Improving the Safety of the Rectification Unit for the Production of Alkylphenols

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Abstract. As a result of the study, the analysis of occurrence of fire hazardous situation during the operation of rectification column of production facility of one of the city's enterprises was carried out. This installation refers to facilities for which additional safety requirements are imposed. The main danger of the operation of rectification columns and their piping used at the installation is the fear of depressurization and the initiation of gas contamination and fire situation on the site. As the result of the fire, the rectification column and supporting metal structures can be in flame or be under the influence of thermal radiation from the flame in adjacent column, which can lead to the collapse of structures or to losses of bearing capacity under the influence of high temperatures. Depending on the height of the column, the water supply system can have different ways of distributing water: at small height of the column, manual water nozzles are used with the use of fire hydrants; at considerable height of the columns, stationary water irrigation systems (irrigation rings) are used.

1. Introduction
Fire safety is an integral part of the overall safety of production facilities.

Fires at the facilities of chemical and petrochemical industry are accompanied by large number of human casualties and increased material damage. They are associated with the accident of technological equipment, since this is often accompanied by the spill of flammable substances over the surface. As a result, a large area can be engulfed in fire.

The fire hazard of rectification columns arises from leaks of flammable liquids and gases. As the result of the fire, the rectification column and supporting metal structures can be in flame or be under the influence of thermal radiation from the flame in adjacent column, which can lead to the collapse of structures or to losses of bearing capacity under the influence of high temperatures. [1-5].

Depending on the height of the column, there can be various options for the water distribution scheme: with the small column height and reliability of water supply, manual water nozzles are used with the use of fire hydrants; at the significant height of the columns, fire monitors on towers or stationary water irrigation systems (irrigation rings) are used.

2. Relevance of the issue with a brief review of the literature
Fires are extremely unfavorable events that entail not only damage to material values, but also pose danger to human lives. Because of this, the task of each member of society is to comply with fire safety.
Fire protection assumes economically feasible and technically sound methods of localization and elimination of fires with the rational use of forces and technical means of fire extinguishing.

To exclude the possibility of fire, it is necessary to carry out fire prevention measures including a number of comprehensive measures in order to prevent the occurrence of fire and reduce its consequences, as well as the use of necessary measures aimed at protecting people from dangerous fire factors [6-10].

Combustion can only take place in the presence of a combustible substance, oxidizer and an ignition source. The exclusion of any of the three constituents makes the occurrence of fire impossible.

An ignition source is such an object, the temperature and the energy reserve of which are capable of initiating the ignition of combustible medium.

At sharp acceleration of exothermic oxidation reactions caused by internal processes or external influences, the process of ignition of combustible medium is possible without an ignition source by spontaneous combustion of a substance.

The induction period of the combustion process is meant by the heating time of the substance, which is necessary to heat the substance to the temperature of thermal decomposition, evaporation and mixing of combustible components with the oxidizer and the appearance of combustion signals.

The following types of ignition sources are distinguished: thermal, mechanical, electrical and self-ignition [11-14].

Thermal sources of ignition include open fire (furnaces, fire boxes, gas burners, torches, etc.); heated surfaces (pipelines, chemical reactors, furnaces, etc.); sparks (during gas welding, from internal combustion engines, etc.); hotbeds of decay (remnants of an unextinguished fire, particles of coal, slag, etc.); heated gas (formed during the burning of torches, fires, gaseous combustion products coming out of furnaces, fire dryers, etc.).

Examples of mechanical sources of ignition are sparks generated by friction of bodies (when grinding, moving stones or metal particles in crushers, when working with metal tools, etc.) and parts and materials heated by friction, such as conveyor belts, drive belts on the pulleys of mechanisms, bearings in case of seizure, lubrication defects, etc.

Electric ignition sources are ones as follows: discharge of static electricity; discharge of atmospheric electricity; gas discharge (spark, arc, glow, switching); red-hot metal particles (short circuit, turning on and off in switching devices, when welding parts by heating the metal with electric arc); the heated surface of body parts and current conductors (short circuit, when the voltage appears on the bodies of electrical devices or parts that are not flowed around under normal technological conditions; when the current is overloaded in power grids, etc.).

The sources of ignition that lead to spontaneous combustion of substance include seat offire of internal heat release during external thermal or physical impact on the substance (heat, light, impact, friction); seat of fire of heat release during the chemical reaction (when the substance interacts with atmospheric oxygen; interaction of substances with each other; spontaneous combustion of pyrophoric substance, etc.) and heat generation centers during microbiological processes.

Certain ignition sources are reflected in the dynamics of the fire and are characteristic of specific conditions and combustion processes; however, for combustible material it is not important what caused the high temperature of the heated surface, whether it be an electric heating device, vortex flows or fire combustion chamber. These details are significant for identifying the involvement of the corresponding phenomenon in the occurrence of fire at the stage of determining the origin of ignition source. In the process of solving the issue of possibility of ignition of some substance or material, the conditions of origin of the ignition source are not of fundamental importance.

3. Theoretical part

The fire hazard of rectification columns arises from leaks of flammable liquids and gases. As a result of fire, the rectification column and supporting metal structures can be in flame or be under the influence of thermal radiation from the fire of adjacent column, which can lead to the collapse of structures or loss of bearing capacity under the influence of high temperatures.
Fire Fighting Unit must timely (before heating the structures to critical temperatures) supply such an amount of extinguishing agents in which an emergency condition is impossible. Therefore, when determining the parameters of fire protection, it is important to know the heating time of structures and equipment to a critical temperature, or their fire resistance [15-20].

Fire protection is based on protecting the rectification columns from the hazardous effects of fire for the time required for the arrival of fire and emergency services and the elimination of the accident. A fire in rectification units can quickly become large-scale, as significant damage or accidents result in the release of large quantities of vapor and liquid heated to boiling point. The vapor escaping from the tower and resulting from the vaporization of the hot reflux escaping to the outside can result in a hazardous concentration. Ignition of combustible vapor mixture leads to a rapid spread of fire throughout the entire gaseous cloud and over the surface of the liquid. It will be all the more difficult to localize the fire, the more flammable substances come out; the higher the damaged area is from the ground level, the more devices and installations will be exposed to high temperatures. Therefore, it is necessary to install the irrigation rings.

Based on this, it can be concluded that the likelihood of situations associated with fires is very high. Therefore, the development of measures for the timely localization of emergency situations is an urgent task.

4. Practical relevance, suggestions
Depending on the height of the column, there can be various options for the water distribution scheme: with the small column height and reliability of water supply, manual water nozzles are used with the use of fire hydrants; at the significant height of the columns, fire monitors on towers or stationary water irrigation systems (irrigation rings) are used.

Irrigation rings operate superficially over the entire area of technological equipment and create a barrier that limits the scale of fire accident.

It is important for the rectification column that water or foam evenly irrigates the structure and prevents the further spread of fire indoors or outdoors. These unique qualities of sprinklers expand the area of their application and complete with the rational consumption of fire extinguishing agent can significantly reduce the cost of protecting a unit of area.

Involute sprinklers "OE-16" are designed to form and distribute the flow of fire extinguishing agent (water, low expansion water-foam solution) over the protected surface, more intense in comparison with rosette sprinklers.

5. Conclusion
In order to prevent and avoid this situation, we proposed installing stationary water irrigation systems (irrigation rings) at a certain height of the rectification column. It is important for the rectification column that water or foam evenly irrigates the structure and prevents the further spread of fire indoors or outdoors. These unique qualities of sprinklers expand the scope of their application and, complete with the rational use of the extinguishing agent, can significantly reduce the cost of protecting a unit of area.

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