Effect of Volatile Corrosion Inhibitors on the Operation of Electric Motors

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The energy usage of electric motors varies as the motors age and oxidize. When the copper windings and other internal components oxidize, their energy usage generally increases and their useful life decreases. In this work, salt spray proved to have a significant effect on the resistance of an untreated electric motor, whereas various volatile corrosion inhibitor products prevented motors from oxidizing.

Corrosion of electric motors can be a serious problem, and there are many causes. Severe environmental operating conditions are the main factor. Included in these are a combination of heat, humidity, salt, and corrosive gases. 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 volatile corrosion inhibitor (VCI) spray was examined. 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 [NaCl]) 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 replacement. Regular application of a VCI spray can greatly increase the effective life of an electric motor, while having little or no effect on the normal operational efficiency of the motor.

Experimental Procedures

Laboratory Tests

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 alternating current (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 s) on three of the motors, each motor was placed in a separate 12 by 12-in (0.3 by 0.3-m) cardboard box, which was then closed. After 2 h, the four characteristics were measured again (Table 2). After the second round of readings, four of the motors (three 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 through 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[1] salt fog cabinet for five days. At this point, all motors were removed, and the electrical characteristics were measured a final time (Table 3).

TABLE 1

Electrical characteristics prior to treating with VCI sprays

Unit	Resistance (Ω)	A (Startup)	A (Running)	V
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 treating with VCI sprays

Unit	Resistance (Ω)	A (Startup)	A (Running)	V
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

Results

See Tables 1 through 4 for the results of the tests.

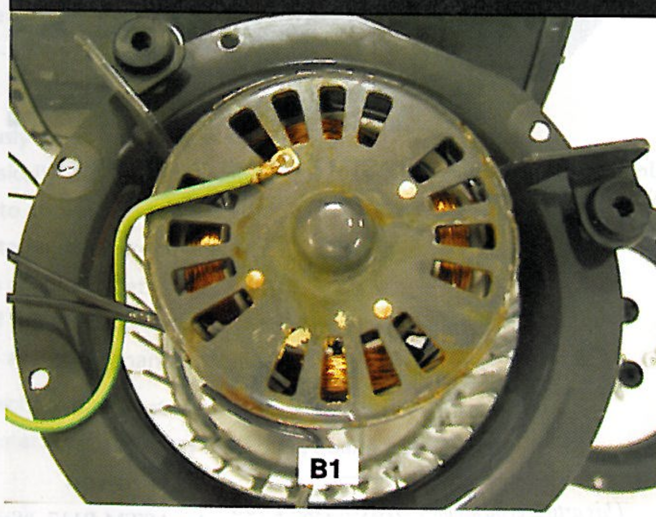
Conclusions

VCI products had no 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 (Unit C1). Minimal changes were seen in other characteristics. The VCI spray products showed excellent results in all cases, with Unit D1 being the best. Unit 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.

FIGURE 1

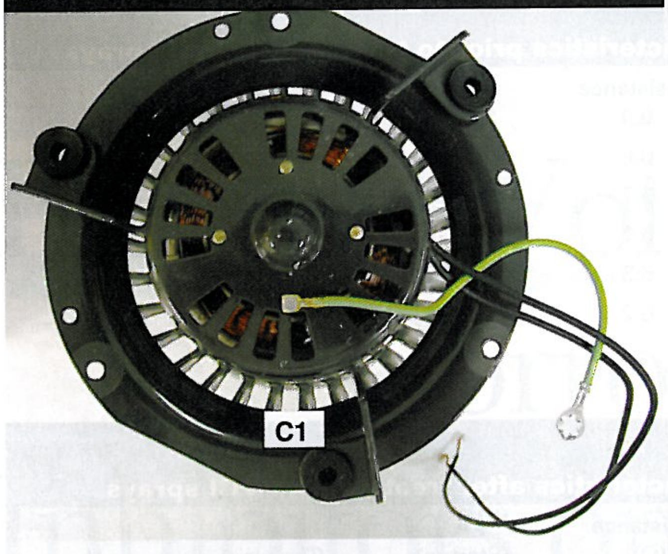
Unit A1, after five days in ASTM B117 salt spray cabinet—VCI spray.

FIGURE 2



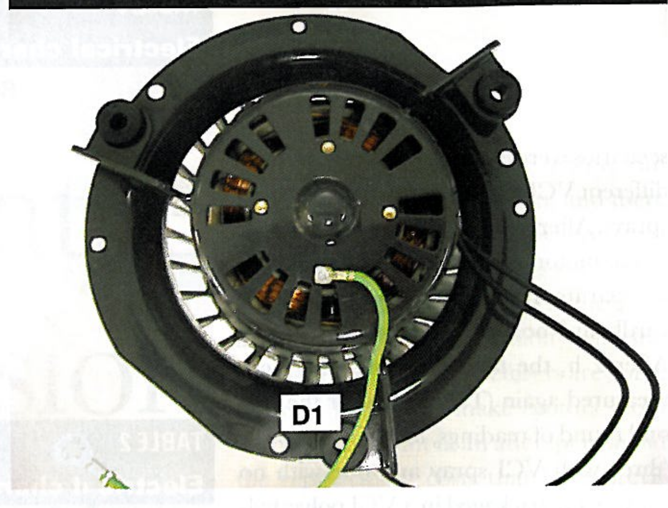
Unit B1, after five days in ASTM B117 salt spray cabinet—VCI spray.

FIGURE 3



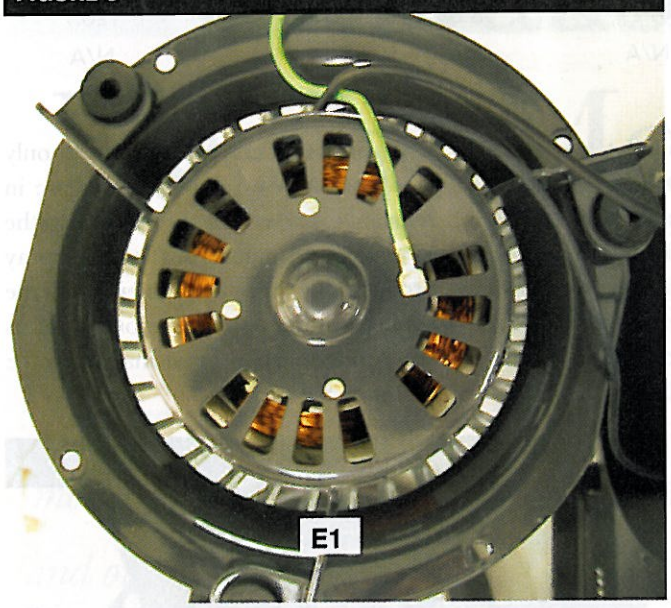
Unit C1, after five days in ASTM B117 salt spray cabinet—VCI film only.

FIGURE 4



Unit D1, after five days in ASTM B117 salt spray cabinet—VCI spray.

FIGURE 5



Unit E1, after five days in ASTM B117 salt spray cabinet—No VCI treatment.

TABLE 3

Electrical characteristics after five days in ASTM B117 salt fog chamber

Unit	Resistance (Ω)	A (Startup)	A (Running)	V
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 (%)	A (Startup, %)	A (Running, %)	V (%)
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

This article is based on CORROSION 2008 paper no. 359, presented in New Orleans, Louisiana.

Reference

1 ASTM B117, "Standard Practice for Operating Salt Spray (Fog) Apparatus" (West Conshohocken, PA: ASTM).

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