脱除; 氢气提纯装置:氢气提纯、氢气压缩; 煤直接液化催化剂制备装置:煤粉制备、反应、过滤分离、储存和输送; 煤直接液化装置:油煤浆制备、煤液化; 煤间接液化装置:合成气压缩、费托合成;	可燃气体探测器和其他火灾探测器

续表 A

火灾自动报警系统的设置场所		适用的火灾探测器种类
生产装置	油品提制加工装置：加氢稳定、加氢改质、轻烃回收、氢气回收； 硫回收装置：含硫污水汽提、脱硫、硫黄回收； 甲醇装置：合成气压缩、甲醇合成、甲醇精馏、氢气回收和压缩、驰放气回收； 二甲醚装置：甲醇脱水、甲醇精馏； 甲醇制烯烃和烯烃分离装置：甲醇制烯烃、烯烃分离； 聚乙烯、聚丙烯装置； 乙二醇装置：草酸甲脂合成、草酸甲脂加氢合成乙二醇； 甲烷化装置：甲烷化； 合成氨装置：合成气压缩、氨合成、氨压缩、氨储存； 酚回收装置：酚萃取、酚精制； 火炬：火炬头、火炬筒体、长明灯、气体密封器、水封罐、点火系统； 生产或使用可燃气体、可燃蒸气的其他装置（包括甲、乙类气体和液化烃，甲、乙类液体的储罐以及现场分析间、化验室）	可燃气体探测器和其他火灾探测器
	空分装置及其厂房	火焰探测器或感烟火灾探测器
储运设施 (煤储运除外)	甲类和乙类气体、液化烃、甲类和乙类液体的储罐(组)区、装卸设施、灌装站，其他可燃气体、可燃蒸气扩散与积聚场所的2区及附加2区内	可燃气体探测器
	单罐容积不小于10000m ³ 的浮顶罐的密封圈处	线型光纤感温火灾探测器

续表 A

火灾自动报警系统的设置场所			适用的火灾探测器种类
储运设施 (煤储运除外)	仓库	甲、乙类仓库	火焰探测器、感烟火灾探测器或感温火灾探测器
		占地面积超过 3000m ² 的丙类仓库	感烟火灾探测器、感温火灾探测器或火焰探测器
其他	控制(监控)中心(室)、电子设备机房		感烟火灾探测器
	锅炉房		感温火灾探测器或点型红外火焰探测器
	柴油机驱动的泵房、柴油发电机室及油箱		感温火灾探测器或点型红外火焰探测器
	油浸变压器室		缆式线型感温火灾探测器或点型红外火焰探测器
	干式变压器室		感烟火灾探测器或缆式线型感温火灾探测器
	电缆隧道、电缆夹层、电缆竖井		缆式线型感温火灾探测器或感烟火灾探测器
	配电室(间)		感烟火灾探测器
	可能积聚可燃气体的电缆沟进口处		可燃气体探测器

- 注:1 对于表中未明确设置火灾探测器及种类的装置、储运设施、辅助生产设施和公用工程设施场所,尚应根据火灾可能发生的部位和可燃物的分析,火灾探测器的种类、灵敏度和响应时间,以及工艺需求等选择相应的火灾探测器,对火灾形成特征不可预料的场所,可根据模拟试验的结果选择火灾探测器;
- 2 对于液化烃压力储罐,宜在储罐底部阀组区设置图像型感温火灾探测器;对于液体硫黄储罐,宜在靠近罐顶通气口处设置图像型感温火灾探测器;储罐区可在防火堤外高位处设置红外火焰探测器或图像型火灾探测器。

附录 B 防火间距起止点

B. 0.1 区域规划、煤化工工厂总平面布置及装置或设施内防火间距起止点为：

封闭式建筑物——外墙外侧结构面。

半敞开式厂房——根据物料特性和厂房结构型式确定。当外围护结构不利于可燃气体扩散时，按厂房最外侧轴线确定；当外围护结构对可燃气体扩散影响不大时，按厂房内设备外缘确定。

敞开式厂房和构架——最外侧柱的外侧结构面或设备外缘。

库棚——最外侧柱的外侧结构面或库棚外缘投影线。

设备——设备外缘。

储罐或罐组——罐外壁。

堆场——材料堆的外缘。

铁路——中心线。

道路——路边。

架空通信、电力线——线路中心线。

码头——输油臂中心及泊位。

铁路装卸鹤管——鹤管立管中心线。

汽车装卸鹤位——鹤管立管中心线。

高架火炬——火炬筒中心。

装置——最外侧的设备外缘、建筑物外墙外侧结构面或最外侧柱的外侧结构面。

本标准用词说明

1 为便于在执行本标准条文时区别对待,对要求严格程度不同的用词说明如下:

1)表示很严格,非这样做不可的:

正面词采用“必须”,反面词采用“严禁”;

2)表示严格,在正常情况下均应这样做的:

正面词采用“应”,反面词采用“不应”或“不得”;

3)表示允许稍有选择,在条件许可时首先应这样做的:

正面词采用“宜”,反面词采用“不宜”;

4)表示有选择,在一定条件下可以这样做的,采用“可”。

2 条文中指明应按其他有关标准执行的写法为:“应符合……的规定”或“应按……执行”。

引用标准名录

- 《建筑设计防火规范》GB 50016
- 《工业建筑供暖通风与空气调节设计规范》GB 50019
- 《氧气站设计规范》GB 50030
- 《供配电系统设计规范》GB 50052
- 《爆炸危险环境电力装置设计规范》GB 50058
- 《建筑灭火器配置设计规范》GB 50140
- 《石油化工企业设计防火标准》GB 50160
- 《火力发电厂与变电站设计防火标准》GB 50229
- 《给水排水管道工程施工及验收规范》GB 50268
- 《石油化工装置防雷设计规范》GB 50650
- 《石油化工控制室抗爆设计规范》GB 50779
- 《消防给水及消火栓系统技术规范》GB 50974
- 《石油化工工厂布置设计规范》GB 50984
- 《消防应急照明和疏散指示系统技术标准》GB 51309
- 《消防联动控制系统》GB 16806
- 《深度冷冻法生产氧气及相关气体安全技术规程》GB 16912
- 《粉尘爆炸危险场所用收尘器防爆导则》GB/T 17919
- 《火灾自动报警系统组件兼容性要求》GB 22134
- 《城市消防站建设标准》建标 152
- 《消防员个人防护装备配备标准》GA 621
- 《石油化工采暖通风与空气调节设计规范》SH/T 3004
- 《石油化工企业电信设计标准》SH/T 3153
- 《石油化工石油气管道阻火器选用、检验及验收标准》SH/T 3413

中华人民共和国国家标准
煤化工工程设计防火标准

GB 51428 - 2021

条文说明

编 制 说 明

《煤化工工程设计防火标准》GB 51428-2021,经住房和城乡建设部2021年4月9日以第57号公告批准发布。

本标准在编制过程中,编制组进行了全面深入的调查研究,总结了我国煤化工工程设计防火的实践经验,同时参考了国外先进技术法规、技术标准。

为便于煤化工工程的规划、设计、建设、施工和监督等部门的有关人员在使用本标准时能正确理解和执行条文规定,本标准编制组按章、节、条的顺序编制了本标准的条文说明,对条文规定的目的、依据及执行中需注意的有关事项进行了说明,还着重对强制性条文的强制性理由做了解释。当正文条文简单明了、易于理解无需解释时,不做说明。但是,本条文说明不具备与标准正文同等的法律效力,仅供使用者作为理解和把握标准规定的参考。

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1 总 则

1.0.1 本条为制定本标准的目的,概括地阐明了制定本标准的理由。

能源是社会经济发展的基础。我国的煤炭资源情况与石油、天然气资源比较起来有相对优势,这样就决定了我国将长期依赖煤炭的能源格局。目前国内已建设了一批煤化工项目,方向已由传统的煤化工向现代煤化工转变,对于缓解我国石油、天然气等优质能源供求矛盾,促进钢铁、化工、轻工和农业等行业的发展,发挥了重要的作用。通过制定本标准,对煤化工工厂生产、储存等生产装置和设施的火灾危险性进行分类,根据其火灾危险性类别,规定工厂各类设施的各项防火安全措施,规范煤化工工程的防火设计,从而预防火灾发生、减少火灾危害,保障人身和财产安全。

1.0.2 本条明确了本标准的适用范围。

本标准主要适用于生产过程需经过煤气化或煤直接液化过程的煤化工工程的防火设计,以适应煤化工产业现代化、大型化发展的需要,包括合成氨、甲醇、烯烃、煤制氢、煤制油、煤制天然气、乙二醇、醋酸等,详见图1。对于图1的后续部分生产加工过程,与石油化工相同的,如聚乙烯和聚丙烯生产及产品储运设施、合成橡胶生产、塑料仓库设计等,可参照执行现行国家标准《石油化工企业设计防火标准》GB 50160。低阶煤分质资源化综合利用技术生产和储运燃料及化工产品的工程、电石和焦炭等传统煤化工产品工厂的煤储运系统和副产品回收的建设工程可参照本标准执行。

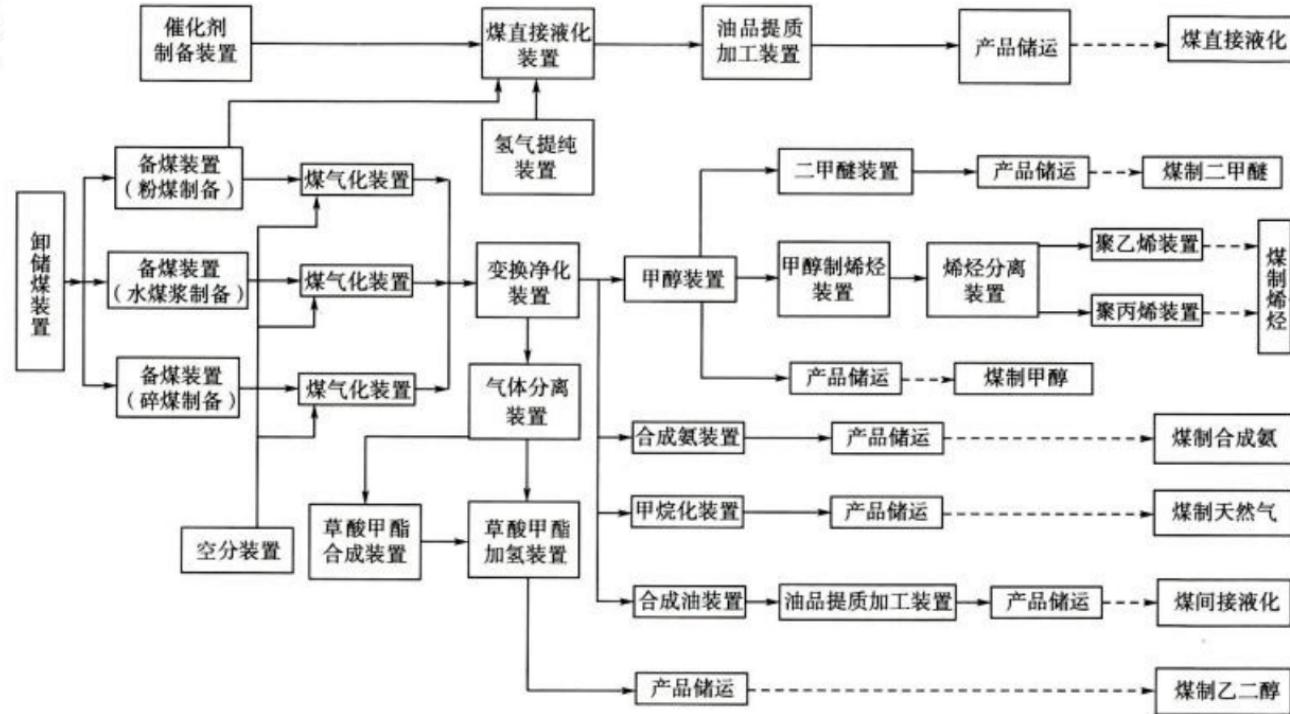


图1 煤化工主要产品生产典型工艺方块流程图

现代煤化工产业具有规模化、大型化、一体化、基地化的特征,技术含量高,投资强度大,本标准根据国家产业政策,结合煤化工工程建设现状,确定了大型、中型煤化工工厂的判定条件:将原料煤消耗总量(以标煤计) $\geq 2000\text{kt/a}$ 或占地面积 $\geq 200\text{ha}$ 的工厂确定为大型工厂;原料煤(以标煤计)消耗总量 $\geq 750\text{kt/a}$ 且 $<2000\text{kt/a}$ 的工厂确定为中型工厂,这是考虑到有些煤化工工厂虽然原料煤消耗量可能小于200万t/a,但是由于后续加工产业链长或者还有其他天然气或油作为原料来源,占地面积比较大,为与现行国家标准《石油化工企业设计防火标准》GB 50160统一,增加了占地面积 $\geq 200\text{ha}$ 这个大型工厂的判定条件;以煤制甲醇为例,经核算年产60万t甲醇计算原料标煤消耗量约 $720\text{kt/a} \sim 780\text{kt/a}$,其占地面积小于100ha,年产100万t甲醇原料标煤消耗量约 $1200\text{kt/a} \sim 1300\text{kt/a}$,加上后续加工,占地面积可能突破100ha,综合考虑以年产60万t甲醇为基准,确定原料煤(以标煤计)消耗总量 $\geq 750\text{kt/a}$ 且 $<2000\text{kt/a}$ 的工厂为中型工厂。

1.0.3 本条提出了本标准的原则要求。

煤化工工程的防火设计要遵循国家基本建设和消防工作的有关法律法规、方针政策。设计中要针对煤化工工程的实际情况,研究生产工艺特点,正确处理生产和安全的关系,力求提高生产过程的安全,控制火源和可燃物,防止火灾发生,万一发生火灾爆炸事故,为减少危害程度、降低损失,要积极采用行之有效的消防措施,在保证安全可靠、技术先进的前提下,做到节省工程投资费用。

1.0.4 本条阐明了本标准与相关标准的关系。本标准是一部行业专用的消防技术标准,具有很强的针对性,煤化工工程的防火设计应执行本标准。

煤化工工程涉及各类建筑、生产装置及设施的防火防爆等技术,不可能将有关内容全部包括进来,而且相关标准在指导工业与民用项目的防火设计中发挥着重要的作用,因此,本标准未做规定的煤化工工程的防火设计,尚应符合国家现行的建筑防火标准和

专业系统标准的有关规定。如不同耐火等级建筑物构件的燃烧性能和耐火极限、防火分区最大允许建筑面积、建筑构造、防排烟系统、消防配电线路、消防应急照明和疏散指示标志的设置部位等的设计,以及全厂性或区域性的办公楼、厂综合楼和生活服务设施建筑的防火设计,现行国家标准《建筑设计防火规范》GB 50016 已做规定并适用于煤化工工程的内容,本标准原则上不再重复规定;本标准涉及的未做具体规定的各专业系统的内容,如灭火系统及设施的设计、暖通、电气专业等的防火设计,应符合相关现行国家标准《自动喷水灭火系统设计规范》GB 50084、《泡沫灭火系统设计规范》GB 50151、《消防给水及消火栓系统技术规范》GB 50974、《固定消防炮灭火系统设计规范》GB 50338、《工业建筑供暖通风与空气调节设计规范》GB 50019、《火灾自动报警系统设计规范》GB 50116、《石油化工可燃气体和有毒气体检测报警设计标准》GB 50493、《爆炸危险环境电力装置设计规范》GB 50058、《建筑物防雷设计规范》GB 50057 等的规定;此外,煤化工工程涉及与相关行业相同或相似的内容,如可燃气体和可燃液体的泄压与排放设施,液化烃、可燃液体和可燃气体的储存设施、装卸设施、灌装站,含可燃液体的生产污水管道,工厂总平面布置和生产装置布置,设备构架的防火保护和疏散,以及消防灭火和冷却设施的设计等,在现行国家标准《石油化工企业设计防火标准》GB 50160 中已有规定,本标准在具体章节中引用该标准代替详细规定;自备热电站内部防火设计和除本标准明确规定外的变电站内部防火设计,现行国家标准《火力发电厂与变电站设计防火标准》GB 50229 等已有规定,本标准不再重复规定。

2 术 语

2.0.2、2.0.3 本标准中原料煤是指用于工艺生产如煤气化用煤和煤直接液化的油煤浆制备及催化剂制备的煤、洁净煤(兰炭)和焦丁,不包括自备发电站的动力煤及锅炉等燃料煤。

2.0.4 防爆墙也可称为抗爆墙,能够抵抗来自建筑物外部爆炸冲击波或来自建筑物内部爆炸冲击波的作用,并能够保持设计压力条件下所要求的防护性能,有钢筋混凝土防爆墙、型钢龙骨钢板防爆墙、型钢龙骨复合抗爆板防爆墙和加固砌筑防爆墙等。

本标准中使用的一些名词说明如下:

(1)“半敞开式厂房”“敞开式厂房”“联合装置”“装置”“工艺设备”“全厂性重要设施”“区域性重要设施”“装置储罐”“罐组”“罐区”“浮顶罐”“常压储罐”“低压储罐”“压力储罐”“防火堤”“隔堤”“液化烃”“沸溢性液体”,在现行国家标准《石油化工企业设计防火标准》GB 50160 中有术语规定,“耐火极限”“不燃烧体”“闪点”“地下室”“明火地点”“散发火花地点”“安全出口”“封闭楼梯间”“防烟楼梯间”“防火分区”“防火间距”“充实水柱”,在现行国家标准《建筑设计防火规范》GB 50016 中有术语规定,“防爆门”“筒仓”,在现行行业标准《火力发电厂煤和制粉系统防爆设计技术规程》DL/T 5203 中有术语规定,本标准不再重复规定。

(2)本标准中厂区、生产区、装置区、动力及公用工程设施、辅助设施、全厂性重要设施和区域性重要设施分别指:

1)厂区:工厂围墙或用地红线范围内,由工厂所属生产装置及各类设施组成的区域。

2)生产区:由使用、产生可燃、助燃物质和可能散发可燃气体或氧气的生产装置区、储运区或设施组成的区域,如煤气化等生产

装置及厂房、空分装置、物料罐区、原料及成品仓库、装卸设施和火炬等组成的区域。

3) 装置区:由一个或一个以上的独立生产装置或联合装置组成的区域。

4) 动力及公用工程设施:为工艺生产过程提供水、汽、电、气和冷冻水等的设施的统称。如净水场、循环水场(站)、消防水泵房(站)、给水加压泵站、自备热电站、变配电站和冷冻站等。

