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Case Study: Residential Sprinkler Head Failure

By

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Background

The sprinkler head was manufactured by a major sprinkler head manufacturing company and was suitable for residential use in buildings up to four stories. This building was two stories, plus a basement. The failed sprinkler head was installed on the first floor. There were no recalls or indications of unusual failures in connection with this type and make of sprinkler. The failure occurred during a severe thunderstorm and power outage. Key parts, the glass bulb and metal seal, of the failed sprinkler head were missing. These parts were likely removed during the cleanup following the failure. The failed sprinkler head and exemplars were examined by visual examination and scanning electron microscopic examination, including energy dispersive x-ray analysis.

Site Examination

Figure 1 – Location of Failed Sprinkler

Figure 2 – Plug Replacing Failed Sprinkler

Figure 1 shows the location of the failed sprinkler. It was in the center of the living room. The plug in the sprinkler and the end of the piping is shown in Figure 2.

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Figure 3 – Hallway Sprinkler

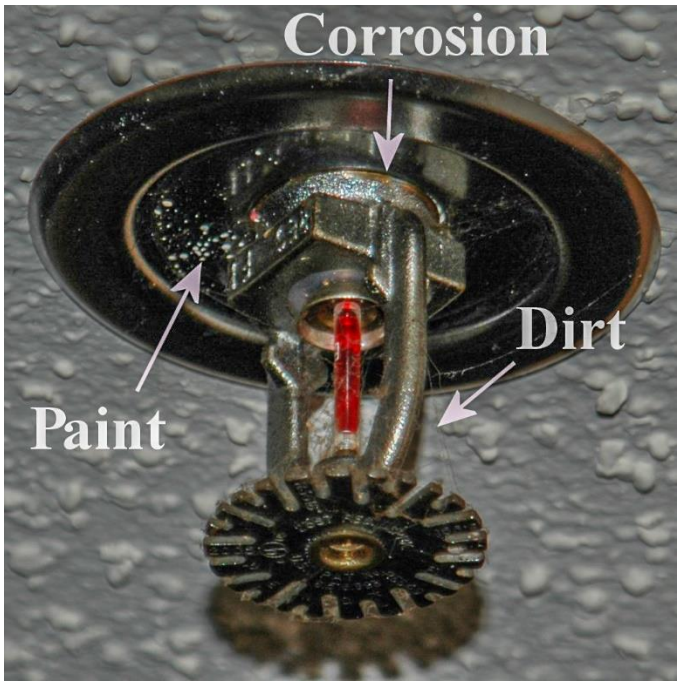

Figure 4 – Laundry Room Sprinkler

The hallway sprinkler head in shown in Figure 3. There were a few paint spatters and dirt on this sprinkler head. The laundry room sprinkler head had paint, corrosion, and a significant amount of dirt on it, Figure 4. The sprinkler head manufacturer maintenance bulletin has the following statement: *Sprinklers should be inspected quarterly, and the sprinkler system maintained in accordance with NFPA 25, 13, 13D, and 13R. Do not clean sprinkler with soap and water, Ammonia or any other cleaning fluids. Remove dust by using a soft brush or gentle vacuuming. Remove any sprinkler which has been painted (other than factory applied) or damaged in any way. A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Prior to installation, sprinklers should remain in the original cartons and packaging until used. This will minimize the potential for damage to sprinklers that could cause improper operation or non-operation.*
Section 5.2 Inspections of NFPA 25, states the following: *5.2.1.1* Sprinklers shall be inspected from the floor level annually.*
5.2.1.1.1 Sprinklers shall not show signs of leakage; shall be free of corrosion, ***foreign materials****, paint, and physical damage; and shall be installed in the proper orientation (e.g., upright, pendent, or sidewall).*
5.2.1.1.2 Any sprinkler shall be replaced that has signs of leakage; is painted, corroded, damaged, or loaded; or in the improper orientation.
5.2.1.1.3 Glass bulb sprinklers shall be replaced if the bulbs have emptied.

Based on the manufacturer's recommendations and NFPA 25 statements, the sprinkler in this rental unit had not been maintained properly.

The failed sprinkler head is shown in Figure 5. The electroplating on the head was chipped and there was foreign material present. This area was examined with the scanning electron microscope and x-ray dispersive analysis to determine the identity of the foreign material.

