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FACTORS AND CAUSES OF THE OCCURRENCE AND DEVELOPMENT OF ACCIDENTS AT OIL PRODUCTS SUPPLY FACILITIES

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The article analyzes the factors and causes of the occurrence and development of accidents at oil products supply facilities. It is shown that the main causes and factors of accidents are the presence of large amounts of oil and oil products at the facility, which are explosive and flammable substances, transportation of oil products under high pressure, operation of equipment under pressure at high temperatures, the presence of periodic processes and transient conditions of equipment as well as the corrosive activity of oil and oil products (especially with sulfur compounds).

Keywords: accident, oil and gas complex, explosion safety, industrial safety, risk analysis.

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ФАКТОРЫ И ПРИЧИНЫ ВОЗНИКНОВЕНИЯ И РАЗВИТИЯ АВАРИЙ НА ОБЪЕКТАХ НЕФТЕПРОДУКТООБЕСПЕЧЕНИЯ

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Анализируются факторы и причины возникновения и развития аварий на объектах нефтепродуктообеспечения. Доказано, что основными причинами и факторами возникновения аварий являются наличие на объекте большого количества нефти и нефтепродуктов, являющихся взрыво- и пожароопасными веществами, транспортирование нефтепродуктов под высоким давлением, эксплуатация оборудования под давлением при высоких температурах, наличие на объекте периодических процессов и переходных режимов работы оборудования, а также коррозионная активность нефти и нефтепродуктов (особенно при наличии сернистых соединений).

Ключевые слова: авария, нефтегазовый комплекс, взрывобезопасность, промышленная безопасность, анализ рисков.

Introduction. Oil-refining enterprises have a rather high level of threat of an emergency of natural and man-made character. Improving the safety of oil refining facilities is the main way to prevent threats of man-made nature, and therefore the factors and causes of accidents at oil products supply facilities during operation are among the most important tasks [1-2].

The existing problem can be solved by assessing the most common causes of accidents and eliminating factors that adversely affect the degree of industrial safety [3-4].

Main part. The causes of accidents and factors contributing to the occurrence and development of accidents at oil products supply facilities depend on the components of this facility.

Typical components of an oil product supply facility (e.g. an oil refinery) are:

- raw hydrocarbons processing facility;
- chemicals section;

- AT-400 facility;
- AT-400/2 facility;
- AT-5 facility;
- WT-1 facility.

For this technological equipment the characteristic factors, which can promote occurrence and development of accidents on objects of oil product supply will be:

1. the presence of oil products in the equipment, which are explosive-dangerous substances, as well as the presence of a constant source of ignition (furnace nozzles), which create a danger of fire, explosion due to emergency depressurization of the unit;
2. operation of equipment under pressure at high temperatures;
3. human factor: non-compliance with the technological equipment operation mode, errors in structure strength calculation;
4. failure of control and measuring equipment;
5. space-time factors;
6. presence of periodic processes and transient operation modes of equipment at the facility.

Possible causes of occurrence and development of accidents at oil product supply facilities for this process equipment will be:

1. parameters exceed critical values;
2. decrease in mechanical strength (defect in design);
3. corrosive wear of equipment;
4. depressurization of equipment as a result of loss of strength;
5. depressurization of equipment as a result of fire, leakage during depressurization of pipelines, adjacent equipment ("Domino effect»);
6. external impact of natural and man-made character;
7. unauthorized outside interference.

In addition to the considered process equipment and facilities at oil products facilities are located:

- feed and product department;
– tank battery;
- gas condensate loading station;
- facility for car loading and unloading of oil and oil products.

For these oil-refining facilities, the factors contributing to the occurrence and development of accidents will be:

1. the presence of significant amounts of gasoline as well as oil, diesel fuel, kerosene, marine low-viscosity fuel and fuel oil in tanks, which is a flammable liquid, which create the danger of the release of a large number of explosive substances during emergency depressurization of tanks and vessels;
2. large single volumes of tanks and main pipelines, which even with minor depressurization (or destruction) contribute to the release of a large number of hazardous substances;
3. availability of equipment of various types (pumps, pipelines, valves) with a significant number of welded and flange connections, valves and control valves;
4. the presence of sulfur compounds in oil and petroleum products, which contributes to the formation of pyrophoric compounds (in interaction with corrosion products), which in turn leads to the danger of their ignition with subsequent explosion or fire inside the equipment;
5. a wide range of hazardous secondary combustion products formed due to the complex fractional composition of petroleum products: nitrogen dioxide, carbon, sulfur dioxide, carbon monoxide, organic acids, carbon dioxide.

As a result of these factors, the possible causes of accidents at oil products facilities will be:

1. defects in the manufacture, installation and repair of equipment that can lead to full or partial depressurization;

2. failure of pipelines, fittings, separable joints, depressurization of the equipment due to internal mechanical defects, overload, mechanical damage, corrosion, and untimely removal of paraffin deposits;

3. influence of external factors (mechanical damage during loading and unloading, heating, atmospheric corrosion, etc.) on the equipment;

4. personnel errors during the technological process of oil/oil products transfer;

5. overpressure above the regulated values;

6. depressurization (destruction) of tanks at their overflow;

7. destruction or significant depressurization of tanks due to the formation of local areas of explosive mixtures of flammable liquids vapors with air at violations of technological regulations at repair works;

8. impact of fires and/or explosions on process equipment and pipelines;

9. errors of maintenance personnel.

Thus, the most significant factors affecting risk indicators at the oil product supply facilities are:

- availability of a large amount of oil and oil products that are explosive and fire hazardous substances at the oil product supply facility;
- transportation of oil products under high pressure;
- operation of equipment under pressure at high temperatures;
- availability of periodic processes and transient modes of equipment operation at the facility;
- oil and oil products corrosion activity (especially in the presence of sulfur compounds);
- pyrophoric compounds in oil.

The main measures that can be aimed at reducing the risk of accidents at oil products supply facilities are:

1. compliance with technological norms and safety parameters specified in technological regulations for the operation of technological equipment;

2. compliance by working personnel with the requirements, rules and norms of labor protection, fire and industrial safety when working with flammable and combustible liquids, training on labor protection;

3. carrying out periodic knowledge assessment of requirements of labor protection and industrial safety before the permit to unsupervised work;

4. timely technical examination of process equipment, devices and pipelines;

5. continuous pressure examination of process equipment and pipelines;

6. maintenance of fire hydrants, leakage detection systems and other safety equipment in working condition;

7. periodic examinations and individual testing of shut-off valves;

8. periodic ground checks of equipment and utilities in accordance with the operating Safety Rules for Operation of Consumer Electrical Installations;

9. periodic function tests of local communication flow chart of workers and engineers and technicians of the object (according to the approved schedule);

10. timely development of priority and future timed action plan (in the case of breaches) approved by the Federal Service for Environmental, Technological and Nuclear Oversight of Russia, for bringing industrial equipment into compliance with the norms and rules of safe operation;

11. timely replacement of worn-out and obsolete equipment;

12. strengthening measures to protect a hazardous production facility from possible terrorist acts;

13. improvement of professional skills of service personnel and its regular recertification;

14. training sessions and training alerts on the emergency response plan according to the approved schedules.

Conclusion. The conducted research allows to conclude that the main causes and factors of accidents are the presence of a large amount of oil and oil products at the facility, which are explosive and fire hazardous substances, transportation of oil products under high pressure, operation of equipment under pressure at high temperatures, presence of periodic processes and transient modes of operation of equipment, as well as the corrosion activity of oil and oil products (especially in the presence of sulfur compounds).

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