




APTECH Engineering Services, Inc. Petrochemical Group



Ethylene Plant Experience



The objective of these projects was to develop a technical position paper on best engineering practices with regard to the inspection of cold-section equipment at several ethylene plants and to conduct Risk Based Inspection (RBI) studies on ethylene plant equipment. In addition, companies have requested Aptech Engineering Services, Inc.'s (APTECH's) assistance in optimizing the inspection programs currently being implemented at their facilities. APTECH also used this opportunity to develop and demonstrate the benefits that can be gained from the implementation of a RBI program.

The project objectives were achieved by completion of the following tasks:

1. Development of a technical position paper on ethylene plant, cold-section inspection
2. Evaluation of current cold-section inspection programs
3. Demonstration of RBI approach to inspection planning.

These tasks are described in more detail below.



Technical Position Paper

APTECH developed a technical position paper covering recognized and generally accepted best engineering practices CURRENTLY BEING APPLIED IN ETHYLENE PLANTS. The evaluation included a survey of the following information sources:

- ◆ APTECH's proprietary databank on worldwide failure experience was reviewed to determine and document causes of failure in ethylene plants. Our databank cites non-documented experience, which is not always available in the open literature.
- ◆ APTECH's full-service, technical library conducted a document search to find any open literature or proprietary data sources that could conceivably contain information that was considered germane to establishing inspection requirements for the cold section of ethylene plants.
- ◆ APTECH specialists conducted interviews with knowledgeable personnel in the industry regarding the best practices currently being employed in ethylene production.



Industry Review

Three of the major licensing architectural and engineering firms responsible for the technology and design of the bulk of the ethylene plants around the world were consulted on their materials selection approach to the "cold-section equipment in the product recovery section of an ethylene plant.

Without exception, the materials specialists for all three companies were overwhelmingly concerned with only the price of the material and its ability to resist brittle fracture at the anticipated startup, shutdown, and normal operating conditions of the facility.

Because of the process requirements to produce product in accordance with specifications from the separation of the cracked gases produced in the pyrolysis section of an ethylene plant, a materials engineer knows that process streams entering the cold section will essentially be devoid of water (H₂O), carbon dioxide (CO₂), air, sulfur compounds, chlorides, and mercury or other potentially damaging organic or inorganic compounds.

Without these contaminants, active internal damage mechanisms in the cold section of an ethylene plant are virtually non-existent. Hence, materials specialists focus primarily on cost-effective material choices for cold-temperature, high-pressure service.

Without exception, materials specialists (and also process specialists) from these three architectural and engineering firms saw no reasons for performing periodic internal inspections on cold-section equipment, except for performance reasons i.e., fabrication problems or process upsets that may lead to tray failures, displacement of demisters, etc.

In addition to architectural and engineering firms, APTECH consulted with owners/operators of 21 existing or former ethylene plants (6 of the ethylene plants have been shut down over the last 20 years due to economics of scale or outdated technology, but each had operated successfully for over 30 years without having any internal inspections performed.) Of the 15 remaining ethylene plants currently operating, 12 of these plants operate under a "no internal inspection program, except for cause." This "no inspection" plan is carefully documented (for Occupational Safety and Health Administration (OSHA) OSHA 1910.119 reasons) on the basis of the lack of no known operative damage mechanisms, history of the ethylene process, and the potential damage that could be done by the unnecessary introduction of moisture and air into the process. Of the remaining three ethylene plants, two of the units have internal inspection programs for cold-section equipment, but fail to understand the justification.

In summary, the great majority of the owners/operators of the ethylene plants surveyed strongly oppose the planned, periodic inspection of the internals of cold-section equipment unless there are compelling process reasons (poor performance, capacity restrictions, etc.) The introduction of air or moisture into these systems complicates the restart of the facility and promotes the formation of rust and peroxides, which can result in other potentially serious operating or process problems.

Risk Based Inspection Studies

In addition to the industry evaluation and reviews, APTECH completed RBI studies on the following two ethylene plants in the USA. These studies involved the evaluation of some 300 equipment items, as well as piping circuits.

ETHYLENE PLANT	EQUIPMENT ITEMS	CONTACT & REFERENCE
Sasol Condea Vista Facility Lake Charles, Louisiana	150 equipment items & piping circuits	Chuck Ballou, PSM Manager Phone: 337-494-5431
Huntsman Chemical Corporation Port Neches, Texas	150 equipment items & piping circuits	Chris Archie, Supervisor – Inspection Design Engineering Phone: 409-989-6824

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