

1.14.20. HOW TO PROTECT HAZARDOUS INDUSTRIAL FACILITIES AGAINST CORROSION

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Chemical corrosion represents the process being continuous in time and conditioning the rate of corrosion and, as a result, aggressiveness of operational environment. Corrosion of structural materials (concrete, reinforced concrete, steel, aluminum, brick masonry, timber) of buildings and constructions is distinguished especially. Is it possible to reduce the risk of damages?

Analysis of statistic data makes it possible to establish that 30 – 35% of accidents at industrial facilities account for corrosion.

Presently, periods of service life of buildings and constructions operated in conditions of chemical aggression are unpredictable practically. It is recommended to calculate predicted normative service life of buildings and constructions operated in conditions of aggressive media (with application of reducing factor $K_{aggr} = 1.5$) under the formula:

$$T_n = 100/1.5 \times W,$$

where W – is replacement-cost depreciation.

At the same time, analysis of state of structures of buildings and constructions at the enterprises of chemical and petrochemical industry, coke-chemical integrated works, plants producing mineral fertilizers and in other branches related with chemical production shows that at some enterprises, actual service life of structures is by 2–3 times lower than normative one.

Besides, considerable quantity of materials is lost irretrievably every year in the process of buildings and constructions operation in the result corrosion impact in industry and civil engineering. Moreover, these losses are not restricted by the cost of annual losses from metal corrosion only, but are formed by expenditures for protection of the main technological equipment, construction structures and additional capital investments related with them, as well as increased expenses for repair and renewal operations. This includes losses related with downtime of basic production assets, as well as the degree of reduction of products output during performance of repairs and recovery of protection against corrosion.

In the course of on-site inspections, it is established that operations for overhaul and recovery of anti-corrosion protection of construction structures bear mainly formal character.

It is known that industrial construction from the end of 1960's and beginning of 1970's was carried out on the basis of typical projects presented in “All-Union catalogue of industrial products for industrial and civil engineering” issued by GOSTSTROI SSSR, 1973. Under NIIZhB prediction, approximately 25% of the general number of precast concrete products are operated in aggressive media. Experience shows that bearing reinforced concrete structures of series 1.420–12, versions 0–1, 0–2, 0–3; series 1.420–6, version 0–1; and series 1.420.1–14, version 0, meet in general requirements of standards for structures applied in mildly and moderately aggressive media.

In strongly aggressive media, special anti-corrosion protection is required. Operation of steel bearing structures in conditions of aggressive media of any degree without special anti-corrosion protection is not permitted.

Analysis of reports on multiple inspections carried out by scientific and research organizations shows that typical reinforced concrete and metal structures operated in aggressive media at enterprises of chemical and petrochemical industry have significant

damages and are in an emergency state even at some facilities. Besides, validity terms of typical albums of working drawings amounts to not more than 10 – 15 years. For this period, normative documents undergo multiple modifications. Therefore, what concerns instructions on protection of structures against corrosion, there is a lot of discrepancies in currently applicable standards.

Application of pre-stressed concrete structures reinforced with high-resistance steel should be noted especially. Number of restrictions is imposed in application of these structures in corrosion hazardous media of chemical industry. In heat hardened reinforcing bars, lateral cracks can develop resulting in immediate collapse of construction. Recently, several accidents with pre-stressed reinforced concrete constructions were investigated. By the results of examinations, it is established that the reason of collapse in all listed cases was inter-crystalline corrosion of pre-stressed reinforcement caused by chlorides. Performed analysis of structural units of buildings and constructions of chemical production facilities allows the following conclusions to be made:

1. Accelerated corrosive wear of structural units of buildings and constructions of chemical industry enterprises is conditioned by drawbacks of technical rate setting during designing, construction and operation causing unpredictable growth of labor and financial costs and consumption of material and technical resources for repair and renewal operations and anti-corrosion protection of structures.

2. Increased durability of structural units of buildings and constructions of chemical production facilities can be ensured by means of implementation of waste-free innovative technologies, which reduce significantly or even eliminate completely emission of aggressive reagents into production environment (experience of metallurgical etching and galvanizing plants in Germany can serve as an example). It may be accompanied by some increase of technological equipment cost, which is compensated by the significant reduction of costs for repair and renewal operations.

3. In order to ensure high quality of construction works in general, we consider it reasonable for designing and construction of new facilities of chemical industry, as well as scheduling and performance of overhaul with solid anti-corrosion protection of buildings and constructions to be subjected to the State unified construction supervision.