



**Quick Links**



Drawing on decades of weathering leadership and expertise, the Atlas Consulting Group provides in-depth consulting services that assist you in developing and applying the best weathering test methods and strategies for your products. **Atlas Weathering Consulting Insights** offers interesting and valuable information on a variety of topics relevant to long-term durability testing.

## Assessing Product Durability... for a Century! A Case Study

Of the many different products that have been the subjects of Atlas Consulting Group projects, one of the most unusual, unique and interesting was the evaluation of the potential service life of highly decorated cemetery headstones (a.k.a. "tombstones").

These specialized memorials allow the formation of detailed images (example in Figure 1) such as photographs of loved ones, and are produced by a unique process (patented as the GLASS Art® process). This consists of laser ablation etching and glassification of a granite surface, followed by the embedding of colored enamel inks into the engraved image "pits" and a final sol-gel sealing to form a vitrified glass-like surface. As one hundred year minimum durability is the prevailing norm in the cemetery monument industry, the manufacturer needed to demonstrate whether this image longevity could be achieved or even exceeded.



Figure 1. An example of the color-imaged granite monument

Evaluating the characteristics and probable failure modes of the finished product, and the results of preliminary screening studies, it was revealed that neither moisture nor temperature effects were likely to degrade the image. Instead, the long term cumulative exposure to sunlight was identified as the most likely stress to result in image degradation.

Two major obstacles to established accelerated weathering testing methods were immediately apparent. The first was the physical size and weight of the product. The second, more challenging hurdle, was the exceptionally long service life expectation. As most accelerated weathering techniques provide about four to eight times higher radiant exposures over natural exposure in the same time frame, a 100 year equivalent accelerated test would still require between 12 and 25 years, clearly unacceptable in both duration and cost. Even the more risky extrapolation of interim data would still require test times exceeding 5 years. Clearly, an innovative approach was required to resolve these complex issues, while preserving fidelity to accepted weathering principles and meeting the needs of the client.

After significant investigation and careful consideration, a somewhat unconventional approach was chosen. This involved exposure to a high energy non-ionizing radiation source used in polymer chain scission, degradation, and cross-linking applications, and also used in the testing of radiation-hardened civil and military satellite and spacecraft components. This testing, a form of a HALT (Highly Accelerated Life Test), is designed to bring out any system weaknesses in as short a time as possible.

The radiation source used could not be directly correlated to natural weathering however, and it could not be assumed that reciprocity was applicable at very high irradiances. With these factors in mind, it was concluded that this was a tolerable risk for this application, and a considerable safety margin for the total radiant exposure was included. The applied radiant exposure was 10X the equivalent dose a GPS satellite in high altitude orbit would receive in 100 years, or 5,000X that of a 100-year terrestrial exposure.

Test specimens were cut from actual color-imaged tombstone granite. Steel bars were used to mask portions of each specimen from the radiation as shown in Figure 2. To avoid overheating from the high energy beam, the horizontal specimen array mounted on a trolley conveyor system was exposed in incremental doses and allowed to cool to near ambient between passes, with maximum specimen temperatures limited to less than 165°C. There were no visible color changes noted from the exposure; some slight speckling of the image occurred in a few of the inks, but these were visually acceptable.

The results provided the client with sufficient anecdotal evidence of 100+ year durability and the product was successfully introduced ([www.graniteimaging.com](http://www.graniteimaging.com)). While not a conventional approach to weathering, the required time and expense mandated a reasonable alternative approach, and although not a complete validation of 100+ year durability, the project provided sufficient assurance to support the manufacturer's market claims.



Figure 2. Test specimens (post exposure) of the imaged granite; steel bar masks provided non-irradiated areas for visual comparison.

### Developing a new product?

Consider testing a sample of your product early on in the development process and utilizing it in a test program designed specifically for you. Not only will it allow you to potentially decrease your product development time and costs, but it can also help identify possible issues at an earlier stage of product development. The Atlas Consulting Group is a team of experts from different fields who are happy to support you in creating appropriate programs for your products, whatever they may be.

For more information contact the Atlas Consulting Group at [atlas.info@ametek.com](mailto:atlas.info@ametek.com) (US) or [atlas.info@ametek.de](mailto:atlas.info@ametek.de) (Europe).

