Improving the Safety of Drying and Packaging Section of Isoprene Rubbers

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Abstract. The analysis of main hazards at the section of isolation and drying of isoprene rubber is carried out. Incident causal factors and scenario analysis were studied and existing measures to ensure industrial safety are reviewed. The main initiating event of an emergency in the workshop is loss of containment followed by release of significant quantities of hazardous substances with subsequent negative development of the accident. The measures aimed at reducing the risk of an accident at the facility are: reducing the likelihood of equipment depressurization; minimizing the amount of hazardous substances entering the accident site; localization of the accident site; limitation of time spent by personnel in hazardous areas. In the event of a power outage, it is proposed to install a diesel generator set of the TSS AD-800S-T400-PM5 brand. This measure allows minimizing the amount of hazardous substances entering the accident site, which leads to a significant decrease in environmental and economic damage from the accident.

1. Introduction

Industrial safety and labor protection are closely interrelated as they ensure the preservation of health and safety of employees. The main goal of industrial safety is preventing and minimizing the consequences of accidents at hazardous production facilities, i.e. destruction of structures and technical installations used at hazardous production facility as well as uncontrolled explosion and release of hazardous substances.

In order to ensure the industrial safety, three main tasks are to be solved:
- making a complete detailed analysis of dangers formed in the activity under study;
- developing effective measures to protect human and its habitat from identified hazards;
- developing effective measures to protect against the dangerous risk of this activity.

2. The urgency of the issue with a brief review of literature

The process of isolation and drying of isoprene rubber consists of the following stages: homogenization of the polymerizate; polymerizate degassing; homogenization of pulp of rubber crumbs; dehydration, drying, briquetting of rubber crumbs, packaging and transportation of finished products; preparing suspension of adhesion reducing powder; obtaining pulp of rubber crumbs by means of extrusion machine [1].
The main danger during the work of technological equipment in the workshop is the process of formation of rubber crumb and its degassing in the apparatus. Polymerizate is degassed in a closed volume; therefore the technological process must be conducted strictly following the norms of the technological regime.

Among the possible causes contributing to the emergence and development of accidents, the following four main groups can be distinguished: [2]
- failures of equipment, pipelines, instrumentation and controls;
- deviations from the regulated production modes;
- events related to the human factor;
- external impacts of natural and man-made character.

The main condition that determines the safe operation of the equipment is that its components must withstand the specified workloads and thus isolate potentially hazardous substances from the environment.

The dangers associated with physical deterioration and corrosion are very relevant, since the hazardous substances reversed in the process have increased corrosive properties (especially with increased moisture content and under conditions of elevated temperatures). Under these conditions, reversible substances are able to interact with the material of the walls of apparatus and pipelines which reduces the service life of equipment. It can lead to emergency depressurization and release of hazardous substances into the environment, explosions and fires at installations [3-11].

The termination of energy supply can lead to disruption of normal operation of workshops and departments, to exit of parameters beyond critical values and creation of an emergency.

Personnel errors are particularly dangerous when starting and stopping equipment, conducting repair and maintenance work related to unstable transient conditions, emptying and filling the equipment with hazardous substances. In case of incorrect actions of the service personnel, there is the danger of depressurization of the system and the occurrence of a large-scale accident.

All of the above reasons can lead to emergency situations characterized by partial depressurization of the tanks and vessels of unit with the release of fire and explosion hazardous products from the process unit.

3. Theoretical section
The main measures aimed at reducing the risk of an accident at the facility are: reducing the likelihood of equipment depressurization; minimizing the amount of hazardous substances entering the accident site; localization of the accident site; limiting the time spent by personnel in hazardous areas [12-17].

In order to prevent emergency depressurization of equipment and pipelines, an alarms and blocking of temperature and pressure in degassers is provided in the technological scheme of polymerization degassing.

To prevent over-pressure on the devices and pipelines, the control panel is installed in the device. Pumps pumping hydrocarbons are equipped with double end seals and appropriate locks that automatically stop the pump when it is depressurized.

All discharges into the sewage system are carried out through hydraulic valves, in order to avoid the ingress of gases from the sewage system into the apparatuses and premises of the shop.

In order to prevent overfilling, the devices are equipped with level devices, level indicators, audible and visual alarms, and an empty circuit has been installed.

To reduce the emissions of explosive gases into the atmosphere with increasing pressure in the apparatus, it is provided to install control safety valves with discharge of gases to the flare.

In case of a sudden power outage, the electric motors of pumps, agitators, screw and belt conveyors, squeezing and drying machines, briquetting and packaging lines, SBS circuits, temperature devices.
4. Practical significance, proposals
For the smooth operation of this technological unit, it is proposed to install a diesel generator set of the TSS AD-800S-T400-*RMS (ТСС АД-800С-Т400-*РМ5) brand. Diesel generators have a large lifespan which allows using these power plants as the main source of electricity for a long time. [18-21]

5. Conclusion
The considered technological object is an explosion and fire hazardous object. In connection with circulation of fire and explosion hazardous substances (polymerizate and its vapors, consisting of isoprene, isopentane, toluene) accidents with exposure of production personnel are possible here.

The main hazards at the facility are related to the emergency depressurization of equipment of the process units, the release of hazardous substances, the formation of an explosive mixture and its possible explosion.

The installation of diesel generator will allow smooth operation of technological equipment and minimizing the amount of hazardous substances entering the accident site which leads to increased safety at work as well as to significant reduction in environmental and economic damage.

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