5) 辅助设施:非工艺流程设施,但对生产过程提供支持的必要设施。如污水处理场、事故池、分析化验楼(室)、环境监测站、维修车间、备品备件库和气防站等。

6) 全厂性重要设施:发生火灾时,影响全厂生产或可能造成重大人员伤亡的设施。分为两类:第一类全厂性重要设施指发生火灾时可能造成重大人员伤亡的设施,如全厂性的办公楼、中央控制室、全厂消防水泵房(站)、全厂消防监控中心、化验室、消防站、电信站等;第二类全厂性重要设施指发生火灾时影响全厂生产的设施,如全厂性的锅炉房和自备电站、变电所、泡沫消防泵站、循环水场的冷却塔等。

7) 区域性重要设施:发生火灾时影响部分装置生产或可能造成局部区域人员伤亡的设施,如区域性的办公楼、控制室、变配电站、消防分站、独立设置的消防给水增压泵房等。区域性重要设施的分类原则同全厂性重要设施。

3 基本规定

3.0.1 本条对液化烃和可燃液体的火灾危险性类别进行了划分。

液化烃是以液态形式储存的,因此把液化烃和可燃液体合并在一起进行分类,因液化烃饱和蒸气压大于闪点 $<28^{\circ}\text{C}$ 的其他甲类可燃液体,故其火灾危险性比闪点 $<28^{\circ}\text{C}$ 的其他甲类可燃液体高。本条将液化烃和甲、乙、丙类可燃液体的火灾危险性按照蒸气压和闪点,在现行国家标准《建筑设计防火规范》GB 50016 的基础上做了适当细化,便于针对不同火灾危险性类别的液化烃及可燃液体在本标准条文中提出不同的措施要求。饱和蒸气压按现行国家标准《石油产品蒸气压测定 雷德法》GB/T 8017 确定的测试温度为 37.8°C ,与现行国家标准《石油天然气工程设计防火规范》GB 50183 一致,与美国防火协会标准 NFPA 30《易燃与可燃液体规程》基本协调。

液体的挥发性随着温度升高而增强,火灾危险性也随之增加,操作温度对乙、丙类液体火灾危险性的影响,在一些国内外标准中都有明确规定,本条表注 1~3 与现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定一致。

煤化工工厂中液化烃、可燃液体的火灾危险性分类举例见表 1。

表 1 液化烃、可燃液体的火灾危险性分类举例

类别		名 称
甲	甲 A	液化石油气、液化天然气、液化乙烯、液化乙烷、液化丙烯、液化丙烷、液化丁烯、液化丁烷、液化环丙烷、液化环氧乙烷、液化甲醚(二甲醚)、三乙基铝、一氯二乙基铝
	甲 B	汽油、石脑油、油煤浆、二硫化碳、甲醇、乙醇、丙醇、糠基硫、1-己烯、二异丙基醚、环氧丙烷、戊烷、异戊烷、己烷、异己烷、丙酮、甲酸甲酯

续表 1

类别		名 称
乙	乙 _A	煤油、喷气燃料、液氨、丁醇
	乙 _B	轻柴油、环戊烷、粗酚
丙	丙 _A	溶剂油、焦油、重柴油、乙二醇、酚、甲酚
	丙 _B	渣油、蜡油、变压器油、润滑油、液硫

表 1 中,对于闪点小于 60℃且大于或等于 55℃的轻柴油,如果储罐操作温度小于或等于 40℃时,其火灾危险性可视为丙_A类,与现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定一致。

油煤浆是煤化工比较特殊的物质,有液体流淌的特点,根据相关课题的研究测试结果,煤直接液化项目中的油煤浆组成中包括煤粉、中温溶剂油和高温溶剂油,中温溶剂馏程范围主要在 220℃~410℃,其闪点范围为 50℃~90℃,高温溶剂馏程范围主要在 290℃~480℃,其闪点为 90℃~150℃。混合后的油煤浆操作温度正常在 167℃~200℃,高于其轻质溶剂油的闪点,因此,按低闪点溶剂油(乙类)及“操作温度超过其闪点的乙类液体应划分为甲_B类液体”确定了油煤浆火灾危险性类别为甲_B类。水分含量较高的水煤浆比丙类物质的火灾危险性低,可按丁类火灾危险性类别确定。

3.0.2 可燃气体、助燃气体和固体的火灾危险性分类按现行国家标准《建筑设计防火规范》GB 50016 的有关规定执行。

煤化工工厂可燃气体和助燃气体的火灾危险性分类举例见表 2。

表 2 可燃气体和助燃气体的火灾危险性分类举例

类别	名 称
甲	氢气、硫化氢、合成气、乙炔、甲烷、乙烷、丙烷、环丙烷、正丁烷、异丁烷、乙烯、丙烯、丁烯、二甲醚、瓦斯、环氧乙烷
乙	一氧化碳、氨、氧气(助燃气)

煤化工生产过程中典型的固体物质有煤、硫黄和油煤渣。煤和硫黄具有火灾危险性,一定条件下的煤和硫黄还具有爆炸危险性。在常温常压下能与空气形成爆炸性混合物的煤或硫黄(硫黄颗粒度小于2mm)粉尘,属于乙类固体物质,油煤渣以及不能与空气形成爆炸性混合物的煤和硫黄,属于丙类固体物质。煤的种类繁多,其可燃和爆炸危险性的影响因素很多,国内相关文献资料给出了部分产地煤的可燃和爆炸危险性的测试参数,设计时可作为参考。

3.0.3、3.0.4 对设备、建筑物的火灾危险性类别做了原则规定。条文的制定参照了现行国家标准《建筑设计防火规范》GB 50016和《石油化工企业设计防火标准》GB 50160的有关规定。

(1)根据条文中物质、设备和建筑物(指生产厂房、辅助生产和公用工程设施建筑物)的火灾危险性类别的判定原则,结合已建和在建煤化工工程项目的实际情况,表3列举了煤化工工程中主要生产装置及其主要生产部位、生产和储存建筑的火灾危险性类别。

表3 常见的生产装置、单元或设施的火灾危险性分类举例

名称	主要生产部位或工艺过程	主要危险物质	火灾危险性类别
空分装置	空气净化(氨制冷)、分离,液氧储存	液氨、氧气、液氧	乙
	空气压缩、液氮、液氩储存	液氮、液氩	戊
煤气化装置	碎煤储存和输送	碎煤	丙
	水煤浆 湿法磨煤、催化剂制备	煤	丙
	制备 水煤浆给料	水煤浆	丁
	煤粉制备:干法磨煤、煤粉分离、煤粉储存和输送	煤粉	乙
	煤气化、粗煤气热量回收、粗煤气水洗	煤粉、一氧化碳、氢气、硫化氢	甲
	煤气化的工艺水处理(闪蒸)	氢气、一氧化碳等	甲

续表 3

名称	主要生产部位或工艺过程	主要危险物质	火灾危险性类别
煤气化装置	粉煤气化的渣水处理	渣水	丙
	碎煤气化工艺水处理(烃回收)	混合重烃、混合芳烃	乙
	煤锁气压缩	氢气、甲烷、一氧化碳等	甲
气体净化装置	一氧化碳变换、酸性气体脱除 (低温甲醇洗或 MDEA 脱硫脱碳等)	一氧化碳、氢气、硫化氢	甲
硫回收装置	转化反应、气体处理	硫化氢、硫黄等	甲
	硫黄成型、硫黄包装	液硫、固体硫黄、硫黄粉	乙
	硫黄储存	粒径大于 2mm 的固体硫黄 (工业成型)	丙
氢气提纯装置	氢气提纯、氢气压缩、尾气回收	氢气	甲
甲烷化装置	甲烷化反应	氢气、甲烷	甲
煤直接液化催化剂制备装置	煤粉制备、反应、过滤分离、储存和输送	催化剂、煤粉	乙
煤直接液化装置	油煤浆制备、煤液化	煤粉、高温气体 燃料气、氢气、油煤浆、液化油	甲
煤间接液化装置	合成气压缩、费托合成	一氧化碳、氢气、合成油	甲

续表 3

名称	主要生产部位或工艺过程	主要危险物质	火灾危险性类别
油品提质加工装置	加氢稳定、加氢改质、轻烃回收、氢气回收	氢气、液化石油气、汽油、柴油、石脑油等	甲
油渣成型装置	油渣成型、储存、输送	液态和固态油灰渣	丙
甲醇装置	合成气压缩, 甲醇合成, 甲醇精馏, 氢气回收和压缩、驰放气回收	一氧化碳、氢气、甲醇等	甲
二甲醚装置	甲醇水解、精馏	甲醇、二甲醚	甲
甲醇制烯烃及烯烃分离装置	甲醇转化、催化剂再生、气体处理	甲醇、乙烯、丙烯等	甲
乙二醇装置	草酸甲酯合成、草酸甲酯加氢合成乙二醇	甲醇、草酸甲酯、亚硝酸甲酯、乙二醇	甲
合成氨装置	合成气压缩、氨合成	氢气、氨	甲
	氨压缩、氨储存	氨	乙
酚回收装置	酚的萃取(溶剂脱酚、溶剂泵)	萃取剂、含酚废水	甲
	酚精制	粗酚	乙
	储存和输送	酚	丙
煤储运系统	翻车机房、运煤隧道、露天储煤场、筒仓、储煤库(包括圆形煤库和条形煤库)、煤棚、筛分破碎室、转运站、运煤栈桥	原煤	丙

续表 3

名称	主要生产部位或工艺过程	主要危险物质	火灾危险性类别
火炬	火炬头、火炬筒体、长明灯、气体密封器、水封罐、点火系统、支撑结构	可燃气体	甲
生产污水处理装置	污水处理的厌氧反应器(池)	沼气	甲
	污水的化学处理、生化处理、汽提处理、沉降澄清、污泥过滤、排水泵	污水	根据生产的火灾危险性确定
装卸栈台	油品、化学品等的装卸机泵、鹤管	油品、化学品	根据生产和储存的火灾危险性确定
控制室、机柜间	全厂中央控制室、区域控制室、装置的控制室、仪表机柜间	电仪设备	丁
分析化验楼(室)	全厂中心化验楼、区域分析化验室、装置分析化验室	化学试剂、可燃固体	丙
公用工程设施	丙烯压缩制冷机	丙烯	甲
	氨压缩制冷机	氨	乙
	全厂变电站、装置或单元变电站	绝缘油	丙
	柴油发电机房	柴油	丙
	电缆夹层	电线可燃绝缘层	丙
	空压机、空气干燥器、压缩空气储罐	润滑油、不燃物质	丁、戊

表 3 中：有限释放可燃气体或粉尘的分析化验楼(室)，当未采取防止爆炸物质积聚及电气防爆等有效措施时，其火灾危险性类

别按可燃气体或粉尘的实际火灾危险性确定；当变电站屋内配电装置设备的充油量 $\leqslant 60\text{kg}/\text{台}$ 时，火灾危险性类别按丁类确定；轻柴油发电机房火灾危险性类别按乙类确定；当电缆夹层采用A类阻燃电缆时，其火灾危险性按丁类确定。

(2)对于表3中未明确的生产装置、设施以及出现的新的生产装置和设施，在项目设计时要按照本标准第3章的基本原则，确定其火灾危险性类别。

(3)在建筑物设计过程中，为减少火灾事故发生、火灾蔓延和便于逃生，有时对防火分区内较高火灾危险性类别的生产场所也采用防火墙和单独的对外安全出口与其他部位进行分隔，如果该场所内较高火灾危险性类别的物质或设备占该防火分区面积的比例小于5%，建筑物的火灾危险性类别可以不按照该场所确定。

4 区域规划与总平面布置

4.1 区域规划

4.1.3 厂内明火或散发火花地点位于煤矿等矿井井口、进风井口全年最小频率风向的下风侧,是为防止井内可能冒出的可燃气体在风的作用下吹向明火或散发火花地点发生火灾。

煤矿等矿井井口是人员出入的部位,全厂性高架火炬在事故排放时可能产生“火雨”,火炬燃烧过程中会产生大量的热、烟雾、噪声及有害气体。为防止火灾发生和保护煤矿等矿井井口人员的生命安全,规定了高架火炬及厂内其他的明火或散发火花地点距井口的距离。

4.1.4 煤化工工厂泄漏的可燃液体一旦流出厂区或进入排洪沟内,有可能与明火接触而引发火灾爆炸事故,造成人员伤亡和财产损失;泄漏的可燃液体和受污染的消防水未经处理而直接排放,会对居住区、水域及土壤造成重大环境污染。例如,2010年7月16日大连某集团公司的输油管道发生爆炸,流出库外的原油和受污染的消防水致受污染海域约 430km^2 ,原油不仅污染到滨海旅游度假区、海滨浴场和保护区等敏感区域,同时也严重影响了当地的生态环境。因此,为了防止泄漏的可燃液体和受污染的消防水流出厂区或排洪沟内,需增设有效措施,如设置事故存液池、受污染的消防水池(罐)、雨水监控池和排水总出口设置切断阀等设施,确保泄漏的可燃液体和受污染的消防水不直接排至厂外或流入排洪沟内。

4.1.5 本条是强制性条文,必须严格执行。地区架空电力线路和其他工厂或设施的架空电力线路若穿越生产区,当发生倒杆、断线或导线打火等意外事故时,可能影响生产并引发火灾爆炸事故;若公路穿越生产区,会给防火和安全管理带来很大隐患。

地区输油(输气)管道和其他工厂或设施的输油(输气)管道不应穿越厂区,目的是避免地区输油(输气)管道、其他工厂或设施的输油(输气)管道和煤化工工厂区内生产设施发生火灾爆炸事故并产生相互影响。输油(输气)管道介质包括合成油、石脑油、轻油、焦油等油品,天然气、氢气、氧气、燃料气等可燃或助燃气体,乙烯、丙烯、苯、液氨等可燃液体,以及硝酸、盐酸、烧碱等腐蚀性液体。

与本厂无关的为其他企业所使用的运煤栈桥和带式输送机通廊,因皮带跑偏和摩擦等原因有起火的现象,为保证煤化工工厂的安全和防止煤化工工厂发生火灾或爆炸事故对其他企业的生产造成影响,规定其他工厂或设施的运煤栈桥不应穿越厂区。

4.1.6 本条是强制性条文,必须严格执行。对煤化工工厂与周围居住区、工矿企业和交通线等处的防火间距做了规定,以减少煤化工工厂与周围居住区、工矿企业和交通线等发生火灾事故的相互影响,防止液体污染环境。现对表 4.1.6 说明如下:

(1)由于煤化工工厂除前期的煤储运系统、煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备厂房以外,后续加工过程的火灾危险性与石油化工基本相同,因此,本表的部分内容参考了现行国家标准《石油化工企业设计防火标准》GB 50160,并适当补充和修改。

(2)氧气在煤化工工厂作为原料使用,一般储存在空分装置区内,且储量较大,为减少火灾时的相互影响,规定了比现行国家标准《建筑设计防火规范》GB 50016 更大的距离。

(3)储煤场区是煤化工工厂的最主要的原料储存地,其安全直接关系到工厂是否能正常生产,因此规定了比现行国家标准《建筑设计防火规范》GB 50016 更大的距离。本标准“储煤场区”包括露天储煤场、筒仓、储煤库(圆形煤库、条形煤库)和干煤棚。

4.2 总平面布置

4.2.1 本条对工厂总平面及重点设施的布置提出了原则要求。

厂内的生产装置、储罐、储煤场区及各类设施，其火灾危险程度、散发油气量的多少及生产操作的方式等均有较大差别，为了安全生产，满足各类设施的不同要求，平面布置时，有必要按生产操作、火灾危险程度和经营管理等特点，并结合地形和风向等自然条件以及交通状况进行分区布置。

1 为减少在生产、储运和装卸过程中泄漏或散发的可燃气体、有毒或腐蚀性气体和粉尘对人员的直接危害和可能大量泄漏的可燃气体遇明火爆燃发生安全事故，应充分利用当地的自然条件，根据全年最小频率风向进行平面布置。

2 为提高氧气的纯度，空分装置要求吸入的空气应清洁，特别要防止乙炔或其他烃类等气体混入而引发爆炸，因此宜将空分装置布置在不受上述气体污染的地段，确有困难时，吸风口的位置应位于空气较清洁的地段。

5 把可燃液体汽车装卸设施特殊的区域加以隔离，限制一定人员的出入，有利于安全管理，并便于采取有效的消防措施。

11 为吸取“7·19”河南某气化厂空分装置重大爆炸事故的教训，消防站与甲、乙类工艺装置的安全防护距离要根据风险评估确定。

4.2.2 为减少投资，厂内一般采用非防爆带式输送机，为防止因皮带跑偏和摩擦等原因产生的静电或明火与可燃气体或可燃粉尘接触发生爆炸，影响其他设施的运行，做此规定。位于防爆区内时可采用防爆带式或管输式输送机等其他形式。

4.2.3 封闭式栈桥容易形成烟囱效应而加速火灾蔓延，且封闭形式增加了火灾的扑救难度，故为防止封闭式栈桥发生火灾殃及相邻栈桥做了本条规定。考虑到带式运输栈桥作为原料和燃料煤的转输设施大量存在于煤化工工厂中，为便于工艺合理布置，并考虑节约用地和保障消防安全，当相邻2座栈桥按本条要求加强防火分隔措施和设置便于扑救栈桥火灾的消防车道时，其防火间距可不受6m的限制。

4.2.5 本条是强制性条文,必须严格执行。本条是对煤化工工厂内各类设施之间防火间距的具体规定,主要依据为:

(1) 爆炸性环境区域范围。煤化工工厂内的煤粉制备和煤气化装置(单元),一般都位于气体和粉尘爆炸的并存环境中,由于现阶段还没有这种环境下爆炸影响范围的具体试验数据和火灾案例资料,仅就煤粉或可燃气体单环境爆炸影响范围看,依据某煤化工工程项目和国内外有关资料,爆炸性煤粉环境区域范围一般在3m范围内,现行国家标准《爆炸危险环境电力装置设计规范》GB 50058-2014把可燃气体重于空气、通风良好且为第二级释放源的主要装置区,其爆炸危险区域2区的范围定为15m,当可燃气体可能大量释放并扩散到15m以外时,其爆炸危险区域附加2区的范围定为2区以外15m,现行国家标准《石油化工企业设计防火标准》GB 50160-2008将可燃液体敞口设备的危险范围定为22.5m,密闭设备定为15m,由此,确定了甲、乙、丙类生产装置之间的防火间距15m~30m。

