Design, Materials, Fabrication, Operation, and Inspection Guidelines for Corrosion Control in Hydroprocessing Reactor Effluent Air Cooler (REAC) Systems

API RECOMMENDED PRACTICE 932-B
SECOND EDITION, MARCH 2012

ERRATA, JANUARY 2014

AMERICAN PETROLEUM INSTITUTE

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Downstream Segment

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1 Scope

This recommended practice (RP) provides guidance to engineering and plant personnel on equipment and piping design, material selection, fabrication, operation, and inspection practices to manage corrosion and fouling in the wet sections of hydroprocessing reactor effluent systems. The reactor effluent system includes all equipment and piping between the exchanger upstream of the wash water injection point and the cold, low-pressure separator (CLPS). The majority of these systems have an air cooler, however, some systems utilize only shell and tube heat exchangers. Reactor effluent systems are prone to fouling and corrosion by ammonium bisulfide (NH_4HS) and ammonium chloride (NH_4Cl) salts.

An understanding of all variables impacting corrosion and fouling in these systems is necessary to improve the reliability, safety, and environmental impact associated with them. Past attempts to define generic optimum equipment design and acceptable operating variables to minimize fouling and corrosion have had limited success due to the interdependence of the variables. Corrosion can occur at high rates and be extremely localized, making it difficult to inspect for deterioration and to accurately predict remaining life of equipment and piping. Within the refining industry, continuing equipment replacements, unplanned outages, and catastrophic incidents illustrate the current need to better understand the corrosion characteristics and provide guidance on all factors that can impact fouling and corrosion.

This RP is applicable to process streams in which NH_4Cl and NH_4HS salts can form and deposit in equipment and piping or dissolve in water to form aqueous solutions of these salts. Included in this practice are:

— details of deterioration mechanisms;

— methods to assess and monitor the corrosivity of systems;

— details on materials selection, design and fabrication of equipment for new and revamped processes;

— considerations in equipment repairs; and

— details of an inspection plan.

Table 1 lists key issues to REAC system performance and section reference for more detail.

Materials and corrosion specialists should be consulted for additional unit-specific interpretation and application of this document. This is especially important since new proprietary research is underway which challenges several previously held beliefs about NH_4HS corrosion in the reactor effluent system. Each facility needs to establish its own safe operating envelope to assure satisfactory service. This RP helps to identify key variables necessary for monitoring and establishing the operating envelope.

Other equipment downstream of the REAC can also deteriorate from these ammonium salts. These include the recycle gas, sour gas and the H_2S stripper and product fractionator overhead systems. Although these are beyond the scope of this document, plant personnel should be alert to these other locations where ammonium salt fouling and corrosion can occur.

Since the first edition of API 932-B was published in July 2004, findings from a recent joint industry sponsored research program contributed important new data on NH_4HS corrosion relevant to these systems. While not all the data are in the public domain, recent publications have highlighted key data which are incorporated into this current edition of API 932-B.