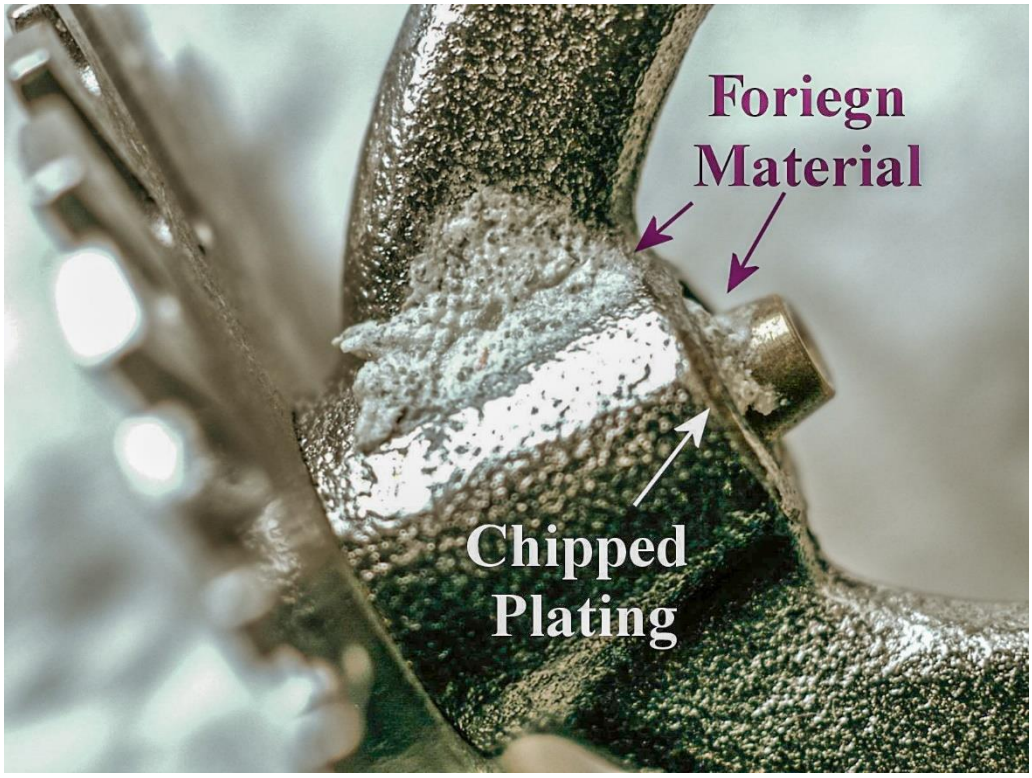

Figure 5 – Foreign Material on Failed Sprinkler Head

Scanning Electron Microscopic Examination

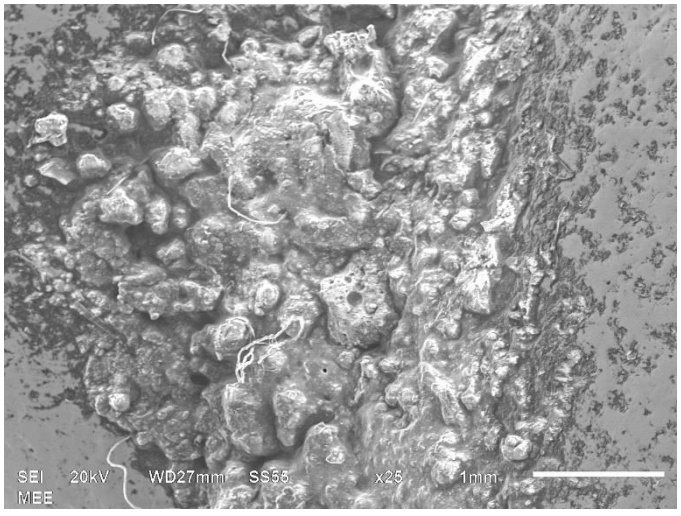

Figure 6 – Foreign Material on Failed Sprinkler Head

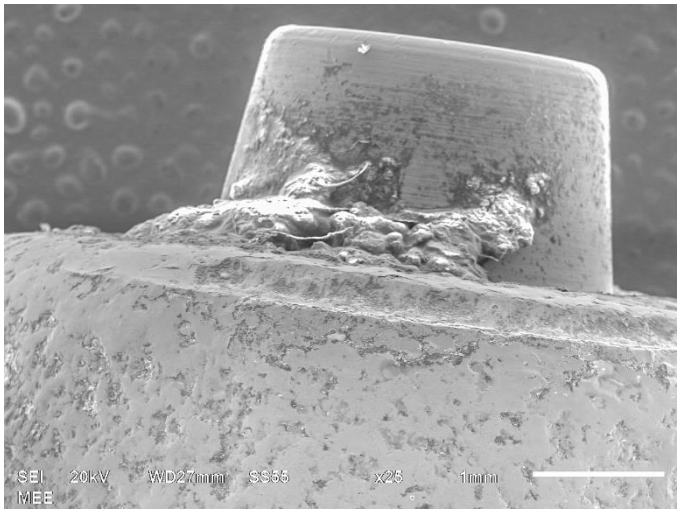

Figure 7 – Foreign Material on Failed Sprinkler Head

Figures 6 and 7 show the foreign material that was on the failed sprinkler head. These two photos show the area in more detail than is shown in Figure 5. In Figure 6, the foreign material appears to contain a crystalline substance. Figure 7 shows the area where the plating was chipped. The chipping of the plating

could have occurred during installation of the sprinkler head. The dark material in Figure 7 is also foreign material, therefore, the deposit of the foreign material occurred after the plating was chipped from the sprinkler head.