(2) 国外有关规定。英国石油学会《销售安全规范》规定,储罐与明火和散发火花的建(构)筑物的距离为15m。日本丸善石油公司的油库管理手册,是以储罐内液体的静止状态和使用状态分别规定储罐区内动火的安全距离,其最大距离为20m。

(3) 火灾情况。根据调查材料统计,绝大部分火灾是由明火引起的(炼厂的统计为67%,商业油库比例更大),而以外来明火引起的较多。如液体经排水沟流至厂外水沟,厂外点火,火势回窜引起火灾。其他原因则有雷击和静电等。

4.2.7 液化烃和可燃液体的装卸栈台和鹤管都是火灾危险性较大的场所,在装卸过程中,经常散发可燃气体,在装卸作业完成后,可能仍有可燃气体积聚在装卸栈台附近或装卸鹤管内,内燃机车在启动、走行或刹车时,均可能从排气筒、钢轨与车轮摩擦或闸瓦处散发火花,为减少火灾危险,本条参照相关标准规定了两相邻栈台铁路装卸线中心线之间及内燃机车与另一栈台铁路装卸线中心

线之间的防火间距。

4.3 厂内消防车道

4.3.1 煤化工工厂消防车道的出入口如只有1个,在发生火灾事故时就可能阻碍交通,外界支援的消防车、救护车、消防器材及人员的进出较多,设2个不同方位的出入口就比较方便。

4.3.2 对设置环形消防车道的场所提出了要求。本条所列均为厂内火灾危险性较大的场所,其周围设环形消防车道,并保证道路足够宽度,有利于消防车辆的通行、调度和停放,能及时转移到有利的扑救地点。高层厂房、占地面积大于 3000m^2 的甲、乙、丙类厂房和占地面积大于 1500m^2 的乙、丙类仓库,消防车道的设置应符合现行国家标准《建筑设计防火规范》GB 50016的规定。

有回车场的尽头式道路,车辆行驶及调动均不如环形道路灵活,一般不宜采用。但在山区小容积可燃液体的储罐区、装卸区和化学危险品仓库区等,因受地形条件限制建环形道确有困难时,可以设置有回车场的尽头式道路。

4.3.3、4.3.5、4.3.6 这三条是对与环形消防车道相连的中间消防车道的设置的规定。生产装置、露天煤堆场和铁路装卸区占地面积均较大,有时其内部设施已超出设置在环形消防车道上消火栓的保护范围,因此增加中间消防车道是必要的。

第4.3.3条,在生产装置内配置一定宽度的纵横道路,把生产装置分隔成区域防火分区,可满足消防通行的需要,又可起到阻止装置区火灾蔓延扩大、减少财产损失的作用。当生产装置的设备和建筑物组成的区域占地面积大于 10000m^2 时,为减少事故情况下设备和建筑物组成的区块间的相互影响、方便消防作业,根据区块占地面积的不同,对区块间的防火间距规定不小于15m和25m。本标准生产装置设备和建筑物组成的区块占地面积,是指生产装置用地边界内消防车道中心线之间或生产装置内消防车道中心线与生产装置边界间的占地面积。

消防车道可以兼作设备检修道路。为了便于生产装置内的设备检修而专门增设的设备检修道路,不受本条限制,增设的检修道宽度通常为 4m。

第 4.3.5 条,露天煤堆场的占地面积和道路间距采用了现行国家标准《建筑设计防火规范》GB 50016 中关于可燃材料堆场的数据。

第 4.3.6 条,消火栓的保护半径一般为 120m,对于液化烃和可燃液体铁路装卸区,本条规定是为了使装卸区内最不利点均位于双侧道路上设置的消火栓保护范围内。

4.3.8 对第 1、2 款规定的场所,要求其周边消防车道的路面宽度不小于 9m,路面内缘转弯半径不小于 15m,是为了满足大型消防车停靠时对灭火救援作业场地的需要并方便其他消防车通行。煤化工工厂生产区建筑如煤气化等高层厂房、高层仓库、煤储运系统转运站及栈桥等建筑,可不设置相关国家标准规定的消防车登高作业场地,但应在本条基础上,根据保护对象的布置要求和举高喷射消防车作业需要等具体情况,合理确定消防车道的路面宽度及消防车作业场地。

5 建筑防火

5.1 耐火等级、耐火极限

5.1.1 本条是强制性条文,必须严格执行。本标准将煤化工工厂的煤气化装置中的煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理等生产建筑和煤直接液化装置中的油煤浆制备及煤直接液化催化剂制备的生产建筑按照生产厂房进行防火设计。

已建和在建的煤化工工厂中,煤粉制备(指煤气化装置和煤直接液化装置的煤粉制备单元)、煤气化、煤气化工艺水处理、煤直接液化的油煤浆制备和煤直接液化催化剂制备厂房的火灾危险性多为甲类,其厂房高度、防火分区建筑面积大多都突破了现行国家标准《建筑设计防火规范》GB 50016 的有关规定,本标准在调研的基础上,广泛征求设计、消防和企业单位的意见,并多次召开讨论会,以及结合煤化工工厂实际情况,对这类高层厂房的耐火等级提出达到一级的要求。

水煤浆气化的水煤浆制备厂房是指原料煤缓冲储斗(碎煤仓)和磨煤机厂房,主要危险物质为碎煤和水煤浆,其火灾危险性属于丙类,本条规定水煤浆制备厂房的耐火等级不低于二级。水煤浆给料厂房的主要物质是水含量在 40% 左右的水煤浆,比丙类厂房的火灾危险性低,按丁类厂房确定。

5.1.3 设备裙座属承重结构,其耐火极限应与所在厂房柱的耐火极限一致。

受工艺和设备的布置以及安装等条件限制,当厂房楼层无法采用钢筋混凝土楼板或压型钢板组合楼板时,可以采用耐火保护的钢楼板作为垂直防火分区的分隔构件,钢楼板的地面可采用满足耐火和耐磨要求的钢丝网细石混凝土或阻燃绝缘面层保护,另

一面(受火面)可采用防火涂料喷涂保护,使钢楼板的耐火极限符合现行国家标准《建筑设计防火规范》GB 50016 的有关规定。

5.1.4 考虑到煤化工工厂使用的煤种类繁多、易自燃,且储煤库(圆形煤库、条形煤库)占地面积大,结构形式多为钢结构,本条参照现行国家标准《建筑设计防火规范》GB 50016 和《火力发电厂与变电站设计防火标准》GB 50229 的有关规定,对储煤库的钢结构提出了防火保护措施要求。

5.1.6 煤储运系统建筑包括转运站、栈桥、破碎楼、筒仓、干煤棚、室内卸煤装置及储煤库(圆形煤库、条形煤库)等,这类建筑构件的耐火极限无相应的标准规定,因此,本条明确应按不低于二级的厂房(仓库)确定。运煤输送机通廊钢桁架、钢支架的耐火极限按不低于二级厂房梁的耐火极限确定。

5.1.7 本条对液化烃、可燃液体、可燃气体及助燃气体球罐覆盖耐火保护层的部位及其耐火极限做了明确规定。球罐的支腿为承重钢结构,储存物多为烃类,且一般在烃类环境范围,其耐火保护层应按烃类火灾环境考虑,耐火极限不低于 2.00h,是参照美国消防协会标准《液化石油气规范》确定的。

5.1.8 本标准中的构架是指支撑设备和设备平台的承重钢结构。构架大部分面积是设备占用场地,无顶棚、四周无围护结构、内部无隔墙,无固定操作岗位,人员较少,平台主要铺设钢格栅、钢板等。煤化工工程中煤气化厂房后续生产装置和煤直接液化装置及其后续生产装置,当受占地限制等因素制约时,生产装置内的设备有的采用构架式布置。设备采用构架布置时,构架要按本条的规定进行耐火保护。管廊钢结构包括装置区钢管廊及管廊钢结构、跨越装置区钢管廊及管廊钢结构、罐区消防车道的钢管架,其耐火保护应按本条规定执行。

5.2 建筑高度、层数和面积

5.2.1 煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、煤直

接液化油煤浆制备和煤直接液化催化剂制备的厂房,受工艺及设备布置等条件要求,其层数较多、高度高,这类厂房在工艺及工艺设备上都采取了本质安全措施,并能够有效预防和控制危险事故发生,因此,在满足工艺生产要求的条件下,本条规定其层数和高度可不受限制。

5.2.2 国内目前已有规模的煤粉制备、煤气化、煤直接液化的油煤浆制备和煤直接液化催化剂制备的厂房,每层建筑面积在 $1000m^2 \sim 2500m^2$,且无人值守。例如:布置1台气化炉的粉煤气化厂房,每层建筑面积大约为 $1000m^2 \sim 1500m^2$;布置2台气化炉的粉煤气化厂房,每层建筑面积大约为 $2000m^2 \sim 2500m^2$;布置4台气化炉的粉煤气化厂房,每层建筑面积大约为 $3000m^2 \sim 3800m^2$ 。布置4台气化炉(三开一备)的水煤浆气化厂房,每层建筑面积大约为 $2500m^2$;布置5台气化炉(四开一备)的水煤浆气化厂房,每层建筑面积大约为 $3000m^2$;布置6台气化炉(五开一备)的水煤浆气化厂房,每层建筑面积大约为 $3500m^2$ 。

本条根据现有的煤化工工程情况,参照现行国家标准《建筑设计防火规范》GB 50016的有关规定,并考虑到煤化工工程今后的发展趋势,对煤粉制备、煤气化等高层厂房每个防火分区最大允许建筑面积做了适当的放宽,但对每层建筑面积进行了严格控制。

水煤浆气化水煤浆制备厂房的火灾危险性为丙类,为保证工艺需要和满足消防灭火等要求,本条对厂房每层及每个防火分区最大允许建筑面积做了规定。本条中高层部分指原料煤缓冲储斗(碎煤仓)区,单(多)层部分指磨煤机区,国内工程的设计,在这两个区之间大都采用了防火墙进行分隔。若水煤浆制备厂房的高层部分与单(多)层部分之间没有采用防火墙分隔时,厂房内每层及每个防火分区建筑面积按不大于 $4000m^2$ 确定。

煤气化等厂房上、下层之间楼板上的开口较多,设备、管道连通也较多,有些部位因工艺需要难以进行防火封堵,对上、下层为不同防火分区楼层之间的吊装孔等应采取防火分隔措施,设备、管

道开孔根据现场具体情况尽量采取防火封堵措施。敞开式、半敞开式厂房的防火分区建筑面积一般按层计算,不考虑有无建筑外围护结构的影响。

5.2.4 当厂房内存在比空气轻的可燃气体环境时,工艺及设备布置一般要求楼层设置钢格栅板作为操作和检修平台,此时,上、下楼层钢格栅板面积可不考虑叠加计算在防火分区建筑面积内,但疏散楼梯按自然楼层设计。

5.2.5 随着国内煤化工工厂生产能力的增强,现行国家标准对室内的储煤库占地面积和每个防火分区最大允许建筑面积的控制满足不了大型化生产的需求,本条通过调研及参照现行国家标准的有关规定,对其占地面积和防火分区面积做了规定,圆形煤库可不再分隔防火分区。

卸煤装置地面上卸煤的格栅板面积可不考虑叠加计算在地下室防火分区的建筑面积内。

5.3 建筑防爆

5.3.1 煤气化生产过程中的物料介质或产品,多为甲、乙类易燃、易爆物质,为了安全生产,这类设备宜露天布置或布置在敞开、半敞开式厂房内,便于泄漏出的可燃气体和煤粉尘及时扩散,减少浓度达到爆炸下限的可能性。当厂房敞开或半敞开时具有良好的泄爆效果,可减轻爆炸时的破坏强度,避免厂房因主体结构受到破坏而造成重大损失。

当厂房需要围护时,其围护材料除要符合现行国家标准《建筑设计防火规范》GB 50016 防火的有关规定外,还要适应室外环境条件,满足防雨水、防冻、防积雪等要求。

5.3.2 本条中的受条件限制,系指属于风沙大、雨雪多的严寒和寒冷的大部分北方地区。因冬季检修、故障停车或生产运行操作时,一些生产的动设备在敞开或半敞开环境中会受到低温等不利条件的影响,需要采取保温及封闭措施,例如,一些独立的建筑如

集中布置液化烃泵、可燃液体泵的场所和可燃气体压缩机厂房，其他如生产物料以工艺水和渣为主、检修工作量大、火灾危险性比煤气化厂房相对低的煤气化灰水处理厂房，可采取封闭形式。另外，为避免设备和管道冬季冻堵、检修人员耐受低温、大风和暴雪等极端恶劣气候，以及避免关键设备在低温环境下运行对设备寿命或安全运行有较大的不利影响，煤气化厂房中生产物料以工艺水和灰（渣）处理为主的楼层，局部操作、维护和检修量大、难以开展露天作业的“输煤”楼层、“烧嘴”楼层及“煤锁”楼层，泵等动设备场所及关键设备“法兰连接”楼层，可采用局部封闭的方式。封闭后自然通风条件差，可燃气体或粉尘容易积聚，为避免发生火灾爆炸危险事故，工程设计单位要依据工艺、布置要求和相关标准的规定进行风险评估并采取相应的安全措施。

第1款、第3款，是对外墙开启窗面积和通风的规定。在不影响生产和检修的情况下，要尽量保持敞开，以保证室内良好的自然通风。冬季生产和检修期间要求外窗保持关闭状态时，上述场所的机械通风措施要满足国家现行标准《工业建筑供暖通风与空气调节设计规范》GB 50019和《石油化工采暖通风与空气调节设计规范》SH/T 3004的有关规定。煤粉制备、煤气化、煤气化工艺水处理、煤直接液化装置中的油煤浆制备及煤直接液化催化剂制备等甲、乙类厂房，以及水煤浆制备丙类厂房和水煤浆给料丁类厂房，可不额外设置供消防救援人员进入的窗口。

第2款，现行国家标准《建筑设计防火规范》GB 50016对散发有爆炸危险的混合气体的泄压比C值没有明确规定，本条规定的泄压比C值，是根据已建工程的实际情况制定的，设计时要尽量加大泄压比C的取值。需要注意，采用轻质墙体作为泄压设施时，要采取必要的保护措施如防爆铰链和泄爆螺栓，避免泄爆时伤害到周围人员和设施。泄压设施的设计除本标准规定外，还要符合现行国家标准《建筑设计防火规范》GB 50016的有关规定。

5.3.3 中央控制室是全厂性的控制室，属一类重要设施，区域性

控制室(指控制2个及以上生产装置的控制室)、装置的控制室和仪表机柜间,属区域性重要设施,都是实现生产控制的重要场所,当与有爆炸危险的建筑、设备邻近布置时,设计中的主要难点是爆炸风险量化评估(确定爆炸源位置、产生的爆炸当量,需要保护的人员及设备财产与爆炸源距离等),精准的计算(爆炸荷载作用下抗爆墙设计的解析计算),选择适宜的产品和节点加固处理等主要技术问题。本条规定,应根据爆炸风险评估确定是否需要抗爆要求,当需要进行建筑抗爆设计时,应符合现行国家标准《石油化工控制室抗爆设计规范》GB 50779的有关规定。

5.3.4 生产装置的控制室、仪表机柜间、变配电室、办公室和分析化验室,属于性质重要、经常有人工作或产生明火及火花的场所,因此与发生火灾爆炸事故几率较高的甲、乙类设备的房间不应布置在同一建筑物内,且一般布置在生产装置外。本条第1款要求,当布置在生产装置内时,要避开爆炸性气体环境和爆炸性粉尘环境的区域范围。

第2款,是为了生产装置发生事故时,保护室内设备和人员安全。

本标准第5.3节、第5.4节中“爆炸危险区域范围”按现行国家标准《爆炸危险环境电力装置设计规范》GB 50058中爆炸性气体环境危险区域范围确定。

5.3.5 生产装置的控制室和仪表机柜间,按生产装置设备和建筑物布置要求,一般距甲、乙类生产装置比较近,为了保护室内重要设备和人员生命安全,避免受到生产装置火灾爆炸事故的影响,应根据爆炸风险评估确定抗爆要求。抗爆设计应执行现行国家标准《石油化工控制室抗爆设计规范》GB 50779的规定。生产装置的变配电室面向爆炸危险区域范围侧的外墙要采用耐火极限不低于3.00h的不燃烧实体墙,其构造应符合现行国家标准《建筑设计防火规范》GB 50016的有关规定,且宜考虑抗爆构造如采用配筋砌块、钢筋混凝土实体墙等。

考虑到人员集中的房间若存在可燃介质,会引起安全隐患,规定控制室或化验室的室内不得设置可燃气体、液化烃和可燃液体的在线分析仪器。

5.3.6 本条根据大连某油库“7·16”火灾事故的教训,对距离有爆炸危险性的可燃介质管道法兰较近的消防泵房的外墙提出了防护要求。

5.3.8 封闭厂房内有爆炸危险的房间与相邻房间连通时,要尽量在外墙上开门,利用外廊或阳台联系,或在防火分隔墙上开门时要设置符合本条要求的防护门斗。门斗隔墙要采用不燃烧实体防火隔墙。

5.3.11 泄漏的可燃液体、比空气重的可燃气体和粉尘易在地沟等低洼处积聚,存在安全隐患,若地沟与相邻厂房或构架连通,发生事故时,影响范围会扩大,因此,应采取规定的保护措施。地沟包括管沟和污水沟。煤气化厂房首层由于工艺需要设置的渣水沟,可不执行本条采用封闭盖板分隔方式,但在正常生产和检修维护期间,也应采取防止比空气重的可燃气体、可燃液体和可燃粉尘积聚在渣水沟内的措施,以及采取可燃气体探测报警和通风等安全措施;含可燃液体的污水沟的设置可按现行国家标准《石油化工企业设计防火标准》GB 50160-2008 第7.3.2条的规定执行。

本标准将相对密度大于0.75的可燃气体或蒸气视为比空气重的可燃气体。

5.4 安全疏散

5.4.1 本条结合煤化工建筑物室内工作人员相对较少等特点,对疏散门的设置做了具体规定。

5.4.2 通过调研及考虑到国内煤化工发展趋势,对于高层厂房的疏散距离本着工艺和设备布置、无固定岗位及人数少的情况,并参照现行国家标准《建筑设计防火规范》GB 50016的有关规定,分别对煤气化、煤直接液化的油煤浆制备、煤粉制备、煤气化的工艺水

