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Assessment of the Effect of Volatile Corrosion Inhibitors on the Operational Efficiency of Electrical Motors

Eric Uutala
Cortec Corporation
4119 White Bear Parkway
St. Paul, MN 55110

ABSTRACT

Chemical and manufacturing industries spend upwards of 10% of their budgets on energy and replacement of electric motors, and these are seen as fixed costs. The energy usage of various electrical motors will vary as the motors age and oxidize. The application of Volatile Corrosion Inhibitors to protect electric motors from oxidation was examined. When the copper windings and other internal components oxidize, their energy usage will generally increase and their useful life will decrease. Utilization of Volatile Corrosion Inhibitors to protect electric motors before and during operation could potentially provide a substantial cost savings to almost any company in chemical and other manufacturing sectors. ASTM B 117 salt spray proved to have a significant effect on the resistance of an untreated electric motor, whereas various volatile corrosion inhibitor products prevented the motors from oxidizing.

Keywords: electric motor, oxidation, volatile corrosion inhibitors

INTRODUCTION

Corrosion on electric motors can be a serious problem, and there are many causes for it. Severe environmental operating conditions are the main factor. Included in these can be a combination of heat, humidity, salt, and corrosive gases, among other factors. Manufacturers are going to great lengths to make motors more corrosion resistant in an attempt to avoid the replacement costs that have previously been associated with scheduled replacement. More motors are being built with composite housings, corrosion resistant casings or coatings, or other means of corrosion resistance. Still, help must be found for motors that do not have the benefit of corrosion resistant designs.

The operational effect on an electric motor by a VCI (Volatile Corrosion Inhibitor) spray was examined for multiple reasons. VCI sprays can be used to protect various metallic components throughout a motor. In this case, copper windings were the main concern. Although copper is generally resistant to corrosion, hydrolysis from salt (sodium chloride) environments can be particularly corrosive. Oxidation on windings will lead to increased resistance and decreased efficiency throughout the life of a motor. Oxidation can eventually render the motor useless, and lead to a need for replacement. Replacement costs can get to be overwhelming in all environments, but particularly in corrosive environments. Regular application of a VCI spray can greatly increase the effective life of an electric motor, while having little to no effect on the normal operational efficiency of the motor.

EXPERIMENTAL

Laboratory Tests

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For this test, five shaded pole blowers with small electric motors were used. Upon receiving the five motors, each was checked for four electrical characteristics: resistance prior to startup, amperage prior to startup, amperage under AC load, and voltage under AC load (Table 1). After initial readings, five scenarios were examined. Three involved different VCI sprays, and two involved no sprays. After light spraying (~3 seconds) on three of the motors, each motor was placed in a separate 12"x12" cardboard box, which was then closed. After two hours, the four characteristics were measured again (Table 2). After the second round of readings, four of the motors (3 with VCI spray and one with no spray) were packaged in a VCI polyethylene (PE) bag, which was heat sealed prior to further testing (Figures 1-4). The final motor (with no VCI spray) was packaged in a plain PE bag (Figure 5). After packaging, the motors were placed in an ASTM B 117 Salt Fog Cabinet[1] for five days. At this point, all motors were removed, and electrical characteristics were measured a final time (Table 3).

RESULTS

Table 1.
Electrical Characteristics Prior to Fogging of VCI Sprays

Unit	Resistance	Amps (Startup)	Amps (Running)	Voltage
A1	6.6	3.97	2.63	120.5
B1	6.7	3.97	2.61	120.7
C1	6.7	3.97	2.61	120.7
D1	6.3	3.90	2.62	120.7
E1	6.2	3.95	2.73	120.0

Table 2.
Electrical Characteristics after Fogging with VCI Sprays

Unit	Resistance	Amps (Startup)	Amps (Running)	Voltage
A1	6.4	3.97	2.63	120.0
B1	6.6	3.95	2.58	120.0
C1	N/A	N/A	N/A	N/A
D1	6.2	3.89	2.62	120.7
E1	N/A	N/A	N/A	N/A

Table 3.
Electrical Characteristics after 5 Days in ASTM B 117 Salt Spray Chamber

Unit	Resistance	Amps (Startup)	Amps (Running)	Voltage
A1	6.2	3.92	2.61	119.8
B1	6.3	3.85	2.60	120.0
C1	6.0	3.85	2.60	120.2
D1	6.2	3.90	2.62	120.7
E1	6.7	3.90	2.71	120.1