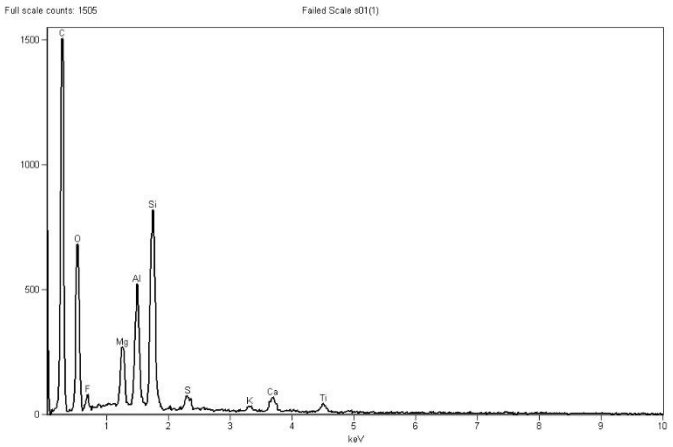

Figure 8 – Spectrum of Foreign Material Figure 6

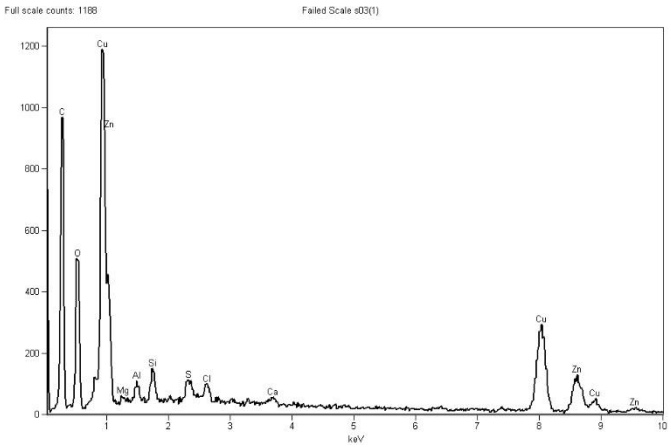

Figure 9 – Spectrum of Dark Material Figure 7

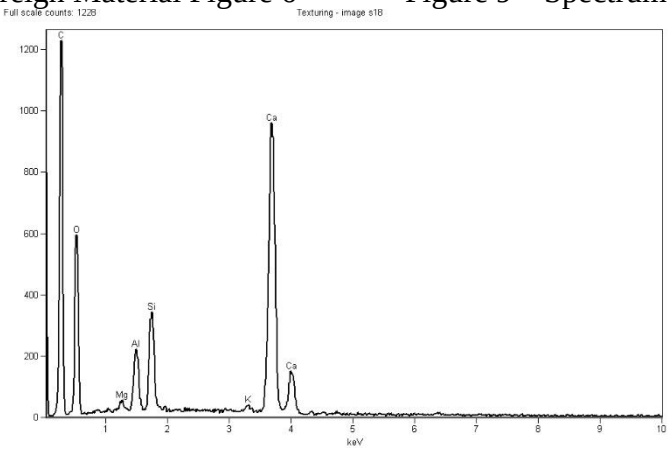

Figure 10 – Spectrum of Ceiling Texturing

The energy dispersive x-ray spectra shown in Figures 8, 9, and 10, compares the ceiling texturing, Figure 10, with the foreign material found on the sprinkler head. The texturing contains magnesium, aluminum, silicon, potassium, and calcium. The foreign material found has basically the same elements present. The foreign material on the failed sprinkler head is most likely texturing material from the original ceiling texturing done in the apartment. There is also evidence that an attempt was made to clean the texturing off the head after it was applied. The silicon material in the texturing is likely as hard or harder than the glass in the tube. Wiping the texturing material from the tube could have scratched the glass tube, weakening it. This is the most likely cause of failure of the sprinkler head.

Conclusion

The sprinkler head should have been replaced after being contaminated by texturing material, or during any of the subsequent inspections and cleanings that were supposed to have taken place. The cause of this failure was failure to follow sprinkler head manufacturer's inspection and maintenance procedures.