处理、煤直接液化催化剂制备、水煤浆制备等甲、乙、丙类高层厂房的疏散距离做了规定,既考虑人员疏散安全也兼顾建筑功能和平面布置的需要。

5.4.3 本条明确了构架和检修平台的安全疏散设计,应执行现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定,并对构架和检修平台的垂直梯可作为第二部疏散梯提出了要求。需说明,垂直梯不应靠近斜梯布置,两个梯子之间要满足 5m 间距的要求。

5.4.4 本条参照现行国家标准《建筑设计防火规范》GB 50016 的有关规定,结合煤化工工程的实际情况,对煤粉制备、水煤浆制备、煤气化、煤气化的工艺水处理、煤直接液化的油煤浆制备和煤直接液化催化剂制备的高层厂房的疏散楼梯形式提出了要求。

1 疏散楼梯要尽量布置在爆炸危险区域范围以外,若确需布置在封闭厂房内的爆炸危险区域范围内时,要按照本标准第 5.3.8 条的规定设置防爆门斗。疏散楼梯的墙体要采用不燃烧实体防火隔墙。另外,室外楼梯扶手等设计要符合本标准第 5.5.7 条的规定。

2 “楼梯间具有自然通风条件”,是指楼梯间靠外墙布置,且每 5 层内可开启外窗的总面积不小于 2.0m^2 时,可视为具备良好的自然通风条件。

3 对厂房内平面局部高出的设备操作及检修平台疏散梯的规定。

5.4.5 每个防火分区设置 1 部消防电梯的规定,与现行国家标准《建筑设计防火规范》GB 50016 的有关规定是一致的。消防电梯利用载货电梯时,载货电梯要满足现行国家标准《建筑设计防火规范》GB 50016 关于消防电梯的功能要求。对于防爆电梯,应根据其爆炸危险环境分区及爆炸危险气体或粉尘,分级分组选择防爆电梯的防爆等级。目前国内电梯制造业的防爆电梯最大速度仅能做到 1m/s ,当用于停站高度超过 60m 的厂房时,防爆电梯运行

速度满足不了现行国家标准对消防电梯的行驶速度从首层站到顶层站运行时间不超过 60s 的计算确定的要求,在此情况下,本条规定防爆电梯的运行时间宜按其最大运行速度计算确定。其他技术性能要满足现行有关国家标准的要求,如现行国家标准《建筑设计防火规范》GB 50016 等。电梯的位置应尽量避开爆炸性气体和爆炸性粉尘同时存在的场所。需要注意的是,电梯机房对外的疏散门要采用乙级防火门,且不要正对疏散楼梯和楼梯间出口。

5.5 建筑构造

5.5.1 厂房内楼层除工艺要求铺设钢格栅板上的吊装、安装等开口外,其他具有防火分隔作用的实心楼板(包括耐火保护的钢板)上的吊装、安装等开口处,要采取防火保护措施,如铺设耐火极限、燃烧性能与楼板一致的盖板或在吊装孔周围三面设置防火墙和一面设置甲级防火门的竖井方式。

5.5.2 本条主要是对厂房内可燃液体设备楼板的防火规定,目的是防止厂房内可燃液体流到其下方,对人员或设备造成损害。

5.5.3 要求防爆门排出口之上的维护平台不应设置孔洞,是为避免防爆门爆破时引起人员伤亡。煤粉制备系统中有法兰连接且检修频繁的楼层,采用无孔洞的楼面,便于煤粉及时清理,避免煤粉扩散到下层,遏止煤粉飞扬,减小相邻楼层的危险。

5.5.4 本条是对变配电室与除甲、乙类设备房间之外的其他房间合建时隔墙的规定。供甲、乙类厂房专用的电压不大于 10kV 的配电室,可一面贴临厂房设置,但要采用无门窗洞口、耐火极限不低于 4.00h 的防爆墙隔开,配电室的外门窗要位于爆炸危险区域范围之外,具体场所例如,当可燃气体压缩机厂房与电压不大于 10kV 的专用配电室等贴临布置时,可按现行行业标准《石油化工生产建筑设计规范》SH/T 3017 进行设计。

5.5.5 国家有关部门的调查资料表明,由电线、电缆本身故障引起的火灾和外部火源引燃电缆并蔓延而造成的火灾,占电气火灾

的 40%，并且此类火灾损失巨大，如 1979 年 12 月福建某 220kV 变电所，室外主变 220kV 电流互感器 A 相爆炸，电缆沟起火，火势很大，逐渐向控制室蔓延，幸亏电缆沟入控制室的洞口被封堵，才使大火未能烧及主控室。因此，电缆沟进入变配电室、电缆夹层、控制室等的开口及缝隙，以及电缆贯穿隔墙和楼板的孔隙，均需采取有效的防火封堵措施，防止电缆着火延燃。

5.5.8 在火灾情况下，塑料类门、窗会释放有毒气体，使人窒息；另外，塑料在燃烧状态下会逐步失去强度，形成火糊状物，对消防疏散及灭火救援造成不利影响。考虑到预防火灾、建筑节能和保温等要求，做了本条规定。还应根据使用环境条件，选用耐腐蚀、不易发生火花的金属型材门窗。

6 装置和系统单元

6.1 一般规定

6.1.1 设备和管道采用可燃或易燃保温材料，在施工和检修中因操作不当极易引发火灾。因此，设备和管道的保温隔热材料要选用不燃或难燃材料，避免或减少可能出现的事故。

6.1.7 本条针对煤化工物料及产品的危险程度，结合现代煤化工厂房和生产装置的高大特点，规定了在可能泄漏可燃气体的生产装置和系统单元，设置可燃气体检测报警系统，及时得到危险信号并采取措施。本条系统单元包括储运设施区。

6.1.8 本标准未明确规定的生产装置和系统单元内的其他防火设计要求，要符合现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定，例如，碎煤加压气化技术，由于其工艺的特殊性，气化炉开、停车排放可燃气体中含有焦油、尘等杂质，排放至全厂火炬会造成火炬管道的堵塞，故需要在气化厂房单独设置气化火炬，其设置要求应符合现行国家标准《石油化工企业设计防火标准》GB 50160 装置内高架火炬的规定。

6.2 装置及设备布置

6.2.1 根据煤气化装置的危险性和大型化的特点，并结合已建和在建工程中煤气化工艺要求，综合考虑防止火灾状况下火势向邻近建筑物蔓延和满足高层厂房消防作业需要以及节约用地等几个因素，本条规定了气化工艺中磨煤、水煤浆制备、气化、工艺水处理设备要分开布置在不同的厂房内，厂房之间要保持一定的防火间距。又根据同开同停的原则，对较小规模的煤气化装置，只要各建筑物占地面积总和小于 3500m^2 ，各厂房之间防火距离可不限。

本条对联系紧密、需要紧凑布置的相关设备的防火间距可不限制,做了明确规定。

煤粉设备是指储存、输送有爆炸性危险的煤粉的设备。在煤化工工程中主要是煤粉制备和催化剂制备中的煤粉设备。

6.2.2 本条对粉尘防爆的电气设备与可燃气体和甲、乙_A类可燃液体设备之间的防火间距提出要求,主要根据其火灾危险性,结合相关行业的火灾案例,参照现行国家标准《爆炸危险环境电力装置设计规范》GB 50058 和《石油化工企业设计防火标准》GB 50160 的有关规定确定。

6.2.4 本条所指热风炉是指火焰在封闭的环境内燃烧,与外部环境隔绝的暗火热风炉。在非正常情况下,靠近煤粉设备布置的热风炉炉壁会出现可引燃煤粉的高温,所以规定在有煤粉防爆等级要求的设备之间设置不燃烧实体墙分隔。

6.2.5 本条高压设备指设计压力 p 符合现行行业标准《固定式压力容器安全技术监察规程》TSG 21-2016 中的高压等级($10.0 \text{ MPa} \leq p < 100.0 \text{ MPa}$)的压力容器。

6.2.7 由于事故停车或检修的原因,为了保证安全,设备内部的工艺介质须排放到收集罐或排放槽中,此类设备一般处于地坑内,因排放坡度要求,收集罐或排放槽需要靠近生产区域,这样极易造成可燃气体在低点的积聚,考虑安全原因,又要满足工艺要求,故应采用能有效防止可燃气体积聚的措施,并设置明显的警示标志。

6.2.8 为了达到满足工艺要求又要安全生产的目的,故对循环气压缩机靠近气化炉的布置做了本条规定。

(1)压缩机与煤气化炉同厂房布置,仅针对煤气化工序的压缩机。条件允许单独布置或集中布置的压缩机,仍按本标准第 6.2.21 条,即现行国家标准《石油化工企业设计防火标准》GB 50160 的有关规定执行。

已建成并生产的 10 多套壳牌煤气化装置(包括国内外等生产装置)中,有的生产装置运行已达 10 年之久,到目前为止煤气化装

置运行是安全的。从目前已建和在建的煤气化装置看，在采取严格有效的工艺防火和配套的安全措施的条件下，将压缩机与煤气化炉同厂房布置，在理论上和实际的生产过程中是可行的。

(2) 压缩机布置在气化厂房一侧，便于通风、消防扑救、维护和检修，并减少对厂房内其他场所的影响。

(3) 压缩机尽量布置在敞开或半敞开式气化厂房内，其目的是使压缩机有良好的通风条件，防止可燃气体积聚。压缩机受自然条件限制采用局部封闭形式时，在封闭场所的外墙下部要设置调节通风的百叶窗和机械通风设施，并应符合国家现行标准《工业建筑供暖通风与空气调节设计规范》GB 50019 和《石油化工采暖通风与空气调节设计规范》SH/T 3004 的规定。

6.2.9 甲、乙类仓库火灾危险性大，不应布置在生产装置区内。为既能保证连续稳定生产，又能将生产装置内仓库火灾危险性控制在一定的范围内，少量乙类仓库(总储量不大于 5t)布置在生产装置内时，要位于生产装置的边缘，减少对生产设施的影响。

6.3 煤粉制备

本节从三个方面考虑了防止火灾发生的措施：控制煤粉制备系统内部不发生煤粉着火和爆炸，防止煤粉泄漏到系统外厂房中，将万一泄漏到厂房中的煤粉及时清除。

6.3.1 向磨煤机内连续、可控制地供煤，是减少煤粉制备系统着火和爆炸的重要措施。碎煤仓结构设计不合理，将会使仓中不能形成整体流，发生起拱、堵煤、积粉而引起阴燃闷烧直至起火爆炸。

本条参照现行国家标准《火力发电厂与变电站设计防火标准》GB 50229-2019 第 6.2.1 条并结合煤化工工程设计实际情况，对碎煤仓的设计提出了要求。与现行国家标准《火力发电厂与变电站设计防火标准》GB 50229 不同之处主要有：

(1) 推荐采用圆筒形钢仓，与现行行业标准《火力发电厂设计技术规程》DL/T 5000-2000 第 6.4.4 条一致。将壁面与水平面交

角从 60°提高到 65°。现有工程设计实际在 70°以上。

(2) 仓内衬超高分子量聚乙烯板或不锈钢板,衬板的主要功能是防粘堵,要求光滑,摩擦阻力小,同时要耐磨、阻燃。

(3) 增加温度监测装置和氮气管道接口,当仓内温度或一氧化碳超过设定值时,根据要求手动或自动进入紧急充氮状态。

(4) 对于褐煤和挥发分高的易自燃煤种,在碎煤仓中储存时间过长(如系统事故停车后碎煤仓中存有较多煤),容易阴燃闷烧,引发火灾。本条增加了一氧化碳分析的要求,如果超过设定值,则自动紧急通入氮气等惰性气体进行保护。

(5) 预干燥后的褐煤,水分降低到 12%以下,极易自燃,危险性大,本条要求储存经过预干燥的褐煤的碎煤仓采取充氮保护。

本标准中“充氮保护”是指连续通入氮气等惰性气体,使其气氛基本为氮气等惰性气体,即无氧状态或微氧状态,系统内氧含量在 1%以下,不致于发生氧化燃烧而引起爆炸。“紧急充氮”是指在系统已监测到发生煤氧化及自燃,如温度或一氧化碳浓度超过设定值时,通入较大量的氮气等惰性气体,阻断煤与氧气的接触,抑制煤粉的氧化及自燃,而不是连续通入氮气等惰性气体。因为煤化工工程一般设有空分装置,具备提供氮气条件,本节系统内(指设备或者管道内)惰性气体一般优先选用氮气,但不局限于氮气。

(6) 本条碎煤仓的设计规定包括油煤浆、水煤浆的碎煤仓。

如果工程需要设计非圆筒形碎煤仓时,应符合现行国家标准《火力发电厂与变电站设计防火标准》GB 50229-2006 第 6.2.1 条的关于原煤仓的规定。

高挥发分煤种,按国家煤炭分类,干燥无灰基挥发分大于 37%的长烟煤属高挥发分易自燃煤种。对于干燥无灰基挥发分为 28%~37%的烟煤,在实际使用中因其具有自燃性,本标准亦视作高挥发分易自燃煤种。

6.3.2 本条提出了煤粉制备系统应在惰性气氛下运行的要求。“惰性气氛”亦称“惰性化”,就是加入一定量的惰性气体,以控制其

氧气含量在某一设定值,使煤粉不致发生燃烧爆炸。煤化工的煤粉制备系统与电力锅炉的制粉系统最大的不同是,对煤粉的细度和水分的要求不同。例如,不论煤种,煤化工的煤粉制备系统要求煤粉水分不大于2%(褐煤为5%~7%)。经西安热工院磨煤试验检测,要达到此要求,中速磨煤机出口的气粉混合物温度应在75℃~110℃之间(因煤种不同而不同)。工程设计为适应煤源变动,并保证煤粉温度不低于80℃,取值为105℃~110℃,超出了电力行业对磨煤机出口的气粉混合物温度的规定范围,故本条未对磨煤机出口的气粉混合物的最高允许温度提出要求,而是提出了更严格惰性化要求。现有的煤化工工程都是按此设计的,运行证明是安全的。

惰性气氛的最高允许氧含量与煤种(主要是挥发分高低)、煤粉细度、煤粉水分、磨煤机出口温度等因素有关。对惰性气氛的最高允许氧含量的控制,德国标准《粉磨固体燃料的制粉系统的防爆规范》TRD 413(2000版)规定大气环境条件下,硬煤为14%(湿基,体积分数),褐煤为12%(湿基,体积分数),见表4。

表4 惰性气氛的最高允许氧含量(%) (湿基)

所在地	硬煤(烟煤)	褐煤
煤粉仓内	12	10
磨煤机内(或系统末端)	12(14)	12

注:()中表示的是现行行业标准《火力发电厂煤和制粉系统防爆设计规程》DL/T 5203-2005中表4.1.6中的数据。

国内电力行业按上述要求设计,实践证明是安全的,未曾出现过爆炸现象。在煤化工工程设计中,国外公司结合煤化工煤粉的特点,提出惰性气氛的最高允许氧含量(湿基,体积分数),对于硬煤为8%,对于褐煤为6%。多项工程均按照此要求进行设计,实际运行是安全的。根据经验,着火爆炸多发生在系统开车、停车和事故停车后再启动时,这些情况下危险性更大。因此在这些工况下其氧含量必须严格保证。

煤粉制备系统设置必要的监测仪表(如温度、压力、流量、料位及氧分析、一氧化碳分析等)及完整的控制联锁系统,是保证煤粉制备系统正常运行的关键因素,万一发生设备及操作事故,报警联锁并按正确的程序停车,避免事故扩大而引发火灾爆炸事故。由于煤粉制备系统各工程均有差异,在这里未一一列出在何处设何种监测仪表及如何联锁,应在工程设计时按工艺流程具体确定。

6.3.3 本标准虽未对煤粉制备系统磨煤机出口的气粉混合物的最高温度做出限制,但其最高温度不允许超过煤粉分离收集器的滤袋材料的允许使用温度。煤粉制备系统是一个闭路循环系统,介质的水蒸气含量较高,其露点在70℃左右,为防止温度过低,水蒸气凝结,使滤袋上的煤粉黏结,或使煤粉黏附在设备管道上,或结块,影响煤粉输送,必须使煤粉制备系统介质末端温度高于水蒸气的露点。

电力行业规定中间储仓系统磨煤机出口温度比水蒸气的露点高15℃。本标准结合煤化工行业煤粉制备系统的特点,推荐磨煤机出口温度比水蒸气的露点高20℃~35℃。

6.3.4 参照现行国家标准《高炉喷吹烟煤系统防爆安全规程》GB 16543-2008第5.1.2条编写。

煤化工煤粉制备系统是一个磨煤机入口为正压、出口为负压的闭路循环系统,如果密封性不好,正压部分将会使煤粉泄漏,负压部分将会漏入空气,提高了系统氧含量,这些都不利于防火,故提出气密性要求。

国内外的有关标准规定,按惰性气氛设计的系统,抗爆设计压力可不按0.35MPa设计。考虑到目前国内的中速磨及给煤机产品均已按0.35MPa设计。系统运行时,可能出现氧含量超过允许最高值的情况,故本条仍要求抗爆设计压力为0.35MPa。已有的工程设计均是按此要求进行的。

6.3.5 煤化工煤粉制备系统采用高浓度袋式过滤器一次分离收集,由于煤粉是属于导电可燃爆炸性粉尘,因此应符合现行国家标

准《粉尘爆炸危险场所用收尘器防爆导则》GB/T 17919 的规定。同时结合煤化工煤粉制备系统特点,补充和强调了具体要求:

1 箱体和灰斗一般为非圆筒形,参照电力行业对煤粉仓的要求,相邻两壁交角的内侧(包括箱体、灰斗)应制成圆弧半径不小于200mm的圆弧形,以防止积粉。灰斗壁面与水平面的交角一般不小于65°,对黏接性强的煤粉,灰斗壁面与水平面不小于70°。

2 煤粉阴燃闷烧将会进一步起火爆炸,损坏滤袋,为防止万一收尘器内堆积煤粉阴燃闷烧(如停车后清灰不彻底),要求其气体出口设置一氧化碳检测报警设施,同时当仓内一氧化碳、温度等超过设定值时,采取自动紧急通入氮气保护。

