

# Preface

In process industry, materials have to handle corrosive and inflammable or lethal fluids at various temperatures and pressures. For example, in hydrogen plant the temperature to which the reformer tube is exposed is close to 1000 °C. On the other hand, in case of urea production the highly corrosive carbamate has to be handled upto a pressure of over 150 bar (2250 psi) and temperature  $\sim 180$  °C. Similarly, in the production of sulphuric and nitric acid the equipment is to handle highly corrosive chemicals. In all these cases the degradation of material is primarily due to corrosion or oxidation. In the production and storage of LNG the conditions are, however, quite different. Here the problem is not corrosion but the susceptibility of materials to fail in a brittle manner at cryogenic temperatures. The equipment exposed to the different conditions need to remain operational without breakdowns for the longest possible time to maintain plant's profitability. To achieve this objective, proper selection of material, corrosion control and good engineering practices are to be incorporated in the design and construction of the plant. Once a plant is commissioned, it is expected to be operated within the designed parameters, which quite often is not possible because of a number of reasons like non-availability of required raw material, changes in the market demand and inadequate operational, inspection and maintenance practices adopted. In such cases, amongst others, upgradation of materials of construction may become necessary to maintain on-stream equipment availability and to avoid any failure which can cause explosion, fire or environmental damage.

In the operation of any continuous process the input feeds are subjected to reactions at different temperatures and pressures that have to pass through various equipment till the intended reactions are completed. Thus the feeds flow from inlet to outlet of the unit in a closed system. A continuous process unit consists of stationary equipment like vessels, towers, exchangers, heaters, piping and valves and rotating equipment like pumps and compressors. The materials used for the equipment are primarily metallic materials, the selection of which for the various components is the first and foremost step in the setting up of a chemical process unit. The first requirement of any material is that it should have requisite resistance to corrosion damage under the operating conditions to ensure the design life or

necessitate minimum replacements during the life time. Next, the selected materials should also have requisite mechanical properties and be amenable to forming and joining. Finally, even if the material of construction (MOC) is rightly selected, the performance of the plant may not be satisfactory if there are deficiencies in design, material specification, fabrication techniques, construction, operation and maintenance. All these aspects, including inspection and maintenance, are directly or indirectly related to the material and constitute what we can call *material engineering*.

Personnel engaged in design or operations of a plant must therefore have the basic understanding of material properties and the damaging effects of environment during operation. As a consultant having the opportunity of interacting with plant engineers for the last forty years, the author feels that the knowledge in this regard is generally limited which makes decision making difficult. To bridge this gap, a special training program was developed for the personnel engaged in design and operation of plant. During the last 17 years I have conducted number of training programs in India, Middle East, and Malaysia. The course contents of the program, along with the fruits of the author's long involvement in finding solutions to material problems during design and plant operation, have been incorporated in this book. The book covers different metallic materials and their properties, metal forming processes, welding and heat treatment, corrosion and corrosion protection, material selection and repair techniques of stationary equipment with respect to oil & gas, refinery and fertilizer industries.

Delhi, India

Dr. Amiya Kumar Lahiri

Applied Metallurgy and Corrosion Control  
A Handbook for the Petrochemical Industry

Lahiri, A.K.

2017, XXIII, 544 p. 260 illus., Hardcover

ISBN: 978-981-10-4683-4