

Corrosion Problems and Solutions in Oil Refining and Petrochemical Industry

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Preface

I invite you to start our journey into the amazing world of crude oil, fuels, and corrosion problems and solutions at oil refineries and petrochemical plants. Look around. Vehicles, computers, modern sources of energy, materials, such as medicines, different goods from polymers, cosmetics, to name a few. The source of all these materials and energy is crude oil and products of its processing. Crude oil was formed in the depths of the Earth during millions of years. Since ancient times, people have used bitumen and other compounds accompanying crude oil or producing from it for waterproof, lubricating axles, and medical treatment.

The modern world depends severely on fuels which are obtained from crude oil in refineries.

The first oil refinery was built at Ploiești, Romania, in 1856–1857. About 60 refineries were built in 1860s in the USA. Then in the beginning of the twentieth century, refineries were erected like ‘mushrooms after the rain.’ Nowadays, more than 700 oil refineries function all over the world and use about 150 different types of crude oil. Most technological processes of elaboration of crude oil were created in the twentieth century.

The word ‘petroleum’ means ‘rock oil’ from the Latin ‘petra’ (rock or stone) and ‘oleum’ (oil). Therefore, ‘crude oil,’ or simply ‘crude,’ is synonym to ‘petroleum’.

We should also differentiate between oil refining and petrochemical industries. Oil refining industry produces the following products from crude oil: liquefied petroleum gas (LPG), naphtha, gasoline, kerosene (jet fuel), gas oil (diesel fuel), fuel oil, lubricating oils, paraffin wax, asphalt (bitumen), coke, and sulfur. Petrochemical industry produces olefins and aromatics. Then, these chemicals are used for manufacturing solvents, polymers, paints, medicines, fertilizers, etc. Our comfort life, health, and we can safely say ‘lifes pan’ are linked to them. Oil refineries and petrochemical plants are firmly connected because the former produce raw materials for the latter. Both are considered as typical chemical plants.

Development of numerous vehicles on the land, sea, and air and demands of chemical, pharmaceutical, and other industries resulted in intensive development of oil refining and petrochemical industry in the twentieth–twenty-first centuries. Metallic equipment and constructions contact crude oils, petroleum products and fuels, solvents, water, atmosphere, and soil. All processes with participation of aggressive substances occur in metallic equipment at temperatures from -196°C to $+1400^{\circ}\text{C}$ and pressures from vacuum to 1000 bar.

Oil refineries and petrochemical plants represent also a high hazard industry with media which are flammable, explosive, toxic to human health, or harmful to the environment. The combination of numerous factors makes refinery equipment very vulnerable to a variety of corrosion phenomena that can lead to serious accidents.

On the one hand, oil refining and petrochemical industry has accumulated large experience. On the other hand, the introduction of new technologies, materials, and strict requirements to the quality of fuels and to the reduction of environmental pollution state new problems to safe functioning of equipment and constructions.

In order to understand and to solve corrosion problems in refinery and petrochemical units, corrosion and materials specialist should learn diverse physico-chemical processes which are the basis of production of fuels and other chemicals. During my long carrier in oil refining and petrochemical plants, above 3000 corrosion events were analyzed and the reasons were defined. It was established that people are responsible in 65–85 % of corrosion cases. Using proper corrosion management, it is possible to diminish them.

In spite of many conferences, publications, researches, reports, and achievements in refining and petrochemical corrosion control and monitoring, a number of corrosion problems is increasing in the last 20 years because of four factors: the first—the introduction of new processes; the second—some universities and colleges removed corrosion courses they had before in the engineering curricula; the third—corrosion engineers in most of oil refineries and petrochemical plants were replaced with consultants; the fourth—corrosion specialists retire and are not replaced.

There are many ways to avoid or control corrosion hazard: selection of corrosion resistant or suitable materials, correct design, use of anti-corrosive chemicals, control of technological parameters, use of coatings, cathodic protection, and, what is very important, inspecting and controlling at all stages of application of these actions.

Interesting event happened to corrosion scientist C. Edeleanu who suggested anodic protection in 1954. He moved into industry from academy and did not take part in corrosion conferences during 15 years. Attending corrosion conference and listening to all presentations after such a long period he exclaimed: “Nothing changed.” New generations of engineers come and face the problems which were solved and even documented. There are good books, but most new information is dispersed in the literature or is present in the heads of specialists.

In this book, considering corrosion cases at different units, I tried to unify and allocate them according to appropriate systems and phenomena. You will find description of processing conditions, materials of constructions, history and service period, visual examination and findings, characterization of failure phenomenon,

causes of failure and its explanation, solutions, and practical recommendations. My experience is given, and the last literature data as much as possible is included. I hope that reading this book will enrich your knowledge and help in your understanding, experience, and job.

Shekhaniya, Israel

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