3 进入袋式过滤器的气粉混合物中水蒸气含量高,露点在70℃左右,袋式过滤器散热降温如低于露点,将会产生粘袋、堵塞引发事故,故要求其外表面设伴热保温,控制温度在80℃(高于露点)。

4 某工程曾发生过因清灰氮气气源压力不稳定,有时低于要求值、清灰强度不够,使部分滤袋上煤粉过厚,使滤袋碳化,发生着火事故。故提出气源压力稳定、清灰可靠的要求。

6 灰斗积料堵塞漫至滤袋同样会引发上述事故。灰斗温度异常亦可反映灰斗料位情况。选择可靠的料位计很关键,电容式料位计经实验证明可靠性差,射线料位计可靠性很高,但其使用受限。本标准未指明用什么型式的料位计,但要求可靠性高。

6.3.6 煤化工用的煤粉的水分低、粒度细、易燃易爆,因此无论是送至煤气化的加压给料,还是送至煤液化的油煤浆制备,煤粉输送必须是密闭输送。输送和处理煤粉的机械,如称重给煤机、旋转给料机、螺旋输送机、埋刮板输送机、纤维分离器等,都应是气密性良好的,保证煤粉不外漏,空气又漏不进去,因此要求其轴封处喷吹密封氮气,使密封可靠。密封气的选择方法是:主要进入系统内部的密封气采用氮气,主要逸至环境的密封气,为保证人身安全、不被窒息而采用空气。注意这类设备内部应没有物料积聚的部位,并能排尽。经过预干燥后的褐煤粒度小、易燃易爆,可参照本条执行。

6.3.7 参考电力行业煤粉仓的有关规定，并结合煤化工工程设计实际情况，提出了本条要求。实际煤化工项目中，煤粉仓及其锁斗、给料仓等，壁面与水平面的交角按 75° 设计，本条规定不应小于 70° ，比电力行业规定大 $5^{\circ}\sim 10^{\circ}$ 。根据煤化工煤粉的特点，提出了连续充氮保护、外表面伴热保温及出口助流要求。

煤化工所用煤粉粒度细、水分低、温度高，其自燃爆炸危险性较高，只要煤粉仓中存有煤粉，不论系统是否处于运行状态，煤粉仓都要充氮保护，控制氧气含量。

为了实时监控煤粉仓的运行状态，应设置料位、温度等检测仪表。温度过低，煤粉流动性变差，容易堵塞；温度超高，表明煤粉阴燃或着火，均应采取防范措施。

6.3.8 本条是强制性条文，必须严格执行。为了防止空气等含氧气体侵入煤粉仓，煤粉仓的进粉口和出粉口必须具有锁气功能。

6.3.9 电力行业规定，当制粉系统设置有中间煤储仓时，宜设置该系统停止运行后的放粉系统。煤化工煤粉制备系统设置有中间煤粉储仓，正常运行时充氮保护。系统停止运行后，煤粉仓若存有煤，长期充氮保护是不经济的，故也应设放粉系统，放粉系统应同（加压）给料系统或给料系统一并考虑。

6.3.10 煤种不同，煤粉产生自燃的情况也会不同。某工程采用 V_{daf} 约为12%的次烟煤，发生严重的煤粉泄漏事件，未发生起火现象，而另一工程采用 V_{daf} 为38%以上的长焰煤，煤粉喷出即着火。经过预干燥的褐煤粉在大气中几个小时后即阴燃直至起火。及时将万一泄漏出来的煤粉清走是重要的防火措施之一。适宜的清扫方法，国外推荐干法——（负压）真空清扫，国内电力行业在运煤系统推荐用湿法——水力清扫，而对煤仓间（不宜水冲洗部位）则应采用真空清扫设施。

煤化工煤粉制备系统及其他系统正常操作不会有煤粉泄漏，万一设备及管件、阀门发生故障，有可能会有煤粉泄漏。本条推荐采用负压吸尘清扫设施。没有强制一定采用真空清扫设施，是兼

顾国内工程的不同条件,某些已运行的工程未设负压清扫的现状。用压缩空气吹扫聚积的煤粉将会引起二次扬尘,爆炸起火很危险,因此严禁采用压缩空气吹扫。

负压吸尘清扫设施的管道都是固定式的,机械动力部分一般分为固定干式吸尘机组和移动式负压吸尘车两种类型。用户在2个及以上的宜选用移动式负压吸尘类型(可节省投资),单独用户宜选用固定干式吸尘机。

对于褐煤或易自燃高挥发分煤种,因其自燃容易起火,本条规定必须设负压吸尘清扫设施。

6.3.11 本条为管道结构及配置上防止煤粉堆积和煤粉泄漏的要求。法兰连接是泄漏事故点之一。煤粉制粉系统操作压力低,连接法兰必须有足够的强度和刚性以保证不泄漏。可以不用法兰连接的地方一律采用焊接,如煤粉收集袋式过滤器,气粉混合物进口和气体出口法兰大且多为矩形,建议采用焊接。

煤粉制备系统尽量减少水平管道布置和弯头数量,减少煤粉在系统内堆积的可能性。

6.3.12 煤粉堆积时间过长容易引起自燃和二次扬尘,故要求煤粉制粉系统的设备和管道以及与制粉系统同厂房布置的设备和管道的保温表面要光洁,方便及时清扫堆积的煤粉。

6.3.13 本条对煤粉制备系统需要设置防爆门的部位和防爆门的设计做出了规定。

(1)本条要求煤粉制备系统中的煤粉收集袋式过滤器和可能超压的煤粉仓,应设置防爆门:

1)按照电力行业规定,在惰性气氛下运行的煤粉制备系统,可不设防爆门。煤化工行业虽在惰性气氛下运行,但为了安全起见,防止氧含量超过允许值或煤粉堆积阴燃引发的事故,在煤粉收集袋式过滤器上设置防爆门。

2)煤气化装置的常压煤粉仓属于非常情况下可能超压的煤粉仓。煤气化煤粉仓是在充氮下运行,不会发生爆炸,而在煤粉仓上

设置爆破板的目的在于防止煤粉仓装料袋式过滤器堵塞,或者煤粉仓至袋式过滤器的气流量过大,流速过高,而引起管道阻力过大憋压而引起煤粉仓超压。煤气化工程多起煤粉仓爆破板破裂的原因是因为煤粉仓至袋式过滤器的管径过小,在煤粉循环或气化炉开停车时气体流量大、阻力过高。解决途径是增大管径,此爆破片一般不会破裂。

3)现行行业标准《火力发电厂煤和制粉系统防爆设计技术规程》DL/T 5203-2005 规定的防爆门设计,均是按可能渗入空气引起爆炸的情况来考虑泄压(泄爆)面积。煤化工工程均采用氮气保护,不存在这种情况。故本标准未提及。

(2)防爆门的设计参照国家现行标准《火力发电厂与变电站设计防火标准》GB 50229-2006 第 6.2.6 条及《火力发电厂煤和制粉系统防爆设计技术规程》DL/T 5203-2005 编写。

1)在煤粉收集袋式过滤器的防爆门推荐膜板式,为了防止爆炸引起膜板破裂压力泄出后空气大量漏入过滤器内氧气突增而引发更大的爆炸事故,膜板外应带自动启闭的门,泄压时开启,压力泄完后立即关闭,阻止空气漏入过滤器。

2)为了防止在非正常条件下有可能超压的煤粉仓防爆门不被破坏,其爆破膜的设计爆破压力应等同于煤粉仓的设计压力。其泄压面积应按煤粉仓出口堵塞时能从爆破门(膜破后)将所有进入煤粉仓的气体引起的超压及时泄放出去考虑。

3)在防爆门后加很长的带弯头引出管或在防爆门前加根部阀,或在防爆门后加挡板的做法,都是违反现行行业标准《火力发电厂煤和制粉系统防爆设计技术规程》DL/T 5203 的规定的,因此本条提出了引出管的原则要求,具体要求需查现行行业标准《火力发电厂煤和制粉系统防爆设计技术规程》DL/T 5203 的有关规定。

6.4 其他

6.4.3 软管站介质一般包括水、蒸汽、氮气和工厂空气,用途是清

洗、吹扫、置换和初期小范围灭火等,是煤气化装置重要的防火措施之一。如用于设备、管道检修时可燃气的置换,设备、管道内部和楼面的清洗,还具有防火、灭火和除尘功能。软管站水管的使用范围主要是指有地漏的混凝土楼面或地面。钢结构楼面由于密封差又无地漏,泄漏点多,存在二次污染等原因,不适合水力冲洗。钢结构楼面一般可不设水软管。软管站覆盖半径一般为15m。

6.4.5 气化炉、高压飞灰过滤器、旋风过滤器等设备进出口法兰采用金属焊接垫圈(图2),可有效防止因应力变化引起垫片损坏而造成危险介质的泄漏。

6.4.6 带传动易积聚静电,可能会产生火花,所以本条规定可燃气体压缩机、液化烃和可燃液体泵不得使用带传动。如果在爆炸性气体环境和爆炸性粉尘环境区域范围内的其他转动设备确实需要使用传动带时,则应采用防静电传动带。

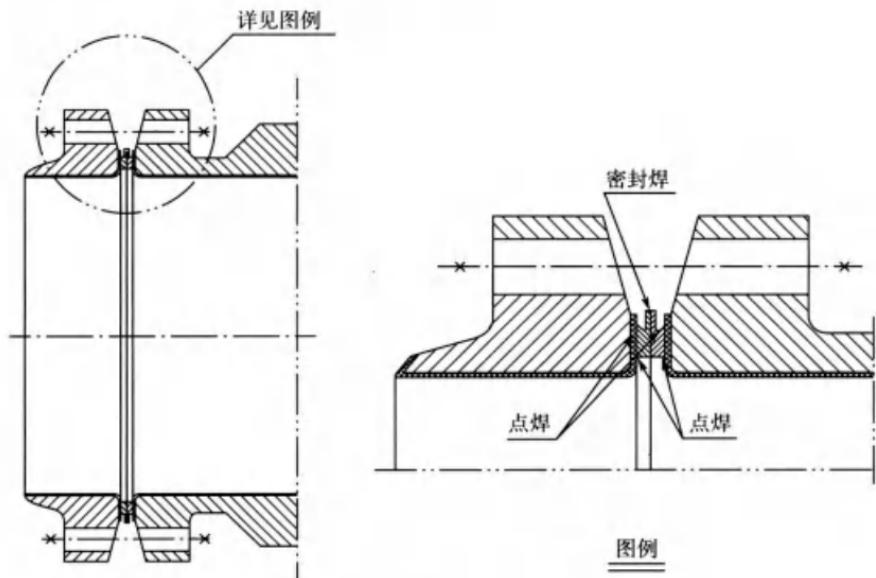


图2 法兰采用金属焊接垫圈示意图

7 储运设施

7.1 煤 储 运

7.1.1 化学性质不同的煤种要分别堆放,以采取不同的安全措施。相邻煤堆底边之间的距离不应小于10m,是参照电力行业的经验确定的。

7.1.2 在落煤点设置除尘设施的目的是为了降尘,降尘一是满足环保要求,二是可以预防煤尘爆炸引起火灾。除尘设施建议选用在实际应用中效果较好的超声雾化除尘、负压诱导除尘等。

7.1.3 由于环境保护条件的提高,近年来大型储煤库已有较多应用,封闭式储煤库除要满足露天煤场的相关要求外,还要求设置通风和手动喷水设施。当储存易自燃煤种时,地下廊道内的电气设施应能防爆。

7.1.4 由于环境保护条件的提高,近年来筒仓储煤的方案在煤化工项目建设中已占有相当的比重。国内已有筒仓爆燃的先例,充分说明制订相关安全措施是十分必要的。防爆门是防止筒仓遭到爆炸破坏的最后防线,其防爆总面积应以不低于筒仓实际体积数值的1%为宜。防爆门总有效泄压面积和结构形式的设计可参照现行行业标准《火电厂煤和制粉系统防爆设计规程》DL/T 5023、《火力发电厂烟风煤粉管道设计技术规程》DL/T 5121的有关规定。

筒仓下部封闭不好会使大量空气漏入,可能形成烟囱效应,从而加剧煤的自燃,因而应有防止空气漏入的措施,如采用惰性气体覆盖。筒仓内储存褐煤或易自燃的高挥发分煤种时,煤的可燃气体析出和聚积有可能造成爆炸,因而宜采取惰化保护措施,防止空气与煤粉混合物及可燃气体在筒仓内积聚。

7.1.5 本条对煤储运系统应采取的安全措施做了规定。

1 煤储运系统带式输送机落煤管转运部位,为减少煤撒落和积存,可采取的措施有:增大头部漏斗的包容范围;采用双级高效清扫器;落煤管底部加装料流调节器或导流挡板,增加物料的对中性;与导煤槽连接的落煤管采用矩形断面;采用拱形导料槽增大其内部空间,利于粉尘的沉降;承载托辊间距加密并可采用45°槽角;设置适当的助流设施。

在设计转运点时,尤其对于易自燃煤种,应避免撒料、积料现象。若煤粉沉积在带式输送机尾部,而且长时间得不到清理,就会形成自燃,这是造成煤化工项目多起烧毁输送带重大火灾事故的主要原因。为杜绝此类事故的发生,制订重点防范事故措施非常必要。

2 自身摩擦升温的设备是导致煤储运系统发生火灾的隐患。近年来煤储运系统的火灾事故中,不少是由于输送带改向滚筒被拉断,输送带与栈桥钢结构直接摩擦发热而升温,引起堆积煤粉的燃烧,酿成烧毁输送带及栈桥塌落的重大事故。鉴于此,对带式输送机应设置安全防护设施做了规定。

3 根据现有产品情况,考虑在满足使用要求的同时,尽量选用防火性能好的材料,避免发生火灾后引起火灾蔓延或延迟燃烧速度。

4 易自燃煤经过一段时间的堆放会产生自燃,从储煤设施取煤的带式输送机上应设置明火监测装置,发现明火后应紧急停机并采取措施灭火,以防止着火的煤进入煤储运系统。

6 破碎机前设置除铁装置是为了保护破碎机。齿辊破碎机的齿牙、颚式破碎机的颚板以及反击式破碎机的冲击锤和反击板碰到金属、铁器很容易损坏或被坚硬的铁器卡住。为了保护破碎机部件,应使进入破碎机的物料不含金属、铁器。同时可防止铁器与破碎机齿辊碰撞产生火花而引起煤尘爆炸。

7.1.6 本条是强制性条文,必须严格执行。煤储运系统中各储运设备之间的程序联锁,除了相关设备按设定程序正常启停联锁外,

还包括事故停机联锁，当发生无法避免的火灾等事故时，应采取事故停机联锁措施，防止火灾蔓延扩大。

7.1.9 与电除尘器配套的电机选用防爆型的要求，是根据电力行业运煤系统的实践经验制定的，电力行业运煤系统采用电除尘方式已很普遍。需要注意的是，从电除尘的机理分析，并非所有场所都适合采用电除尘方式，对于煤粉制备系统场所，不适合采用电除尘器，对于煤化工工厂煤储运系统，应当根据煤尘的性质来确定是否能采用电除尘方式，可参照现行行业标准《火力发电厂运煤设计技术规程 第2部分：煤尘防治》DL/T 5187.2 的有关要求确定。当采用高压静电除尘器时，控制煤质干燥无灰基挥发分小于46%，与电力行业相关标准一致，是根据西北电力设计院在龙口电厂所作“高压静电除尘工业性爆炸试验”（褐煤）及在辽宁发电厂所作“高压静电除尘破坏性爆炸试验”报告编制。

7.2 可燃液体、可燃气体地上储罐

7.2.1 钢制储罐与非金属储罐比较具有防火性能好、造价低、施工快、防渗漏性好、检修容易等优点，故要求地上储罐采用钢制储罐。

1 本款规定是为了控制储罐事故风险，目前我国最大浮顶储罐单罐容积为150000m³。

2 根据现行国家标准《泡沫灭火系统设计规范》GB 50151-2010第4.4.1条的规定，采用钢制单盘式或双盘式的内浮顶储罐，泡沫的保护面积应按罐壁与泡沫堰板间的环形面积确定；其他内浮顶储罐应按固定顶储罐对待（即泡沫需要覆盖全部液面）。安装在储罐罐壁上的泡沫发生器发生的泡沫最大流淌长度为25m，为保证泡沫能够有效覆盖保护面积，故规定“固定顶和储存甲、乙A类可燃液体内浮顶储罐直径不应大于48m”。

3 储罐过高不利于储罐发生火灾时进行消防救援，为此本款规定限制储罐罐壁高度不应超过24m。

4 本款规定的目的是为消防人员上罐灭火创造有利条件。

7.2.2 本条是强制性条文,必须严格执行。储存沸点小于45℃或真实蒸气压(即液体最高储存温度下的蒸气压。真实蒸气压为液体气化率为零时的蒸气压,又称泡点蒸气压,根据现行国家标准《石油产品蒸气压测定 雷德法》GB/T 8017 测定的雷德蒸气压换算得到)不小于76.6kPa的甲_B类液体在常温常压下极易挥发,所以需要采用压力储罐、低压储罐或低温常压储罐来抑制其挥发。对第1款、第2款具体要求说明如下:

1 用压力储罐或低压储罐储存甲_B类液体,罐内易燃气体浓度较高,要求“设置氮封保护系统”是为了消除储罐爆炸危险;要求“密闭回收处理罐内排出的气体”是为了避免有害气体污染大气环境。

2 对沸点小于45℃或真实蒸气压不小于76.6kPa的甲_B类液体,采取低温储存方式也是一种可以抑制挥发的有效措施。“控制储存温度低于液体闪点5℃及以下”,气体挥发量就很少了,基本处于安全区域。要求“设置氮封保护系统”,是为了防止控制措施不到位或失效的安全保护措施。

7.2.3 本条是强制性条文,必须严格执行。储存沸点不小于45℃或真实蒸气压小于76.6kPa的甲_B、乙_A类液体可以常温常压下储存,但仍有较强的挥发性,所以规定“应选用浮顶储罐或内浮顶储罐”来抑制其挥发。

有些甲_B、乙_A类液体化工品有防聚合等特殊储存需要,不适宜采用内浮顶储罐。所以,本条规定允许这些甲_B、乙_A类液体化工品选用固定顶储罐、低压储罐和容量小于或等于50m³的卧式储罐,但需采取氮封、密闭回收处理罐内排出的气体、控制储存温度低于液体闪点5℃及以下等必要的安全保护措施。

