Chapter 16
Guidelines on the Use of Traditional Organic Sulfonate Corrosion Inhibitors

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ABSTRACT

In this chapter the authors summarized the molecular structure and classification of organic sulfonate in the market. To disclose corrosion inhibition properties of organic sulfonate, a series of test methodologies were established by mimicking different application environment from general and indoor storage to harsh exterior environments, including salt spray test, rust prevention test in the presence of water solution, seven day accelerated lamination test, water displacement test, and single piece rust prevention test. The correlation between the molecular structure, like base number, cation type, micelle size,

DOI: 10.4018/978-1-6684-7689-5.ch016

cation sulfur ration, etc., and the corrosion inhibition performance of organic sulfonate under various mimicked test conditions was systematically revealed, with the comprehensive analysis of their action mechanism based on the produce of hydrophobic adsorption film excluding water and air from reaching the metal surface. Further aspects with respect to the development, synergy effect, and application of organic sulfonate was discussed as well.

INTRODUCTION

Corrosion is a common problem faced by all countries in the world, which has caused huge losses to human beings. Corrosion causes a lot of catastrophic accidents, depletes precious resources and energy, pollutes the environment, and does great harm to human life, health, and the balance of nature. According to the statistics, the economic loss caused by corrosion is about 3% ~ 5% of the gross national product (GDP) in the world every year.

The corrosion inhibitor is a chemical substance or compound that exists in an appropriate concentration and state in an environmental medium and forms an adsorption film on the surface of the metal when used to prevent or slow the corrosion of the material, it is one of the most important corrosion protection methods, and is widely used in petroleum, chemical, steel, machinery, power and transportation industries.

Oil-soluble organic sulfonate is one of the most important and commonly used anti-rust additives. Since 1930, petroleum sulfonate is still the preferred oil-soluble anti-rust agent, which has been widely used in some major anti-rust oils in China. Petroleum sulfonate is divided into barium salt, calcium salt, sodium salt, magnesium salt, etc., of which barium sulfonate is the most widely used oil-soluble anti-rust agent, and with the largest output. Barium petroleum sulfonate and synthetic barium sulfonate (barium dinonylnaphthalene sulfonate, barium heavy alkylbenzene sulfonate) has excellent resistance to moisture, salt spray, salt water, and good water displacement and acid neutralization characteristics. But with the increasingly stringent environmental protection requirements, the use of barium salt will gradually be replaced.

With the development of science and technology and the demand for application, there are more and more kinds of organic sulfonate corrosion inhibitors, as listed in Table 1 and Table 2. It can be seen from the tables that there is a variety of organic sulfonates in the market, with great differences in the structure, source, content of main components, base number, and viscosity, so it is very difficult for the technical personnel in related fields to choose appropriate organic sulfonate corrosion inhibitor during the development of the rust inhibition formula. Therefore, in this chapter, the molecular structure and classification of organic sulfonate corrosion inhibitors were summarized, and based on the establishment of the test methods for evaluating the corrosion inhibition performance of organic sulfonate, the relationship between the molecular structure of organic sulfonate and their corrosion inhibition performance was analyzed in detail, including the influence of base number, type and size of cations, micelle size, the ratio of cations/sulfur elements, etc. The related action mechanism was also discussed to guide the application of organic sulfonate.