Air Contaminants That Affect Carbon Brushes, Motors, & Generators

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Morgan Advanced Materials

A carbon brush is the part of the motor that conducts electrical current between the stationary wires (stator) and the rotating wires (rotor) of a motor or generator. A brush riding on a commutator develops a film, or patina, over the commutator. The film is mainly copper oxide that has formed on the commutator surface because of a reaction among copper, graphite, oxygen and other free particles within a range of temperatures. This film has a friction component and voltage rating (measured in the form of contact drop through the film). There are a variety of contaminants that may be found in the air that may cause problems with how the film forms on the collector and how it affects contact drop, operating temperature, brush wear, and slip ring or commutator wear.

The following are a few examples:

1. **Sulfur Compounds (Emulsified Sulfur, Elemental Sulfur Pastille, Multi-Purpose Sulfur)** Sulfur dioxide and hydrogen sulfide are by-products of many industrial processes such as steel mills, petroleum products, and coal power generation.
2. **Chlorine (Bleach, Cleaning Compounds, Solvents Used in Paper & Plastic Manufacturing)** Chlorine is used in cleaning and bleaching operations throughout most applications.
3. **Acids (Sulfuric Acid, Nitric Acid, Citric Acid)** Acids are used in cleaning and in the manufacturing process of some products.
4. **Abrasive Dust (Dirt, Process Debris)** These materials, when introduced to the film and brushes, will immediately shorten brush life. This abrasive material will then cause severe grooving to commutators and slip rings (mining, cement plants, and papermills).
5. **Silicone (Silicone-based Oils, Greases, Insulating Materials)** When this material and/or its vapors are introduced to electrical machinery you will immediately see rapid brush wear. There only needs to be a small concentration in the air to cause extreme damage to the brushes, commutators, and slip rings.
6. **Moisture (Water Collection Systems, Cleaning, Condensation)** Moisture is important to the development of the film. Too much moisture will cause rust in unseen locations. This material, when introduced to the commutator or slip ring, will then create non-conductive films causing arcing, rapid brush and commutator or slip ring wear. Low humidity—as seen in northern and desert climates, freezer, and high altitude applications—will result in rapid brush wear due to mechanical friction caused by an inability to create a film.
7. **Oil Vapors (Oil Leaks, Poor Maintenance Practices, Poor Storage)** Oils, greases and other lubricants are used everywhere in industrial environments. Their vapors are invisible to the eye. When an uncontrolled oil vapor contaminates the brush to commutator or slip ring interface, higher contact drop and brush temperatures can be expected.

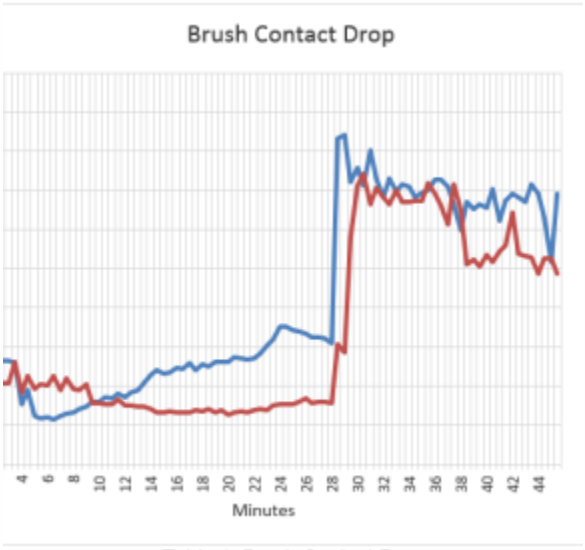

Table 1: Brush Contact Drop

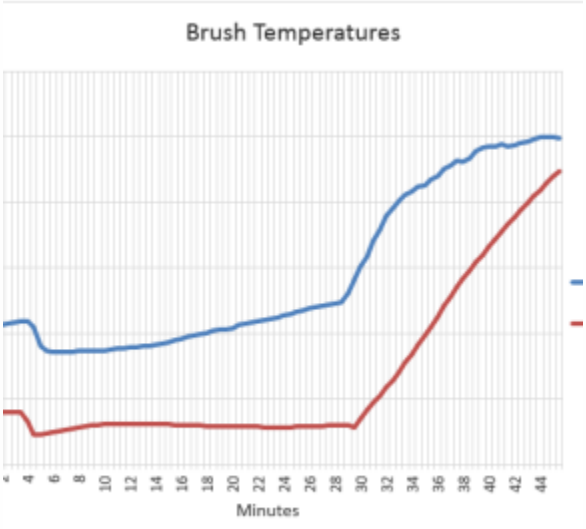

Table 2: Brush Temperatures

Tables 1 & 2 show the results of an oil contamination test conducted in the Morgan Lab. Two different scenarios were tested.

- The first test (blue) introduced an oil spray into the air supply system.
- The second test (red) had a heated pan of oil placed underneath the commutator.

Both forms of oil were introduced at the 28 minute mark. Immediately contact drop and temperatures were affected. Note: Also measured but not displayed was an increase in friction (measured as motor wattage). The friction increased by 50% at the same time and similar step function as the brush contact drop.

Summary: Morgan impregnates many different proprietary ingredients into carbon brush materials for many varied reasons—to improve performance and life being foremost. These impregnations are processed at various levels and curing temperatures. All impregnations will affect the contact drop and friction. Controlling these changes is the major concern when developing a brush material. When an uncontrolled contaminant is introduced to the brush film a higher contact drop and higher friction with resulting higher brush temperatures can be expected. The increase in the contact drop and friction directly affects the brush operating temperature, possibly not allowing the machine to perform as designed. This could cause overheating, limit production, and increase maintenance costs. Morgan recommends that all contaminants be removed or be cleaned from the immediate area and air supply. Brushes, motors, and generators work best in a clean, well-ventilated, uncontaminated environment just like you and I like to work in. It is understood that some industrial contaminants cannot be totally removed due to the manufacturing processes. In these applications, Morgan uses a wide portfolio of brush grades to provide a stable film that assists in protecting the commutator and provides long brush life ergo reducing cost of ownership/repairs.