3 对于二硫化碳这种易挥发的液体,一般采用固定顶储罐或卧式储罐储存,罐内用水和惰性气体密封。

7.2.6 浮盘采用易熔材料制作的内浮顶储罐在发生火灾时浮顶

易失效并形成全液面火灾,故本条要求采取氮气密封保护等安全措施。

钢质单盘或双盘式浮顶由不小于5mm厚的钢板焊接而成,其耐火性能、密封性能和结构强度均强于组装式浮顶,本款规定是为了提高单罐容积大于5000m³的内浮顶储罐的安全性能。

7.2.8 依据现行国家标准《建筑物电子信息系统防雷技术规范》GB 50343-2012第3.1.3条规定,平均雷暴日数 $T > 90$ 的地区为强雷区, $40 < T \leq 90$ 的地区为多雷区, $25 < T \leq 40$ 的地区为中雷区, $T \leq 25$ 的地区为少雷区。燃烧性能指标见现行国家标准《建筑材料及其制品燃烧性能分级》GB 8624。

7.2.10 一个储罐组内储罐数量越多,发生火灾事故的机会就越多,单体储罐容量越大,火灾损失及危害就越大,为了控制一定的火灾范围和火灾损失,根据储罐容量大小规定了最多储罐数量。由于丙B类油品储罐不易发生火灾,而储罐容量小于1000m³时,发生火灾容易扑救,故对这两种情况不加限制。

7.2.11 本条规定是参照现行国家标准《石油化工企业设计防火标准》GB 50160制定的。

7.2.12 本条对可燃液体储罐罐组设置防火堤做出了规定。

2 规定的防火堤耐火极限是考虑了火灾持续时间确定的。只要防火堤自身结构能满足此要求,不再采取在堤内侧培土或喷涂隔热防火涂料等保护措施。

3 为防范罐体在特殊情况下破裂,造成满罐液体全部流出的极端事故,参照国外标准,本条规定防火堤内有效容量不应小于最大储罐的容量。

4 参照现行国家标准《石油库设计规范》GB 50074制定。防火堤的堤外高度提高至不超过3.2m,主要是针对受地形、场地等条件限制或标准限制,而堤内储罐数量少,单罐容量又很大的情况提出的,目的是在满足消防车辆实施灭火的前提下,尽量节约用地。最低高度限制主要是为了防范泡沫喷洒,故从防火堤内侧设

计地坪起算;最高高度限制主要是为了方便消防操作,故从防火堤外侧地坪或消防道路路面起算。

5 防火堤大于高度 2.2m 增加了消防救援难度,本款关于操作平台内容的规定是为消防救援创造有利条件。操作平台面积是考虑移动消防炮最大仰角 78°,两人操作,水炮长度近 1m,加上管道等制定的。

7.2.13 本条第 1 款~第 4 款是参照现行国家标准《石油化工企业设计防火标准》GB 50160 制定的。第 5 款是参照现行国家标准《储罐区防火堤设计规范》GB 50351-2014 制定的。第 6 款规定考虑在不增加管道敷设难度,不增加罐组雨水排放口的前提下(罐组雨水排放口过多不利于安全管理),满足“单罐单堤”要求,尽量减小漏油及流淌火漫延范围。

7.2.14 丙类液体储罐一般采用固定顶储罐,甲类和乙_A类液体(如轻污油)进入丙类液体储罐会使丙类液体改变为甲类和乙_A类液体,火灾危险性大增,以往油罐火灾事故就有这样的案例,故本条做此规定加以防范。

7.2.15 相关研究成果表明,高温下泡沫灭火剂会失效,无法使用,水施加到超过 100℃ 的油品表面也会发生沸溢现象,导致油品飞溅。本条的规定,旨在避免高温油罐火灾事故影响范围扩大。

7.2.17 本条要求主要是为了满足油罐区发生火灾时,方便消防人员操作及消防车辆接近着火油罐,实施消防救援。

7.2.18 本条是强制性条文,必须严格执行。甲_B、乙类液体的固定顶罐内油气浓度较高,经常处于爆炸危险范围内,要求其通气管上设阻火器,是为了防止外部火源引爆油罐;要求其通气管上设呼吸阀,是为了减少小呼吸油气损耗;要求采用氮气或其他惰性气体密封保护的储罐还应设置事故泄压设备,是为了防止氮气或其他惰性气体密封保护设备失灵对储罐造成破坏作用。常用的事故泄压设备有卸压人孔、呼吸人孔等。

7.2.20 可燃液体的储存温度也是影响安全的一个重要因素,储

存温度高,可燃液体挥发出的蒸气就多,于安全就不利。本条规定
的各类液体的储存温度,兼顾了安全因素和可操作性。

7.2.21 储存于固定顶罐内的乙_B和丙类液体的储存温度,高于本
标准第7.2.20条规定的储存温度时,挥发出的蒸气会在罐内
气相空间形成爆炸性气体,采取氮封保护措施可以防范爆炸和火
灾事故发生。

7.2.22 本条采取温度控制措施的目的是,防止实际储存温度超
过设计储存温度。

8 管道布置

8.0.1 本条是强制性条文,必须严格执行。蒸气和热水管道与可燃液体、可燃气体和液化烃的管道敷设在同一条管沟内,会造成可燃液体、可燃气体和液化烃的管道温度上升,压力增高,影响正常运行,甚至威胁到安全,故需加以限制。

8.0.4 本条规定意在避免固体物料在管道内积聚,保证管道通畅,减小管道磨损,确保管道安全运行。

8.0.5 加热炉燃气管道压力过低[0.05MPa(g)]容易产生气压波动回流,发生回火爆炸,需设低压自动控制或阻火器作为保护措施。

8.0.6、8.0.7 这两条是强制性条文,必须严格执行。液化烃、甲_B和乙_A类液体一旦泄漏,处理措施难度大,且泄漏后易发生火灾事故。本条要求意在加强与液化烃、甲_B和乙_A类储罐连接的液体管道上阀门的可靠性,并在事故时能迅速关闭阀门。

紧急切断阀快速关闭时,管道上游压力加上水击力易导致金属软管破裂,故柔性连接不宜采用金属软管。可通过管道布置或设置弹簧支吊架来实现管道与储罐的柔性连接。

8.0.8 本条是强制性条文,必须严格执行。本条要求进、出生产装置和储罐区的可燃液体、液化烃和可燃气体管道,应在生产装置和储罐区的边界处设隔断阀和8字盲板,是为了使生产装置在因检修或其他原因停车期间与外部系统隔离,确保安全。

8.0.9 大连某油库“7·16”火灾事故教训之一是供电系统被摧毁后,储罐进出油管道上设置的电动阀不能快速人工关闭,致使事故规模扩大。本条规定意在避免类似情况发生,建议小于或等于DN600口径的电动阀人工开关时间以不大于10min为宜。

9 消防给水排水、灭火设施和消防站

9.1 一般规定

9.1.1 本条要求稳高压消防给水系统维持系统压力宜采用稳压泵形式,系统压力大于或等于0.7MPa可满足煤化工工厂一般建(构)筑物的消防水压力要求。对于煤化工工程所特有的高大厂房,本标准第9.5节条文有相关要求。

本标准要求“煤化工工厂装置区、储运区、动力及公用工程设施区、辅助设施区应设独立的高压或稳高压消防给水系统”,相对于现行国家标准《石油化工企业设计防火标准》GB 50160规定大型企业装置区、罐区等应设独立的稳高压消防给水系统,是提高了要求,主要考虑新型煤化工产业技术路线尚未完全成熟,煤气化及备煤等高大厂房消防问题较复杂等,提高要求是必要的。

本标准提出丁、戊类辅助生产设施区(含生产管理区)可采用低压消防给水系统,最不利点消火栓水压不低于0.25MPa,可保证水枪充实水柱不低于13m。

9.1.3 本标准主要针对煤化工产业所特有的保护对象或场所的室内外消防冷却及灭火设施的设计,其余场所火灾危险类别或保护对象的火灾危险性质与石油化工行业类似,采用现行国家标准《石油化工企业设计防火标准》GB 50160可满足工程建设要求,本标准不再重复规定。

9.2 消防设计流量和用水量

9.2.1 本条对煤化工工厂的消防给水系统的设计用水量做了原则规定。一次火灾消防用水量是指某处一次火灾消防设计流量和火灾延续时间的乘积。

9.2.2 大型煤化工工厂设置 2 座消防泵站互为备用,提高了消防给水系统的安全性。由于煤气化装置高大厂房,消防冷却灭火时系统所需压力较高,一般针对煤气化装置区设置消防泵站,这样分区供水更加合理。但需要注意,对于大型工厂如何设置消防泵站,应统一规划。

9.2.3 本条中原煤处理量是指一个系列的处理量,目前一个系列 4 台气化炉原煤处理最大量不大于 10000t/d 。

煤粉制备、水煤浆制备、煤直接液化、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备厂房等是煤化工所特有的高大厂房,其室外消火栓系统设计流量是参照现行国家标准《建筑设计防火规范》GB 50016 中甲、乙、丙类厂房一次灭火的室外消火栓用水量,并根据原煤处理量分级综合确定的。当煤粉制备厂房与煤直接液化或粉煤气化厂房合建、筒仓或圆形煤库成组布置时,火灾危险性加大,发生火灾扑救困难,因此,适当地提高了室外消火栓系统的设计流量。

9.2.4 煤气化装置的后续生产装置和煤直接液化装置及其后续生产装置,因其火灾危险性与石油化工行业生产装置类似,故可参考按照现行国家标准《石油化工企业设计防火标准》GB 50160 有关石油化工或合成氨及氨加工部分的规定估算消防用水量。

空分装置,其消防用水量按照现行国家标准《石油化工企业设计防火标准》GB 50160 的规定执行,宜为 $120\text{L/s} \sim 200\text{L/s}$ 。

9.2.7 本条规定主要是根据公安部大型火灾案例扑救经验,提出大型、中型煤化工工厂增加 10000m^3 消防储备水量,满足移动消防车取水的要求。

1 工厂若设有 3 套高压或稳高压消防给水系统,只要给水系统之间消防管网达到互联互通要求,备用消防储水量可减去相应的有效供水量。

2 临近天然水源是指工厂附近已有湖、河、水塘等自然或人工水体,可提供备用消防水源,工厂采用远程供水系统供水,或采

用消防车，在天然水源岸边通过设置的固定取水设施和接口取水，且均具备远程有效供水能力（从接警开始行动到正常出水的时间控制约40min内）。

9.3 消防水源和消防泵

9.3.1 本条对工厂生产给水管网进水管提出数量和管径的设计要求，目的是提高消防给水由工厂水源直接供给时，工厂生产给水管网的进水管的供水能力。

9.3.3 本条规定是要求工厂布置消防水泵时，应尽可能远离爆炸危险源，提高消防设施可靠性，同时也是因为消防水泵作为重要设施，火灾时会有人员操作的可能性，远离爆炸危险源可减少人员伤害，如设有消防值班室时，应通过消防安全评估解决。

9.3.4 本条第4款，所指阀门不包括管路上设置的专用于检修的阀门。

9.3.5 本条要求消防泵站设置的消防水泵组应在火灾时满足保护区域内稳高压消防给水系统所需流量和压力的要求，同一泵组型号一致，可提高供水效率。

9.3.6 目前全厂占地面积不超过 1000000m^2 、设置1个消防泵站的工厂很多，消防给水系统均按照现行国家标准《石油化工企业设计防火标准》GB 50160进行设计，采用稳压泵维持系统压力大于或等于0.7MPa。但粉煤气化、煤直接液化的油煤浆制备等高层厂房按本标准要求设置室内消火栓等灭火设施时，系统压力可能不满足室内有可燃物的最不利点处消火栓或固定消防系统灭火需要，若为了满足粉煤气化等高层厂房最不利点消防要求的水压，需要提高整个系统的管网压力等级，对于已建项目改造非常困难，因此，本标准提出当受条件限制时，应考虑设置区域消防给水增压泵，当发生火灾并确认后，及时启动该泵，使室内管网的压力和流量达到设计要求。

本条第2款的规定，主要是为了在全厂消防给水系统的消防

水泵启动之前满足室内初期灭火所需的水量。

9.3.7 本条规定了稳压泵的设计压力和设计流量,稳压泵设计流量过小会导致稳压泵频繁启动,过大会影响消防主泵的启动时间;稳压泵的设计压力应满足煤气化等高层厂房室内消火栓系统充满水,最不利点消火栓的静水压力不低于0.15MPa。

9.3.8 煤化工工厂稳高压消防给水系统供水能力大,往往是3台水泵依次启动,消防水泵在接到报警后2min以内全部投入运行可满足灭火救援要求。强调消防水泵依管网压降信号自动启动,是为了使系统尽快达到最大供水能力。

9.3.9 目前国内消防控制柜主要针对380V低压泵控制柜提出的相关技术要求,煤化工工厂消防水泵均为6000V以上高压电机驱动泵,无对应的消防产品标准可采用。目前煤化工工厂大都采用DCS、PLC或F&S系统控制,为了规范消防控制系统,本标准首次提出消防水泵站可采用安全可编程序控制器(PLC)独立控制,系统压力、水位及报警信号、水泵运行及控制阀启闭状态信号应实时显示并记录。目前市场上用于安全可编程序控制器失效概率(PFD)一般要求不小于0.01%,主要技术要求为:

- (1)控制器、电源模块、网络通信模块均1:1冗余设计;
- (2)当AC 220V电源出现故障时,控制系统连续工作时间不少于3h;
- (3)需要联锁启动控制的I/O卡1:1冗余配置。

此外,还要求控制系统具备与厂区计算机监控管理系统通信的功能,具备接收火灾报警控制器的报警信号等要求。

9.4 室外冷却、灭火设施

9.4.2 本条对室外消防给水管道的布置提出了要求。生产装置内设有检修道路时,在道路边设置消防给水管道,增加了系统的可靠性。

对于可燃液体、液化烃的火车和汽车装卸栈台,提出了沿消防

车道设置消防给水管道及消火栓,符合总图道路布置要求;火炬区可采用枝状消防水管网,符合实际情况,便于操作。

通过调研了解到我国北方严寒地区已建成的石油化工企业消防给水管道,管顶距冰冻线虽然满足不小于150mm的要求,但因消防管道内的水平时不流动,冬季管道出现冻裂事故,工程设计中可视具体情况适当增大严寒地区管顶距冰冻线的距离。

9.4.4 本条对煤化工工厂室外消防炮、水喷雾、泡沫等灭火设施的设置部位及选用的系统类型做了规定。

(1)煤气化装置的后续生产装置和煤直接液化装置及其后续生产装置,一般采用露天构架或地面设备群布置,对于生产装置内固定水炮不能保护的特殊危险设备及场所,本条推荐设置水喷雾灭火系统,主要是进行防护冷却和控火,但应注意带压设备的喷射火不适用水喷雾系统扑救,工艺安全泄压设施可防内压升高发生爆炸事故,安全联锁保护设施可切断物料使火熄灭。

“特殊危险设备及场所”主要是指着火后人员难以靠近,若不及时给予水冷却保护会造成重大事故或损失的设备及场所,由于标准无法对特殊危险设备及场所进行界定,工程上一般根据工艺包要求或经过工艺安全软件分析再确定。例如,无隔热层的可燃气体设备,若自身无安全泄压设施,受到火灾烘烤时,可能因内压升高、设备金属强度降低而造成设备爆炸,导致灾害扩大。对于不属于上述特殊的危险设备(如高塔等)及场所,可不设水喷雾(水喷淋)系统的原因如下:

1)露天生产装置的高大构架及设备群均设有避雷设施,钢结构承重梁及支架、设备支座均设置耐火保护,地面火灾不会危及构架主体结构的安全,且设备有不可燃隔热保温层及安全泄压设施,受到火灾烘烤时,不会因内压升高、设备金属强度降低而造成设备爆炸。反之,当设备发生泄漏时,可采用设备的安全连锁保护、安全隔离、安全泄压等措施切断物料使火熄灭,同时采用地面水炮对构架主体结构或塔底部和周围设备进行冷却保护,起到控火的作用。

用,再通过消防竖管、消防蒸汽系统、小型灭火器和移动消防力量等常规消防手段扑灭火灾。

2)高塔着火的部位可能发生在塔顶或塔底地面。由于设备位于敞开环境,当塔底物料泄漏发生火灾时,可采用设备的安全连锁保护、安全隔离、安全泄压等措施切断物料使火熄灭;再有塔器周围的平台采用钢格栅板不会积液,塔泄漏的液体可以排至地面,使得大面积池火只可能在地面上出现,一般大面积池火的火焰最大高度大约8m(API 520),消防水炮能够将水喷至火焰高度的上方,且对塔器的支撑裙座进行了防火处理,至少耐火2.00h。

3)若塔顶部出现火灾,塔顶设有安全泄压设施,受到火灾烘烤时,不会因内压升高、塔体金属强度降低而造成爆炸,同时塔的附近设有消防水炮和消火栓,从底部进行冷却,对周围的设备也进行冷却,顶部的喷射火只会导致塔的顶部局部损坏,不至于出现结构整体性的破坏,导致塔体倒塌,从而可能危及周围的设备或人员,导致灾害扩大。再有高空中除静电火花外不存在其他外部点火源,高塔发生由外部点燃泄漏气体的几率较小。

(2)大型空分装置高压氧设备进出口法兰密封面及阀组区设置水炮,主要用以覆盖该装置的大型高压氧设备进出口法兰密封面及阀组,并对其周围设施防护冷却,防止火灾蔓延。本标准所指的大型空分装置是指制氧量不小于 $30000\text{m}^3/\text{h}$ (标准大气压下)规模的空分装置。

(3)煤粉制备、水煤浆制备、煤气化、煤气化的工艺水处理、煤直接液化的油煤浆制备和煤直接液化催化剂制备等煤化工工程所特有的高层厂房,建筑物火灾危险类别除水煤浆制备厂房为丙类外,其余均为甲、乙类,且室内部分场所存在粉尘和气体双爆炸危险环境,室外设置地面固定消防水炮,可对厂房或周边设施进行防护冷却,防止火灾蔓延。对于厂房周围设置的消防水炮,同时作用的消防水炮数量应结合平面布置确定,本条规定同时作用的消防水炮不应少于2门,主要是考虑发生火灾时至少2门消防水炮同

