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THE INFLUENCE OF SECTION FORM OF METAL STRUCTURE ELEMENTS ON CORROSION WEAR

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Abstract: The article provides the corrosion examples in metal structures, as well as their types. In most cases, metal structures are used in buildings with an aggressive environment. Corrosion is influenced by factors such as humidity, dust, various gases, technological process and etc. And also corrosion is influenced by the cross-sectional shapes which made the structural rods. There are given recommendations for the corrosion-resistant profiles use in metal structures and measures for their protection against corrosion.
Keywords: corrosion, gas, dustiness, aggressive environment, operation, humidity, condensate, profile element, wear, destruction, durability, speed, section.

Introduction

The structures optimality concept also includes the durability concept, due to which the structural form rationality characteristics refer to corrosion-resistant metal structures, i.e. to obtain optimal design solutions, it is important to take into account the requirements for increasing corrosion resistance.

The forthcoming widespread use buildings and structures free planning principles, the large-span and multi-storey buildings design make corrosive wear a determining factor in assessing durability and service life, as well as to obtain an optimal design solution.

Simultaneously with the requirement for durability, the requirement for reliability is also imposed on structures. The reliability concept should also include the social aspect - ensuring the operation safety for people serving a particular technological process [1,2].

The sudden collapse possibility of any structure, including due to corrosive wear, should be excluded. The certain types' nature of corrosion can lead to a local weakening of the working elements sections of structures, nodal connections to the stress concentrations occurrence, which often causes a sudden exit from the structures work.

Methodology: According to the corrosion conditions, which are very diverse, there are many corrosion destruction types and subspecies. This type includes atmospheric, gas, ground, under stress, corrosion with cracks, etc.

Atmospheric corrosion in industrial areas can, in turn, be subdivided into three types according to the course and kinetics conditions of the corrosion process. All of them proceed under an invisible moisture film and, as a rule, have a phase adsorption nature of occurrence [4].

1. Dry atmospheric corrosion - direct oxidation of the metal surface and the oxide films formation. It proceeds at low humidity and is typical in the initial period of structures operation. Its quantitative

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intensity indicators will be determined mainly by the specific surface value contact the structural element "a" with the atmosphere, the so-called section fusion:

$$a=p/A$$

A structural element with relatively large thicknesses and a smaller surface, as well as closed sections, will have less corrosive wear. Here, corrosion is also influenced to a certain extent by the element surface state, in particular the scale after rolling.

Fusion to some extent characterizes a surface exposed to an aggressive environment. According to this indicator, it is possible to quantitatively compare various structural elements having one or another sectional shape and design dimensions. Fusion is determined through the relative coefficient of corrosion resistance

$$\beta=A/0{,}383P$$

A is the cross-sectional area, P is the outer perimeter, 0,383 is the of resistance coefficient against corrosion sections from corners with 8 mm thickness. For corner sections, it increases with increasing thickness. Angles with more than 12 mm thickness can be considered relatively corrosion resistant, channel beams (β = 0,85-2,05) are relatively unstable, I-beams have the best performance (β = 0,95-2,5). The tubular section of the post is already at 6 mm wall thickness; at large thicknesses, the sections are also the most preferable. With dry atmospheric corrosion, one of the layout principles could be most fully and justifiably used in the design - the material concentrations principle, which provides elements' large thickness in the section, greater fusion and corrosion resistance [5]

2. Wet atmospheric corrosion - occurs at a relative humidity less than 100% by an invisible film formed on an element surface due to adsorption capillary or moisture chemical condensation.

3. Wet atmospheric corrosion is staining when a metal surface is directly moistened by atmospheric precipitation or industrial emissions. Among all types of corrosion, the most destructive is wet atmospheric corrosion. Most steel structures in industrial environments are affected by it. The various corrosive gases presence in the atmosphere (sulfur gas, sulfur dioxide, hydrogen sulfide, carbon dioxide, ammonia, hydrogen chloride, chlorine, etc.) affects the corrosion development rate. Another factor influencing the corrosion rate is dust falling from the atmosphere or deposited on the elements surface during industrial emissions. Despite the fact that measures are constantly being taken to cleanse the air pools of cities, the air pollution degree with aggressive gases continues and for a long time will determine the corrosive intensity wear of open engineering structures and industrial buildings.

Most metal structures are operated in the industrial areas atmosphere and are directly exposed to corrosive gases, dust, moisture caused by the technological equipment operation. A clear example is the previously conducted the metal structures research of Samarkand chemical plant and the buildings structures and structures located in the plant vicinity, as well as power lines metal supports, which in most cases are made from angle profiles.[6,7].

Study: The earlier studies results of the chimney towers of Samarkand chemical plant and the power transmission line supports showed that many supports elements are corroded and the wear is about 1 mm. Corrosion in the elements is uneven, in some areas they go to local, selective.

Throughout the service life of the supports and the plant workshops frames, through elements rusting was recorded.

With increasing height (in the supports), the corrosion spread increases. Typical for many structures is the so-called crevice corrosion, which occurs in the elements structural gaps. [2]

Corrosion in crevices often leads not only to large deformations, but also to tie bolts or welds separation, as well as in the supporting supports parts, which are anchored with anchor bolts to the foundation.

In order to avoid cracks, mud bags, dust accumulating places in structural elements, it is necessary to strictly take into account the corrosion resistance requirements when designing a structure and use more corrosion-resistant constructive forms, as well as provide structure reliable protection during operation.

The rational sectional shape choice is a determining condition for increasing the individual elements durability and the structure as a whole.

The corrosion distribution is not the same for different shapes elements. Solid sections, which do not have areas in which salt and dust particles accumulate and remain for a long time, corrode more evenly.

The most favorable from the point of view of less corrosive wear and corrosion greater uniformity are solid, smooth sections in round and rectangular pipes form. The worst performance is in sections made of corners and channels with slots, N-shaped profiles, where the horizontal shelf is constantly moistened.

Moving from traditional types of cross-sections with a through structure from two corners to tubular, box-shaped, monolithic, T-shaped and even to a cross-section from single corners, it is possible to reduce corrosion wear by more than 2 times. The tubular and box-shaped and closed sections advantage is also convenience, simplicity and lower cost of applying protective coatings, which is especially important when re-painting, despite the high cost of pipe structures.

Additional costs for the design of such structures are fully paid off by increasing their durability.

Conclusions.

When designing elements and structures with increased corrosion resistance, the following recommendations should be followed.

a) tubular sections application without gussets.

b) solid-wall elements application without dust and moisture accumulation places and areas.

c) refusal to arrange cross-sections with the cracks formation when operating in environments with gassing, dust deposits and high humidity.

d) sections layout without sharp corners, edges, hard-to-reach areas, intermittent welds rejection.

The main directions of corrosion resistance durability increasing are the use of more resistant building steels grades and aluminum alloys, as well as reliable protection of metal structures with paints, varnishes and various chemical additives.

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