VOLATILE CORROSION INHIBITORS USED FOR CONSERVATION OF REFINERY EQUIPMENT AND FACILITIES

Janko Mose, Franjo Holcer and Zdenko Culig
INA Refinery Sisak
Subiceva 29
41000 Zagreb, Croatia

Samie Lafte and Milivoj Ivanusic
DeltaMerkur
Dugi Dol 35
Zagreb, Croatia

Published: March 1996
Denver

ABSTRACT

This paper describes the implementation of volatile corrosion inhibitors and migratory corrosion inhibitors for preservation and protection within the oil refineries. The effectiveness of protection for plants at a standstill is well documented by the results, which is of great importance due to a high cost of refinery equipment.

Keywords: refinery equipment, volatile corrosion inhibitors, migratory corrosion inhibitors, oil refineries.

INTRODUCTION

There exists a major problem within refineries; temporary protection of used equipment. This problem arises from the inability to thoroughly clean the interior of equipment and facilities, and incomplete inhibition - inability to introduce inhibitors to each and every part of the surface. Pipelines, with all of their organic and inorganic sediments, present an additional problem.

There are several common methods of protection, some of them with advantages and some with deficiencies. However, each of them require thorough cleaning of equipment prior to temporary preservation.

1. Nitrogen atmosphere protection requires thorough purging, a continuous source of clean nitrogen, periodic review and release of condensate. The method is simple but not efficient due to the impossibility of complete drying of the system, ineffective control of condensation and corrosion underneath the remaining sediments.

2. In using inhibited gas, oil or petroleum, it is possible to almost completely fill up the system after purging and inhibit corrosion efficiently, depending on the chosen inhibitors. However, it is not possible to protect all hard to reach areas, particularly where moisture condenses. The costs of this form of protection are high.

3. Passivization with dry air works only on completely clean surface. Any areas of condensation, as well as areas not entirely cleaned of sediments, remain beyond control of simple passivation and local corrosion damage is possible.

4. Corrosion inhibition by volatile and migratory inhibitors was something new for the refinery. We required cleaning of the equipment in the same manner as for a turn around and introduced Volatile Corrosion Inhibitors (VCIs) on the equipment as well as into the equipment. It was expected that these inhibitors would prevent corrosion on all surfaces within the equipment by evaporation and inhibition on clean surfaces, by monomolecular layer or by penetration of the remaining sediments. Corrosion is also prevented in condensate by use of the proper inhibitor.

PROTECTION TASKS

The protection task was to temporarily protect the combined plant atmospheric distillation - including all facilities and equipment, electrical instruments, civil works and other equipment.

Protection was performed on: atmospheric distillation column, stabilizing column, splitter column, desalters, exchangers, air/water coolers, process heaters, refractory lining in process heaters, pipelines, pumps, electric motors, instruments and other utilities. Further cleaning was necessary on exchangers and convection zone on the flame side of the process heater. All procedures were performed simultaneously to allow completion of equipment protection before start up of the plant.

Temporary conservation of the internals of the equipment and facilities with associated equipment was for a one year period with the possibility of extending it to two

years. The method of protection had to be non combustible, non-explosive and only a minimal amount of work required prior to plant start up. Corrosion rate was monitored by means of corrosion coupons.

TECHNOLOGY AND PRODUCT APPEND

Protection technology is conditioned by the application of volatile corrosion inhibitors. The state of equipment for protection stipulated the application of additional procedures for cleaning of the part of equipment, and hydrotesting exchangers and coolers stipulates the choice of products for conservation.

Technology has been offered and described by the manufacturer according to the requirements and conditions of application.

3.1 Description of conservation technology.

3.1.1 Columns and vessels.
Purge dry air, introduction of powdered volatile corrosion inhibitor in accordance with volumes of the vessels, and closure was necessary.

3.1.2 Heat exchangers and water coolers.
Purge shells and bundles with dry air, introduce volatile corrosion inhibitor, assemble exchangers and water coolers, pressure test, drain and introduce powdered volatile corrosion inhibitor formulated as water soluble.

3.1.3. Air coolers-trim condensers.
Purge inner and external surfaces with dry air, air dry inside, introduce powdered volatile corrosion inhibitor and close.

3.1.4 Pipelines, pumps and process heater.
After the pipelines and pumps have been flushed by water, drain and close the pipeline and open in direction of vessels and columns since the quantity of volatile corrosion inhibitor introduced in the column and vessels has been evaluated for the volume of pipeline as well. Should the period of conservation be extended, it is possible to introduce powdered inhibitors in the pipeline.

3.1.5 Process Heater
After cleaning process heater tubes, conservation was performed by means of volatile inhibitor. Refractory lining within the heater is impregnated by volatile and migrating inhibitor.

3.1.6 Electric motors.
Flushed and wrapped with extensible foil which consists of volatile inhibitor.

3.1.7 Instrumentation equipment.
Any such equipment installed on process lines, vessels, exchangers, etc., is conserved together with these facilities. Instrumentation equipment external to process facilities shall be conserved by means of impregnated sponges with volatile inhibitors.

3.2 Products applied for conservation.
Volatile and migrating corrosion inhibitors are produced by CORTEC CORPORATION, Minnesota, USA.

OBSERVATION OF PROTECTION EFFICIENCY

The efficiency of protection was monitored using corrosion coupons and periodic inspections of internal surfaces. Equipment was inspected at the same time the corrosion coupons were changed, i.e., every 60-70 days and always by the same person.

Both carbon steel and copper were used. After the second review (140 days) it was determined that a control is not needed during an interval less than 6 months.

RESULTS

Inspection reviews in the period of 60-70 days found no further corrosion damage to protected equipment. Corrosion coupons were treated in the same manner as the equipment and showed no signs of corrosion, nor were there any changes in width or appearance. More importantly, there was no weight loss on the coupons.

CONCLUSIONS

Powered volatile corrosion inhibitors applied as described are a more efficient means of conservation of vessels and columns than nitrogen or inhibited oil or gas. Volatile inhibitors applied in accordance with described technology ensured protection of metal surfaces during hydrotesting of on heat exchange bundles and water coolers. In combination with water soluble powder, the inhibitors were able to preserve the equipment without measurable corrosion. Clean and passivate the surface using rust removers (passivator) when conservation is not needed. Extensible foil in combination with impregnated sponges proved efficient both for used and new (electrical) equipment. VCI products are almost entirely non-toxic, biodegradable, nonflammable and non explosive.

REFERENCES

1. B. Miksic, Temporary Protection, Lay-Up and Mothballing. St. Paul, 3/87.
2. Ivan Esih, Zvonimir Dugi, Technologija Zastite of Korozije, Skolska Knjiga, Zagreb, 1990.
3. Allan B. Hughes, Morgan C. Larkin, Corrosion Inhibited in Steel Vessel Stored outdoors, Plan Services, 8/87
4. B. B. Hopkinson, G. Villasmill, Mothballing of Refinery Process Equipment, Corrosion 13, 1987.