时开启，防护冷却厂房一侧的长度范围可达到80m~100m，起到防护冷却隔离的作用。

(4)液化烃一旦泄漏将十分危险，遇到点火源会发生猛烈燃烧或蒸气云爆炸，火灾蔓延面积较大，并产生强烈辐射热，灭火人员难以及时接近着火部位，本条要求设置远控消防水炮，是考虑对单罐容积较大的液化烃罐组加强保护，减少辐射热效应对灭火人员的影响。

(5)沸点低于45℃的甲类液体压力罐，发生火灾后在防火堤内可能会产生流淌火灾，配置足够数量的泡沫枪可用于扑救液体流散火灾。

9.4.5 本条对固定消防炮设计做出了规定。

2 参照现行国家标准《固定消防炮灭火系统设计规范》GB 50338并结合工程情况，一是允许利用就近的建(构)筑物设置消防炮平台的方式代替设置消防炮塔，二是对地面布置的消防炮可以选用手动炮，对远离地面的消防炮要求选用远控炮，主要考虑：

(1)设置消防炮塔投资较高，有些场所受场地限制布置炮塔困难，如煤化工工程敷设可燃气体、可燃液体及可燃固体管道的管廊较多，消防炮的射流受管廊遮挡无法布置在管廊下，而布置炮塔经常会受到场地限制而难以实现，在就近的建(构)筑物上或在管廊上设置消防炮平台的方式代替设置消防炮塔，可以起到消防炮塔相同的作用且节约投资。

(2)生产装置周围的固定消防水炮，煤粉制备、煤气化、水煤浆制备、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备的高层厂房周围的室外固定消防水炮，以设置地面手动消防炮为主，发生火灾时，可采用离火灾现场相对远、热辐射强度较小、不易威胁人身安全部位所设置的地面手动消防炮冷却或灭火。

(3)在消防炮塔或高位平台上若只选用手动炮，发生火灾时，消防人员难以及时到达消防炮位；人员远离地面操作难度大、危险性大；当突发的大火或爆炸威胁到消防炮位人员的紧急情况出现

时,人员撤离消防炮位的安全性无法与地面撤离相比。因此,对消防炮塔和高位消防炮平台上设置的消防炮,要求选用远控炮。

9.4.6 现行国家标准《消防给水及消火栓系统技术规范》GB 50974-2014 第 5.4.2 条文解释已明确水泵结合器是专为室内消防给水系统设置的,但对于煤化工工厂生产区设置的水喷雾灭火系统,也应设置便于消防队员利用移动设施提供消防水源的接口,因此在系统控制阀后设置半固定接口是提高系统可靠性的合理要求。

9.5 室内冷却、灭火设施

9.5.5 本条规定了除消火栓外的室内冷却、灭火设施的设置部位及选用的系统类型。

(1) 输送褐煤和易自燃的高挥发分煤的运煤地下廊道内一旦发生火灾,火灾的蔓延速度快、扑灭难度大,因此要求设置雨淋灭火系统或水喷雾灭火系统。

(2) 煤化工工厂的运煤栈桥输煤量大、输送距离长,与煤气化等高大厂房连接的栈桥坡度大,发生火灾易形成烟囱效应,本条要求输送褐煤和易自燃的高挥发分煤的运煤栈桥与运煤地下廊道、筒仓、煤气化厂房等连接处的洞口设置防火分隔水幕,是为了防止火灾蔓延扩大。

煤化工工厂厂外运煤栈桥一般很长,厂外长距离的运煤栈桥在进入厂区处设置防火分隔水幕,可减少厂外火灾对厂内生产装置的影响。

(3) 目前国内建造的圆形煤库直径最大为 120m~130m,采用一般直流水炮可满足射程要求,但远距离喷水时水流冲击力很大,不利于控火,采用具有水雾喷射功能的消防水炮,适合室内储存固体散装丙类物料的大空间使用,可避免水力冲击扩大火灾。

(4) 煤化工工程煤粉制备系统从碎煤仓到煤粉仓整个工艺过程复杂,碎煤粒径约 3mm,从磨煤机出口煤粉的粒径为 $70\mu\text{m}$ ~

250μm,特别是褐煤及高挥发分煤,泄漏后极易发生火灾及粉尘爆炸,通过调研,基本确定了粉煤气化厂房内易发生煤粉泄漏或合成气泄漏的部位——磨煤机、旋转给料机、袋式过滤器、煤粉仓上下部、煤粉锁斗上下部、气化炉点火烧嘴及合成气出口法兰连接处、飞灰过滤器可燃气体进出口法兰连接处、循环压缩机等,这些部位是否都设置固定灭火系统还有待于进一步研究。本标准编制过程中结合工艺本质安全要求及火灾案例分析,对于发生过火灾的部位均作为重点部位,要求设置适宜的固定灭火系统,但考虑到袋式过滤器虽火灾发生频率高,因火灾一般发生在检修期间,可通过加强管理并采用消火栓系统保护。需要注意的是,由于水进入煤粉仓会给工艺操作带来影响,系统布置时要尽量避开煤粉仓爆破口或采取措施防止消防水经泄爆口进入煤粉仓。

煤气化厂房内火灾事故发生时,火灾自动报警系统的设置可将事故控制于早期,有利于事故或隐患的控制及消除,因此,在煤粉仓的煤粉泄漏部位等重点区,应设置由火灾自动报警系统联动控制的固定灭火系统。为避免室内设置的自动灭火系统可能因误动作给生产带来不便及产生不必要的损失,室内灭火系统要具有工艺操作人员确认后延迟启动的功能。

(5)粉煤气化厂房内的磨煤机和循环压缩机一般布置在首层,当其室外设置的固定消防水炮的射流不会受到外墙等障碍物阻挡且能有效覆盖厂房内的磨煤机和循环压缩机时,室内可不必设置保护磨煤机和循环压缩机的固定消防水炮等设施。

(6)现行国家标准《水喷雾灭火系统技术规范》GB 50219-2014规定了水喷雾灭火系统的设计喷雾强度等相关参数,水喷雾灭火系统的防护目的主要是灭固体火灾(煤粉)时,设计喷雾强度不小于15L/(min·m²);对于粉煤气化厂房循环压缩机,水喷雾灭火系统的防护目的主要是防护冷却,设计喷雾强度不小于9L/(min·m²)。

(7)表9.5.5注2规定,除储煤库外,其他室内设置的固定消防水炮系统用水量宜按2门水炮的水射流同时到达保护区任一部

位的要求计算,主要是考虑到储煤库内机械化程度高、室内消火栓无法布置。目前对于大直径的圆形煤库一般采用在环墙上设置固定消防炮的方式,若采用两门水炮的水射流同时到达保护区任一部位很难实现,且由于原煤的火灾危险性相对小,因此,本标准要求有效覆盖被保护对象即可。储煤库固定消防水炮系统的设计流量,是参照了现行国家标准《建筑设计防火规范》GB 50016 高大丙类仓库室内消火栓设计流量确定的。对于其他室内消防炮系统设计流量不应小于 40L/s 的规定,主要是考虑煤气化厂房、油煤浆制备厂房内设备较多,消防炮易受到设备的遮挡,且一般距保护对象较近,要求两门炮同时到达保护区、1 门炮流量 20L/s 的有效射程及喷水强度可满足要求,不宜选用大流量室内炮。

9.5.6 据近年来发生于控制室、机柜间、计算机室、电信站等区域的火灾资料统计,约 90% 的火灾是由于机柜内电路、元件等过热、老化、短路等原因引发的。对于大型、中型煤化工工厂生产装置独立的仪表控制机柜间(指不设 24h 值班人员的相对独立场所),由于该场所无人值守,发生火灾后无法实施早期灭火,直接影响到生产装置的安全生产,因此要求在生产装置独立的仪表控制机柜间设置自动气体灭火设施,如全淹没气体灭火系统或仅对设备(如配电柜)采取局部保护的小型自动灭火装置(如 S 型气溶胶或火探管等)。

与有人值守的控制室布置在同一建筑物内的机柜间,发生火灾后工作人员可及时采用灭火器等扑灭初起火灾,因此可不设置自动灭火设施,但要按照本标准及相关标准的规定设置火灾自动报警系统和建筑灭火器等。

9.5.7 对于煤化工工厂煤粉制备、水煤浆制备、煤气化、煤气化工艺水处理、油煤浆制备和煤直接液化催化剂制备的高层厂房设置的消火栓系统、水喷雾灭火系统、固定消防水炮系统,要求在系统控制阀后设置代替水泵结合器的大流量半固定接口,便于消防队员利用移动设施提供消防水。

9.6 消防站

9.6.1 煤化工火灾应以自救为主、协作为辅,设置专职消防队,对于新型煤化工工厂尤为重要。当生产、储存物品的特性和火灾危险类别相近的煤化工、石油化工和石油库等工业企业毗连建设时,可以根据实际情况建设具有区域联防协议的联合专职消防站。

9.6.2 本条对消防站的等级确定进行了说明。

1、2 消防站车辆类型及其配备数量,要根据被保护对象选择。目前大、中型石化企业多以载液量在 12000kg 以上的泡沫消防车为主,且配备了干粉或干粉-泡沫联用消防车和举高喷射消防车,基本配置情况调查见表 5。

表 5 基本配置情况调查

企业规模	多功能指挥车	泡沫消防车	供液消防车	干粉或干粉-泡沫联用消防车	举高喷射消防车
中型石化企业		2		1	1
大型石化企业	1	3	1	1~2	1~2

本标准根据煤化工工厂的特点和灭火需要,结合煤化工企业消防站实际状况,提出了消防站、消防分站和站内消防车的设置标准。大型、中型煤化工工厂车辆装备配置要满足本单位事故灾情处置需求,应对液体储罐全液面火灾、液化烃罐组火灾、生产装置流淌火灾和设备立体火灾、可燃气体泄漏等灾情等级处置和控制技战术需要(高、中、低车辆结构,车型种类、载剂供给时间、战斗编程、战术实施等),控制初起阶段、猛烈燃烧阶段和稳定燃烧阶段的火灾。表 9.6.2 中工厂必配车辆类型是能对装置或储罐进行冷却或泡沫灭火的消防车和举高喷射消防车。

举高喷射消防车的最大工作高度和最大工作幅度等指标应根据保护对象的高度和半径等条件确定。需要在狭小空间展开作业的举高喷射消防车可以通过限制臂架长度、增加臂架节数来实现。

表 9.6.2 注 1,选配车辆可由本单位提供,也可由具有消防协作条件的邻近单位提供。具有消防协作条件的邻近单位,在接到火灾报警后 10min 内能对装置或储罐进行冷却的消防车和在接到火灾报警后 20min 内能对着火储罐进行泡沫灭火的消防车,以及在接到火警后 20min 内到达火场的供液消防车和供气消防车,可计入表 9.6.2 中选配车辆。

表 9.6.2 注 9,工厂车载泡沫灭火剂储量,按工厂最大储罐全液面火灾、连续供液不低于 30min 所需泡沫液用量确定。18m~25m 举高喷射消防车是工厂主战消防车,综合考虑其基本配置数量、不同生产类型工厂储罐规模差别较大、扑救油类和醇类采用非抗溶性和抗溶性泡沫液等情况,规定大型工厂一级站、中型工厂二级站的 18m~25m 举高喷射消防车泡沫罐载液量,按工厂最大储罐全液面火灾、连续供液不低于 30min 所需泡沫液用量的 25%~50% 确定,泡沫罐载液量按最大 10000kg 计,水罐载液量不低于泡沫罐载液量。

表 9.6.2 注 10、注 11,可根据东、西部和南、北方煤化工工厂不同的自然条件及工厂的特殊需要,在现行标准基础上增减功能和选配车辆类型,如煤制天然气和合成氨项目,可根据需要将供液消防车或泡沫消防车改配为水罐消防车并配备远程遥控的移动消防水炮,对于寒冷和严寒地区,可根据实际需要在泵室配备加热暖风系统,出水阀设置电加热解冻阀芯,可能发生有毒气体泄漏的火灾场所,如合成氨项目等,可选配正压送风细水雾排烟车。

3 消防站内宜将泡沫液储存于高位罐中,依靠重力直接装入消防车,或从低位罐中用泡沫液泵将泡沫液提升到消防车内,保证消防车连续灭火。

4 消防通信指挥室是指挥消防站实施火灾及其他事故处置的职能部门,需接受全厂消防监控中心的指挥,知晓发生的火灾警情,指挥及联络现场处置人员与车辆,消防通信指挥室及消防站电信设施需满足现行行业标准《石油化工企业电信设计标准》

SH/T 3153 的规定。

5 消防站无线通信的需求是管理操作简单、使用稳定可靠、不受环境影响,需要考虑在基础设施瘫痪和远离基地执行任务时的通信联系,独立的无线对讲通信可实现任意两台同频对讲机间的同频通信,符合消防站的应用特点。消防站的无线通信系统可以根据需要设置中继设施,中继设施可以设置在消防站通信室和消防指挥车上,以使无线通信距离得到扩展。消防站的无线通信系统具有语音录音功能。

9.6.3 本条主要消防车辆的技术性能及灭火器材配备标准均为最低要求,设计时应根据生产装置的火灾危险性及布置要求,适当提高配置,如对于密集化大型联合装置,配置车载大流量远射程的消防水炮等。

9.7 消 防 排 水

9.7.1 本条是强制性条文,必须严格执行。为防范和控制火灾扑救及事故处理过程中因消防排水而产生的次生灾害,要采取可靠的消防排水的收集与处理措施。

9.7.4 本条规定煤粉制备、水煤浆制备、煤气化、煤气化工工艺水处理、油煤浆制备和煤直接液化催化剂制备高层厂房消防排水应有组织排放,应设收集设施;煤粉制备、煤直接液化催化剂制备高层厂房各层设置水力清扫设施,消防排水管道和水力清扫排污管道可以合并设计,但需按消防排水量校核管径。水力清扫排污管道应在地面层设置污水集水坑。

10 电 气

10.1 消防电源及配电

10.1.3 本条是强制性条文,必须严格执行。本条规定的供电回路,是指从低压总配电室或分配电室至消防设备或消防设备室(如消防水泵房、全厂消防监控中心、区域消防控制室、消防电梯机房等)最末级配电柜(箱)的配电线路。

根据灭火实战需要,消防员到达火场时要切断电源,以防止火势沿配电线蔓延扩大,避免触电事故的发生。很多工厂火灾案例表明,混合敷设配电线,造成消防人员不易(无法)分清哪些是消防用电设备的配电线,不得不全部切断电源,致使消防用电设备不能正常运行。因此,应将消防用电设备的配电线与其他动力、照明配电线分开敷设。同时,为避免误操作和便于灭火救援,应设置清晰、简捷易读的说明、指示等明显标志。

10.1.5 煤化工生产中有较多的腐蚀性介质,因此,对于有可能接触腐蚀性介质的地方,消防配电线要采取防腐蚀措施。

10.2 电气装置

10.2.1 本条主要考虑以下几个方面,确定了煤粉仓泄爆口外部爆炸性煤粉环境的区域范围。

(1)煤粉仓中煤粉的特性。与普通煤粉相比,煤化工工程中煤直接液化装置的液化煤粉、煤气化装置的气化煤粉粒度细、水分低,且煤直接液化装置中液化煤粉挥发分较高,因此其粉尘层和粉尘云的引燃温度低、点火能量小、爆炸下限浓度低,更容易发生爆炸;最大爆炸压力及爆炸压力上升速率大,发生爆炸后破坏力大。

(2)煤粉仓释放煤粉的可能性。液化煤粉和气化煤粉的粒度

很细,煤粉流动性能好,煤粉流量的控制难度较大,如果进入煤粉仓的物料(煤粉+气体)流量太大,就容易导致煤粉仓超压而使泄爆口爆破片启动,泄漏出的煤粉飘散在环境中会带来事故隐患。

(3)煤粉仓的位置及容量。由于工艺布置需要,液化煤粉和气化煤粉的煤粉仓所处的位置高度高,且容积较大,煤粉仓泄爆口的爆破片启动后会泄漏出大量的煤粉,煤粉的颗粒密度约为 400kg/m^3 ,比较轻,露天布置时,在较大的风速下能随风飘散到很远的地方,在空气中容易形成爆炸性粉尘,遇到点火能就会发生爆炸,造成严重的后果。

(4)参考美国消防协会标准《化学品加工区中电气装置用可燃粉尘和危险区域的分类推荐实施规程》NFPA 499(2008年版)。对于操作设备封闭的场所,Ⅱ类2区的范围为释放源周围3.05m(10ft)。

(5)参考国际电工委员会标准《爆炸环境 第10-2部分:可燃粉尘场所分类》IEC60079-10-2(2009年版)。对于22区范围:21区周围和释放源周围3m的距离就足够(垂直向下延至地面或者楼板水平面)。

10.2.2 煤化工工程设计中,要尽量避免出现爆炸性气体和爆炸性粉尘并存的环境。受工艺限制不可避免时,电气设备、仪表,要选用同时满足爆炸性粉尘环境要求和爆炸性气体环境要求的防爆电器设备。

10.2.3 本条是强制性条文,必须严格执行。电缆等线路因使用时间长会出现绝缘老化、线路破损等产生短路,而管沟中敷设的可燃液体、可燃气体及煤粉管道破损不易被及时发现,容易积存危险物质,成为火灾和爆炸事故的隐患,因此规定不应敷设在同一管沟内。

10.3 火灾自动报警系统

10.3.1 火灾自动报警系统需在全厂管理范围设置成统一管理的系统,消防管理体系、系统结构需从全厂的功能与管理需求统一

考慮。

10.3.2 本标准将火灾事故处置与消防管理工作的责任明确在全厂消防监控中心。全厂消防监控中心(岗位)负责全面掌控工厂消防设施的状态,负责全厂火灾事故接警、指挥全厂火灾事故处置、消防安全管理。由于煤化工工厂的生产流程连续性强,且工艺复杂,标准中要求全厂消防监控中心(岗位)与全厂性生产调度中心(岗位)合建,这样有利于全厂消防管理和生产管理的统一。全厂消防监控中心负责的是整个工厂范围的消防管理,服务对象并非所在建筑物,因此中心位置的设置应该以方便生产管理为主,无需局限在建筑物的首层或地下一层。全厂消防监控中心需设置有独立操作的全厂性受警、监控、指挥与管理设施,当工厂需要进行系统间的集成或设置安全管理预警指挥系统时,应该从火灾自动报警系统的统一接口输出信息,以保证系统的完整性。