Table 4.
Overall Percentage Change in Electrical Characteristics

Unit	Resistance	Amps (Startup)	Amps (Running)	Voltage

A1	-6.1%	-1.3%	-0.8%	-0.6%
B1	-6.0%	-3.0%	-0.4%	-0.6%
C1	-10.0%	-3.0%	-0.4%	-0.4%
D1	-1.6%	No change	No change	No change
E1	+8.1%	-1.3%	-0.7%	-0.08%

CONCLUSION

Use of VCI products did not have a significant negative impact in the electric motors, when compared to the unit not treated with VCI products. Of the VCI products, the largest change in resistance was seen in the motor packaged only in VCI film (C1). However, minimal changes were seen in other characteristic. The VCI spray products showed excellent results in all cases, with D1 being the best. Motor E1, which was untreated, was the only motor to show a significant increase in resistance. It was thought that due to the solvent-based nature of the VCI spray product, there may be problems with the copper windings on the motor, as well as any rubber bushings that may be in the motor or the casing.

REFERENCES

1. ASTM B-117 “Standard Practice for Operating Salt Spray (Fog) Apparatus

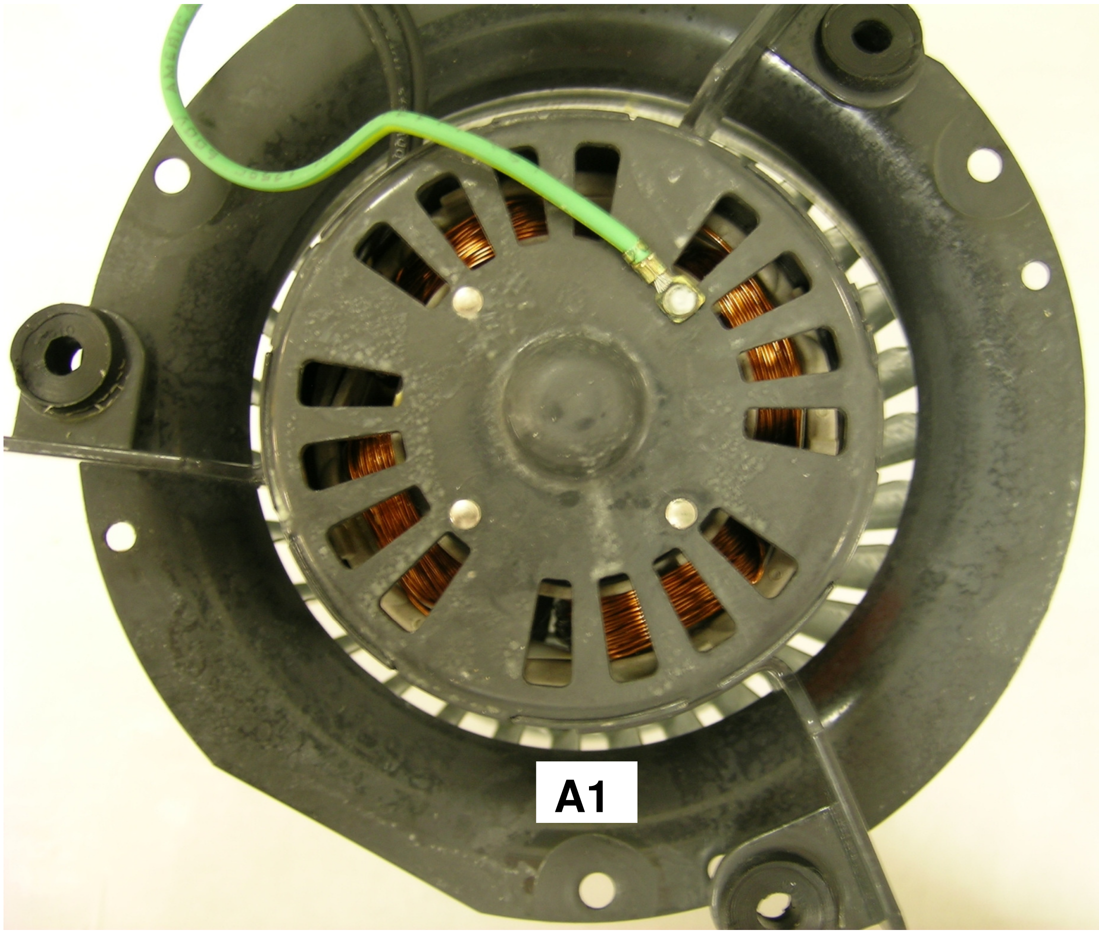

Figure A1: Motor A1, after 5 days in ASTM B 117 Salt Spray cabinet

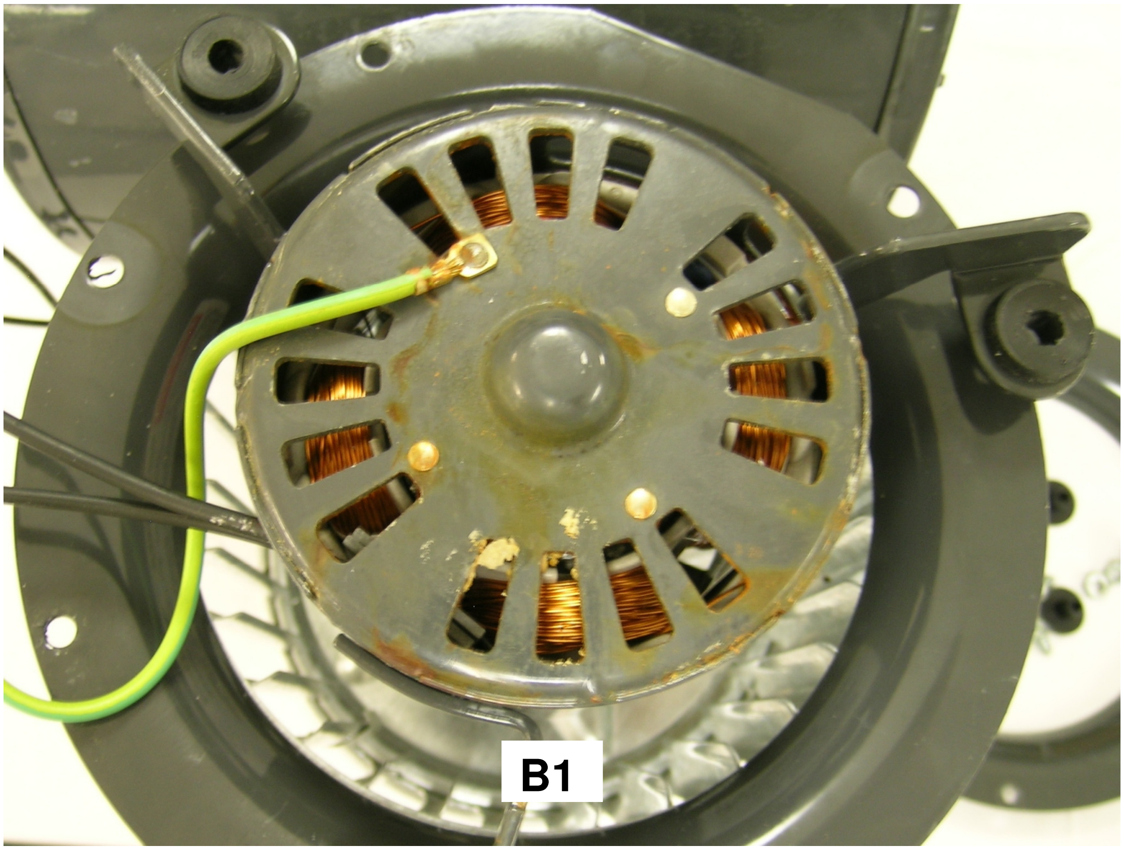

