MIGRATORY VCI INHIBITORS FOR WET THERMAL INSULATION

By

B. A. Miksic
4119 White Bear Parkway
St. Paul, MN 55110

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GENERAL

The corrosion of metals under thermal insulation is an industry wide problem, specifically during idle or cooling-down periods. The presence of condensed water, airborne contaminants and corrosive agents that are generated through thermal decomposition and aging of insulating materials further increases the rate of attack on underlying surfaces. Due to failure of outer barrier wraps or jackets, the moisture content of the insulation can often reach the point of saturation. This combined with elevated temperatures can cause the corrosion rates to multiply to exceedingly high levels.

M I G R A T O R Y V C I'S

The effectiveness of volatile corrosion inhibitors to inhibit corrosion of metals in recessed and hard-to-reach areas is well documented (1). The idea has occurred to utilize the unique transport mechanism of VCIs to stop the deterioration of metals under thermal insulation and thus to extend the useful life of the structures. However, for VCIs to be useful for this specific application, they must meet a specific set of requirements:

(1) VCI must be capable of migrating or penetrating to relatively great distance form point of injection or application.

(2) They must be effective in arresting further corrosion under existing corrosion or scale deposits.

(3) They must have balanced partial vapor pressure between VCI compounds in the formulation in order to provide rapid saturation of insulation jacket after application, and long term protection by minimizing the length of time between the application.

E X P E R I M E N T A L

Based on the above requirements, a formulation has been developed which utilizes a volatile, non-flammable liquid carrier (Cortec VCI-656x), to improve the migratory capability of the inhibitors. Sections of carbon steel pipe covered with wet calcium silicate thermal insulation were injected with the VCI at the metal/insulation interface. The entire system was kept wet at an elevated temperature to provide high possible rates of corrosion for the VCI to overcome. The rate of injection of the inhibitor was 1 gallon of liquid per 23 cu. feet of insulation. The test pipes were prepared with blast-to-white metal finish yielding maximum profile 1 to ½ mils, insulated with calcium silicate insulation 1½" thick and covered with 16 MIL aluminum jacketing prior to putting into test.

The test conditions were 200^{o} F to 200^{o} F surface temperature and 5 psig steam pressure which was maintained by continuous water injection at 5 ml/hr. (2)

R E S U L T S A N D C O N C L U S I O N S

After six months, the test was shut down and disassembled. The following visual observations were made:

- Control pipe was approximately 80% covered with the major part of the bottom half covered with a build-up of corrosion products.

- The pipe inhibited with liquid VCI was approximately 5% corroded at the two of the water injection points.

Considering the severity of the test, and experience with anti-corrosion coatings under similar conditions, it is believed that the VCI compounds show promise as an effective method of corrosion protection under existing insulation. It should be further mentioned that due to the unique transport mechanism, this method could result in significant material and labor savings in extending the useful life of the insulated structures, as the cost of reinsulating and repair could be considerable.

UNDERCOATING FOR INSULATED SURFACES

Another area of application is the new insulation work. Here the requirements for VCI are somewhat different as compared to injecting into the existing (wet) insulation. A typical case history involved a large Midwestern Utility that specified temporary coating for their ESP precipitators that have been fabricated on the location near the Gulf Coast.

Those large units were partially insulated at the fabrication yard with the additional requirement that the units had to withstand barge shipment to the Ohio location and up to one year field storage without appreciable corrosion attack. The limiting factor for the selection of temporary coatings were the start-up conditions, as the wall temperature of the precipitators is 475^{o}F with excursions up to 700^{o}F anticipated. Wax like coatings were ruled out due to high temperature conditions and concern for decomposition products that would form under the insulation. The conventional zinc rich primers could not be used because of Zn reversing the potential at elevated temperatures. Further obvious choice, the polyester lining material was excluded due to the marginal surface preparation, dampness in the yard and cost factor associated with the application of lining to large structures.

After careful review of the above requirements, a combination of contact and volatile corrosion inhibitors has been developed to provide temporary protection for ESP precipitators during fabrication, and in transit and storage before plant start-up. The formulation was designated VCI-619 X and utilizes water as a carrier assuring safe application from stand points of flammability and health hazard. The coating was designed to withstand high start-up temperature conditions, thus eliminating concerns about decomposition products that would be formed. The material is shop applied by spray or brush to steel surfaces using commercial equipment and it does not require stringent surface preparation as with the linings. It can be applied directly to the surfaces covered with tight oxide film or scale. Treated surfaces are allowed to air dry from ten to sixty

minutes (depending upon ambient conditions) before further handling or covering with insulation.

The temporary coating was submitted to laboratory and field tests to prove its effectiveness in retarding corrosion attack. Under laboratory conditions described above, it showed approximately 30% corrosion which, considering severity of the test was still acceptable (control pipe was covered over 80% with heavy corrosion product). The field experience showed even more promising results - a total of 20 ESP precipitators have been coated and insulated together with the associated equipment. All units have been transported by river to the Midwest location and stored on site for over 1 year. The periodic inspection show no or minimum amount of corrosion under thermal insulation.

R E F E R E N C E S

(1) B. A. Miksic, Chemical Engineering, September 1977

(2) E. I. Dupont Co., Internal memorandum Jan 15, 1988 (Haldeman & Hughes)