10.3.3 当煤化工工厂的厂区范围较大时,由全厂消防监控中心进行集中管控会存在一定的困难,工厂可以根据需要设置区域消防控制室(功能与现行国家标准《火灾自动报警系统设计规范》GB 50116 中的分消防控制室一致),以弥补全厂消防监控中心(功能与现行国家标准《火灾自动报警系统设计规范》GB 50116 中的主消防控制室一致)控制管理能力的不足。作为区域消防管控岗位,区域消防控制室需受全厂消防监控中心管理、指挥,并负责本区域的消防管理及操作,区域消防控制室设置可以独立设置,也可以与其他生产岗位操作(控制)室合建,合建的区域消防控制室仍需符合现行国家标准《消防控制室通用技术要》GB 25506 的规定,并需独立设置本区域的消防受警、监控、指挥与管理操作设施。

10.3.4 煤化工工厂属于易燃易爆危险企业,在火灾事故发生后,有些固定灭火系统无法靠近操作或需要迅速启动,在这种状况下实施远程控制非常必要,因此本标准规定,需要实施远程控制的固定灭火系统需由消防管理岗位的专职人员在全厂消防监控中心或区域消防控制室进行远程集中控制,远程控制的线路由控制设备

用专用线路直接连接到固定灭火系统。“专用线路直接连接”是要求用独立的专用线路从控制设备端直接连接到受控设备端或受控设备自己配套的现场控制盘柜，连接线路中间不允许有任何元器件，且需符合第 10.3.5 条第 5 款要求的线路。考虑到有些户外固定灭火系统可能距离较远，DC24V 电压无法直接控制，本标准规定可以采用 AC220V 电压对固定灭火系统实施控制。

全厂消防监控中心需对全厂性重要消防设施和固定灭火系统实施监控，当固定灭火系统的专用控制线路接入区域消防控制室时，全厂消防监控中心需经区域消防控制室控制器通过专用线路对其实施远程控制。

10.3.5 本条对火灾自动报警系统的设计做了规定。

1 工厂的消防管理和火灾施救是在统一的指挥下，由多个部门共同完成的操作过程，各参与消防管理和火灾施救的操作岗位均需要及时了解火灾状况，采取应对措施，因此要求火灾自动报警系统的联网方式采用对等网络结构，工厂火灾自动报警系统报警与受警结构见图 3。

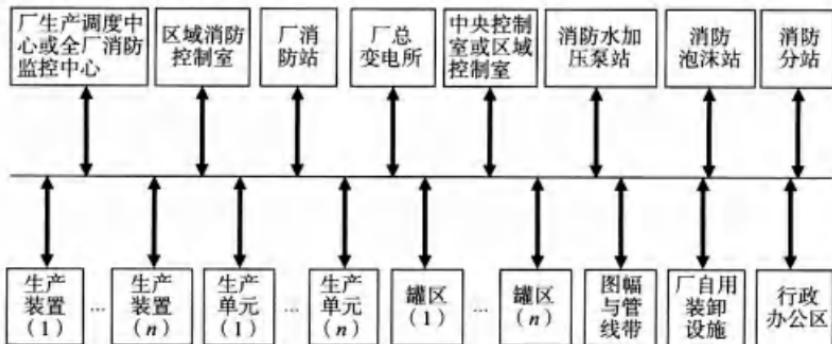


图 3 火灾自动报警系统报警受警结构图

对等网络为单层网络构架，信息以对等通信方式传递，系统中各火灾控制器与工作站之间均以相互对等共享的方式传递信息，不会因一台设备异常而影响整个系统的正常工作。系统可任意定义一台或多台控制器为集中报警控制器，定义后的集中报警控制

器能够监视整个网络中所有报警与控制设备的信息,也可根据需求定义监控部分报警与控制设备的信息,这种灵活的系统管理结构非常适合煤化工工厂的多岗位接警需求使用环境,因此规定煤化工工厂采用对等网络结构。在现行的设备结构中,对等网络又分为部分对等网络和全部对等网络,部分对等是部分控制器或工作站可以显示控制全部设备进行对等通信信息共享;全部对等是系统中所有控制器或工作站之间均可显示控制其他设备,共享所有信息并实现相互监控,在设计中应根据工程的实际要求合理选择部分对等网络和全部对等网络结构。

2 在对等网络结构中火灾报警控制器可以作为集中报警控制器用于消防控制室等处,也可作为区域报警控制器设置在各区域用于接受本辖区报警点的信息和对消防设施实施控制,并根据需求可接收全厂的消防报警信息。

消防信息图形显示设施包括火灾报警与消防设施信息图形显示屏、消防控制中心图形显示装置,其作用是使操作人员在第一时间完整地了解火灾报警及相关信息。火灾报警与消防设施信息图形显示屏可以根据需求设置成全厂或区域的2D或3D显示方式,当全厂消防监控中心和区域消防控制室设置的火灾报警与消防设施信息图形显示屏与/或消防控制中心图形显示装置达不到完整地显示信息需求时,可增设消防控制中心图形显示装置,补充完善显示信息的内容。

5 本款是强制性条文,必须严格执行。“专用线路”是指专门为设备间连接的实体线路,线路传输的信息中不含有其他系统的信息,也不能利用无线通道进行信息传递。

火灾自动报警系统线路包括信号线路、控制线路、消防应急广播的干线线路与扬声器线路、火灾电话报警系统用于消防直通联系的电话线路,这些线路应该是独立的线路,不得与其他系统的线路合用,各线路段应有线路故障侦测报警功能。

火灾自动报警系统线路设计需考虑在火灾和爆炸等应急工况

下对线路正常工作的影响,每条线路均有自己的使用功能时段要求,如报警线路需保证报警信息送出前的线路畅通,灭火控制线路需保证受控设备完成消防工作状态前控制线路和供电回路的畅通,消防应急广播线路需能够在火灾与事故状态下实施有效广播,火灾电话报警系统和用于消防直通联系电话的线路需确保整个消防过程中能够进行有效通话,线路的工程设计需根据上述原则进行线缆选型和敷设方式设计。标准中线路的“工作时段功能正常”是要求线路在完成探测报警与联动控制前线路能够正常工作,设计需依据报警、警报、控制、通信设备各自的作用与工作时序,结合线缆敷设的环境与工况合理选择线缆与敷设方式。在设备线路的安全要求中,报警设备的线路仅需考虑在正常状态的工作和火灾等状态下能够将警情报告出去,而固定灭火系统的线路则要考虑在正常状态下的信号传输和火灾、爆炸等应急工况下能够正常工作,用于消防管理岗位间通信联络的直通电话线路则应确保在整个灾害施救过程中的通信畅通,设备作用的不同造成了线路可靠性需求的不同。在现行行业标准《石油化工企业电信设计标准》SH/T 3153 中规定了线缆选型与敷设方式的要求,设计可根据线缆敷设的环境与工况的需要,在满足“工作时段功能正常”的前提下,合理选择线路在室外环境下架空、桥架、直埋、管道、电缆沟的敷设方式。

6 火灾报警控制器等对等网络中各控制设备节点间采用光纤连接可以延长传输距离、避免干扰、简化设计与施工,适合于工厂的应用环境,因此本标准要求控制器间采用光纤连接;环状连接可以提高线路的可靠性,在线路出现一处断点时仍能继续完成通信,因此本标准要求采用环状连接。

8 在工程设计中需要特别注意火灾自动报警系统中各类设备之间的接口和通信协议的兼容性,需要满足现行国家标准《火灾自动报警系统组件兼容性要求》GB 22134-2008 和《消防联动控制系统》GB 16806-2006 中的规定,在连接线路中要进行线路故障侦

测功能的设计,连接线路必须保证连接的各段线路故障侦测报警,不得存在有缺失和盲区,以使设计的火灾自动报警系统功能完整。

10 火灾自动报警系统与电视监视系统联动弹出报警区域的图像,有利于快速确认火灾事故的状况,及时采取应对措施。

煤化工工厂的环境、火灾成因和燃烧物料特征复杂,传统的探测设备有时难以有效、迅速、稳定地探测出火灾事故,因此本标准许可能够有效、及时、稳定探测出火灾的电视监视设备作为火灾探测器,用于火灾自动报警系统,如利用热成像技术捕捉环境中热温度场并通过阈值判断的方式进行报警。设计时,需根据使用环境、火灾成因、物料燃烧特性、探测器探测原理和探测反应时间合理选择探测方式。

11 在煤化工工厂内时常设置扩音对讲或公共广播系统用于生产指挥或日常管理,为了节省工程投资,许可扩音对讲或公共广播系统替代消防应急广播系统,并规定在全厂消防监控中心或/及区域消防控制室将其自动/手动切换至消防应急广播状态,但扩音对讲或公共广播系统设备与线路设计要满足消防应急广播系统的功能要求,并设置成应急广播优先的工作模式。

10.3.6 装置内地面手动火灾报警按钮的距离是指步行能够通过到手动火灾报警按钮的距离,设计中应考虑因设备、管线和沟坎等障碍物的阻挡造成的绕行通行距离。当建(构)筑物上(内)设置手动火灾报警按钮时,需执行国家现行标准《石油化工企业电信设计标准》SH/T 3153 和《火灾自动报警系统设计规范》GB 50116-2013 第 6.3 节的规定。

10.3.7 在工厂中,通常可燃气体探测器的信号输出是连续量信号,在检测控制器中进行阈值判断输出预警和报警信息,因此当火灾自动报警系统需要汇总此信息时,应从可燃气体检测控制器中取出信息。

除了本条规定外,可燃气体探测报警系统的具体设计,还应该符合现行国家标准《石油化工可燃气体和有毒气体检测报警设计

标准》GB 50493 和《火灾自动报警系统设计规范》GB 50116 的有关规定。

10.3.8 为确保接警的正确性,及时掌握火情的真实状况,在受警岗位需设置电视监视系统监视终端,联动报警信息主动监视火场情况,有利于在第一时间做出正确判断、制订处置方案。

10.3.9 火灾报警设备应该配备配套的电源设备,当没有配套的电源设备时,需配备符合要求的不间断型消防设备应急电源设备,并进行电源线路的可靠性设计和监控设计,消防设备应急电源的设计还需符合现行行业标准《石油化工企业电信设计标准》SH/T 3153 的要求。

10.3.10 本标准规定了煤化工工厂火灾自动报警系统和火灾电话报警系统的基本要求,设计时还需按照现行行业标准《石油化工企业电信设计标准》SH/T 3153 中工厂火灾报警系统、消防控制系统及与之相关系统的结构、选型、技术指标、设备布置与线缆敷设要求,进行合理设计,在此基础上,对于两标准未涉及的通用要求,要执行现行国家标准《火灾自动报警系统设计规范》GB 50116。

10.4 火灾电话报警系统

10.4.1 火灾电话报警系统是工厂传统的火灾报警方式,通常是采用行政电话与调度电话系统的专用号进行报警,系统需在企业管理的辖区内统一规划设置,火灾电话报警系统应该是工厂独立设置与管理的系统,不能采用工厂以外的电话系统作为火灾电话报警系统。火灾电话报警系统的功能包括专用号报警和全厂消防监控中心与消防管理岗位间直通联系的功能。

在本次标准编制中,要求建立全厂消防监控中心,专用号报警的受警岗位由全厂消防监控中心负责,改变了以往标准由消防站通信室接收专用电话号码报火警的规定,减少了消防管理的交叉,明确了责任。

全厂消防监控中心作为消防管理的主体责任岗位,应该具有与其他消防管理岗位建立具有可靠保障的通信指挥联系,所有进出全厂消防监控中心的通信信息均需有语音记录,语音记录的内容包括通信线路编号、起止时间、通话内容,语音记录设备的总时长大于2h,且为循环保存记录信息,即保存最后一段的信息。考虑到接警与直通电话分机多时容易造成混乱,规定当全厂消防监控中心的火灾受警电话与直通电话之和超过4台时,采用具有录音功能的按键式双手柄消防调度台作为语音通信终端。当采用消防调度台作为语音通信终端时,要求消防调度台具有多方接听功能,以便在接收电话专用号报警时能够满足消防站通信室及其他消防管理岗位同时监听报警内容,做好事故处置准备。

通常电话系统不具有线路故障和电话脱机侦测功能,本规定中要求用于消防管理岗位间的直通电话具有此功能,以使系统具有可靠的保障。规定中明确工厂的火灾电话报警系统可替代现行国家标准《火灾自动报警系统设计规范》GB 50116中的消防专用电话系统,以使工厂的报警系统更加适合工厂的使用环境和有可靠的保障。

火灾电话报警系统与无线通信系统联网,可以扩展和延伸火灾电话报警系统的服务范围,当局部区域无法设置火灾电话报警分机时,可以通过无线通信终端向火灾电话报警终端报警。

10.4.2 工厂火灾电话报警系统的设计还需参照现行行业标准《石油化工企业电信设计标准》SH/T 3153的内容,并满足与之相关的系统结构、技术指标、设备布置与线缆敷设的要求。

10.5 消防应急照明和疏散指示系统

10.5.1 本条对消防应急灯具的设置场所做了规定。要求设置消防应急灯具的场所,主要是发生火灾时需要继续工作的场所和人员疏散通行的部位。

10.6 防雷和防静电

10.6.2 煤化工工厂存在静电引燃、引爆的危险场所,要设置静电接地等防护措施,防止静电积聚。各种静电防护措施要根据现场环境条件、生产工艺和设备、物料特征及发生静电危害的可能程度等选用。静电防护标准有国家现行标准《防止静电事故通用导则》GB 12158、《化工企业静电接地设计规程》HG/T 20675、《石油化工静电接地设计规范》SH 3097 等。

表 4.2.5 煤化工工厂内装置或设施之间的防火间距(m)

| 项 目 | 工 艺 装 置
 | 全 厂 重 要 设 施 | 地上可燃液体储罐 | | | | | | | | | | | | 液化烃储罐 | | | | 可燃气体储罐 | | | 液化烃及甲、乙类液体 | | 灌装站 | | 罐区
甲、乙
类液
体或液
化气
体仓库(包
括装卸场区) | 铁
路行
驶(中
心线)
污水
处理
场内
原料
及产
品运
输油
罐道
路(路
面边)
变配
电室) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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 | | 甲、乙类固定顶罐 | | | | | | 浮顶、内浮顶或丙A类固定顶罐 | | | | | | 清点
低于
45°C
的
单
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装卸
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5000m ³ | 40 | 35 | 30 | 50 | 40 | 35 | | | | | | | | | | | | | | | | | | | | | >500m ³ ~
1000m ³ | 30 | 25 | 20 | 45 | 35 | 30 | | | | | | | | | | | | | | | | | | | | | ≤500m ³ 或
卧式罐 | 25 | 20 | 15 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | 甲、乙类
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20000m ³ | 35 | 30 | 25 | 45 | 35 | 30 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤500m ³ 或
卧式罐 | 25 | 20 | 15 | 35 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>5000m³</td><td>70</td><td>65</td><td>60</td><td>90</td><td>80</td><td>70</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>>1000m³~
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5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 30 | 30 | 30 | 30 | 30 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 20 | 15 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>2000m³</td><td>40</td><td>35</td><td>30</td><td>50</td><td>40</td><td>35</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>>500m³~
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500m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤500m ³ 或
卧式罐 | 25 | 20 | 15 | 35 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | |
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1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1">
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5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
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| >1000m ³ ~
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| >500m ³ ~
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 | 25 | 20 | 45 | 35 | 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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1000m ³ | 30 | 30 | 30 | 30 | 30 | 30 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 20 | 15 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>2000m³</td><td>40</td><td>35</td><td>30</td><td>50</td><td>40</td><td>35</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>>500m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | <table border="1"> <tr><td>>1000m³~
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10000m ³ | 70 | 65 | 60 | 90 | 80 | 70 | | | | | | | | | | | | | | | | | | | | | >1000m ³ ~
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1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
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5000m ³ | 60 | 55 | 50 | 80 | 70 | 60 | | | | | | | | | | | | | | | | | | | | | >100m ³ ~
1000m ³ | 30 | 25 | 20 | 40 | 30 | 25 | | | | | | | | | | | | | | | | | | | | | ≤100m ³ 或
卧式罐 | 20 | 15 | 10 | 30 | 25 | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| >20000m ³ | 40
 | 35 | 30 | 50 | 40 | 35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| >5000m ³ ~
20000m ³ | 35
 | 30 | 25 | 45 | 35 | 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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注:1 工艺装置或可能散发可燃气体的设施与工艺装置明火加热炉应按明火确定。

2 全厂性消防水泵房与甲类工艺装置的防火间距不应小于 50m。区域性重要设施与相邻设施的防火间距，不应小于全厂重要设施规定的 75% [火炬除外]。

3 与散发火花地点的防火间距,不应小于与明火地点规定的50%,且散发火花地点应布置在火灾爆炸危险区域之外。

⁴ 堤坝与其他设施的防火间距应按各自最大容积确定;堤坝储罐与其他设施的防火间距不应小于50% (火炬除外)。当固定顶可燃液体罐采用氮气密封时,与船舱设施的防火间距不应小于浮顶、内浮顶罐的规定;丙类固定顶罐与其它设施的防火间距不应小于15m。类固定顶罐相应的

防火间距规定的 75% [火炬除外]。表中小于或等于 $1000m^3$ 的甲、乙、丙类可燃液体储罐与全厂性变电所、全厂性消防水泵房的防火间距不应小于 30m。

5 丙类液体不应小于 75%{火焰除外}。当甲、乙类液体铁路装卸采用全密闭装卸时，对于装卸设施的防火间距不应小于 75%，且不应小于 80m{火焰除外}。

6 对于转运站、筛分破碎室、卸煤装置、进煤栈桥，其防火间距不应小于储煤场区规定的 75%，且不应小于 18m。

7 本项包括可燃气体、助燃气体的实瓶库。对于乙、丙类物品库(棚)和堆场,不应小于 75%;丙类可燃固体堆场不应小

8 丙类液体(房)不应小于 75% (火炬除外),但当地面上可燃液体储罐单罐容积大于 500m³ 时,不应小于 10m;地上可燃液体储罐单罐容积小于或等于 500m³ 时,不

9 污油泵、单独设置的含油污水池的防火间距不应小于隔油池规定的 75% (火炬除外)。

10 铁路走行线和原料产品运输道路应布置在火灾爆炸危险区之外。原料及产品运输道路不应小于表中括号内数值。

11 废氢储罐不应小于乙₂类固定顶储罐

12 表中“—”表示无规定。

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