Figure 2: Motor B1, after 5 days in ASTM B 117 Salt Spray cabinet

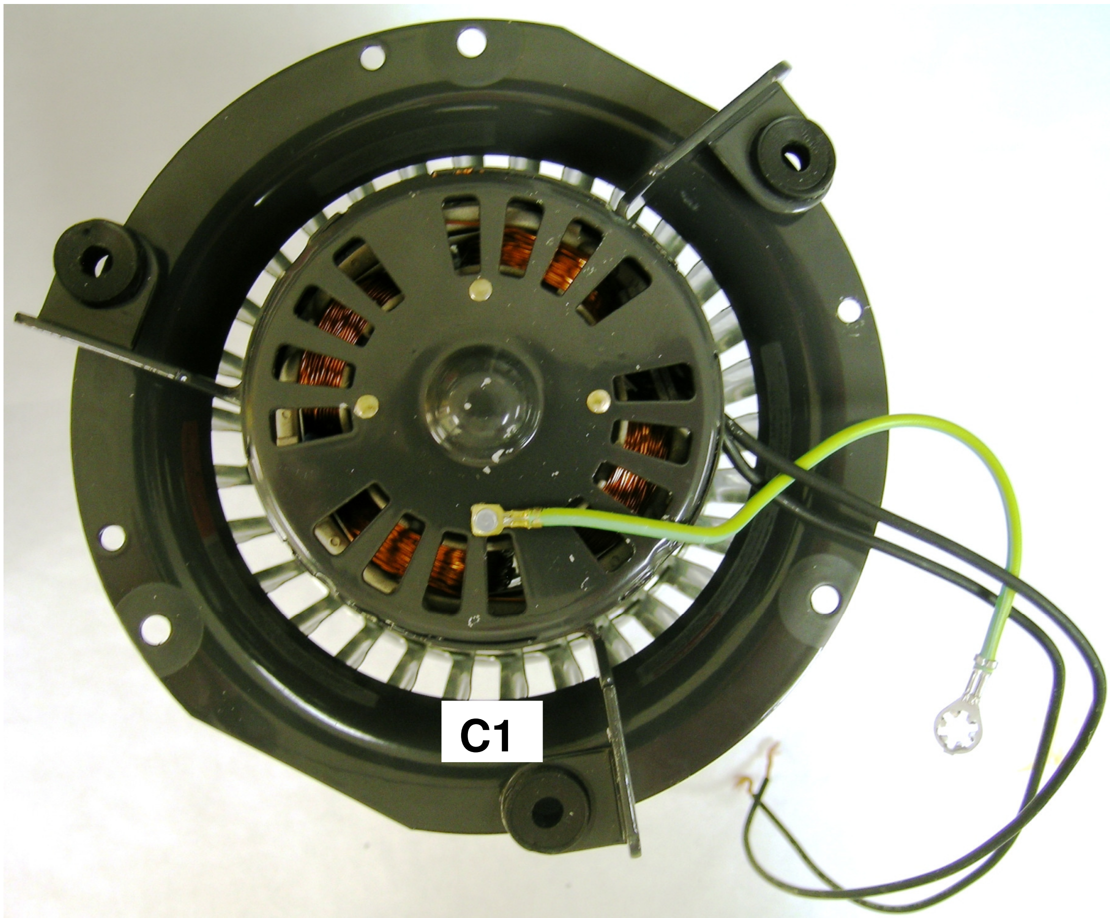

Figure 3: Motor C1, after 5 days in ASTM B 117 Salt Spray cabinet

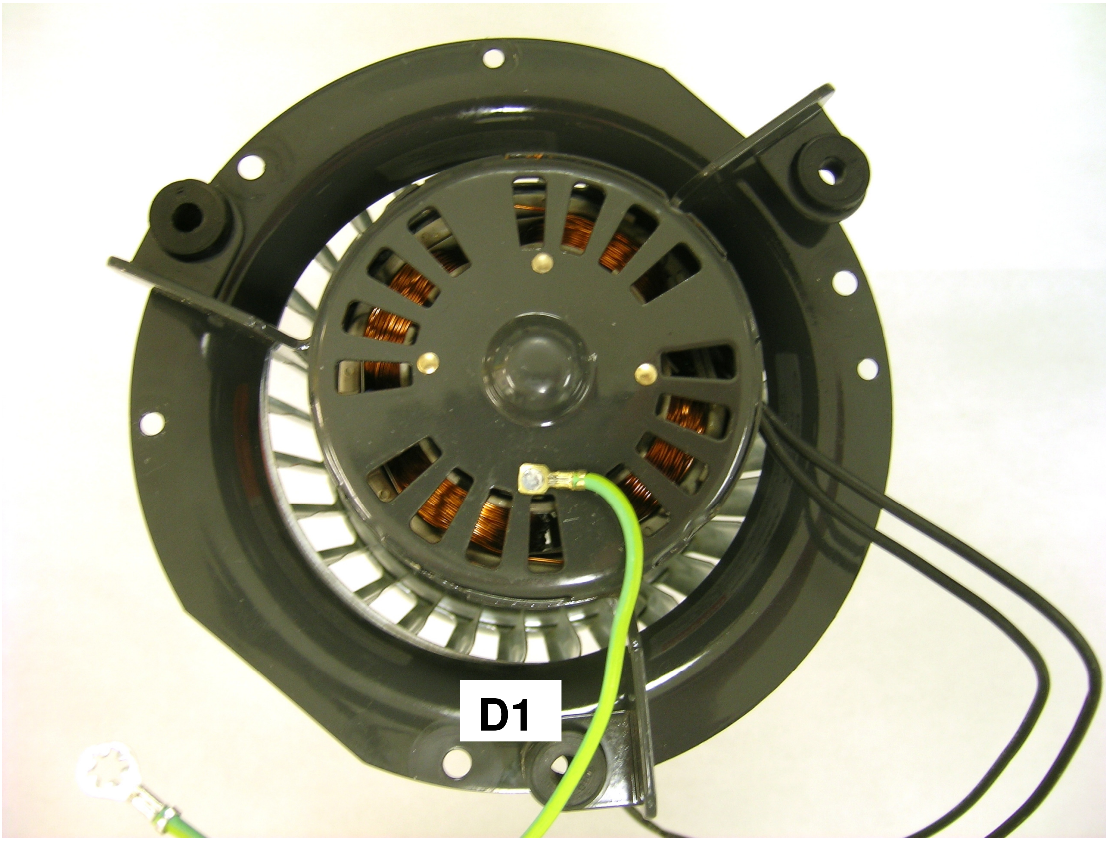

Figure 4: Motor D1, after 5 days in ASTM B 117 Salt Spray cabinet

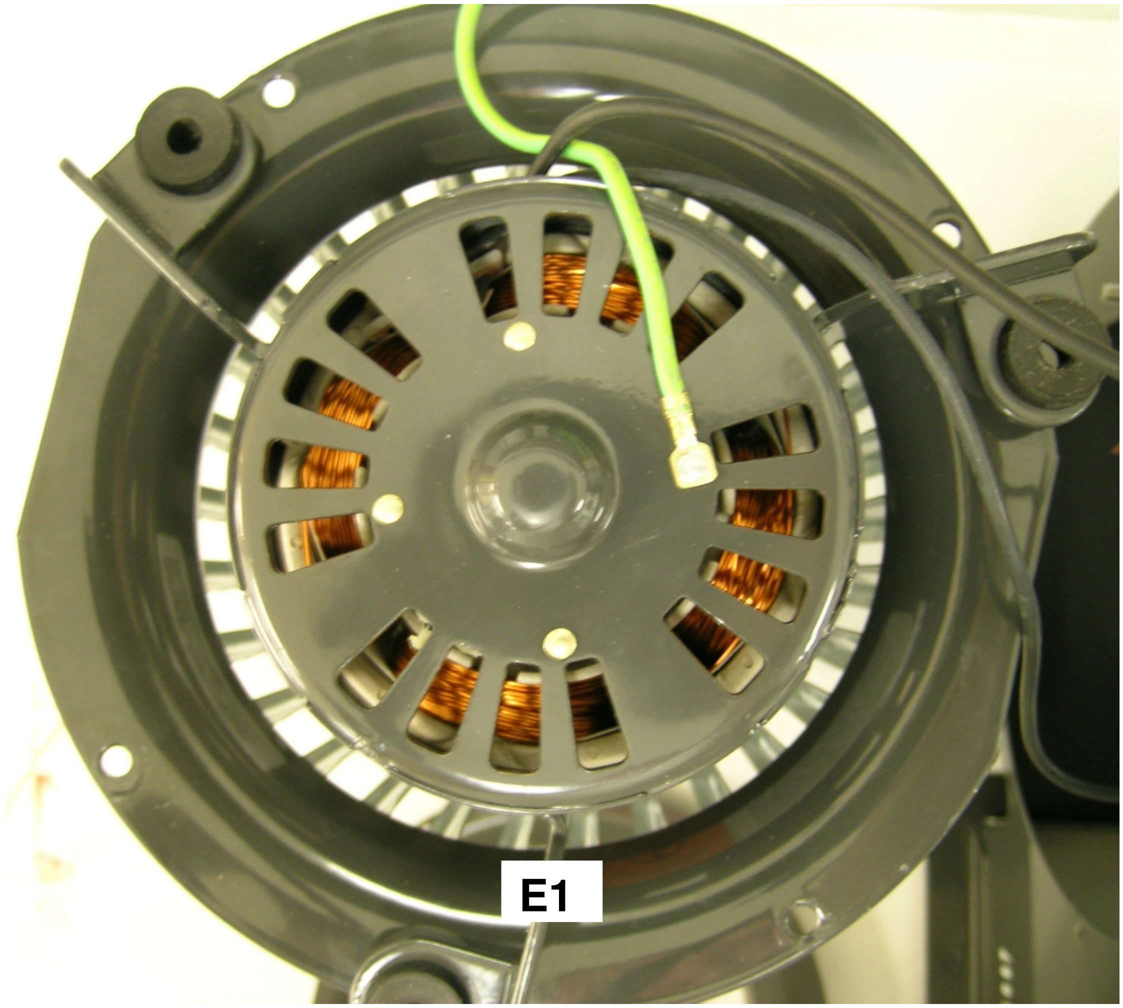

Figure 5: Motor E1, after 5 days in ASTM B 117 Salt Spray cabinet