### 10.1.1 Introduction

Organizing the scope of weathering test methods into logical order helps the engineer visualize tools available for weathering tests. One order organizes exposures showing those with slowest rate of degradation on one extreme through the exposures showing the fastest rates of degradation on the opposite extreme. An example of this order may place the end use environment of an automobile in rural Michigan towards one end, at latitude exposures in Florida and Arizona farther along, sun tracking and EMMAqua exposures farther still, up to harsh artificial laboratory methods such as high irradiance xenon or metal halide exposures towards the other end. Organizing exposures in this manner points out a primary consideration for the engineer; a trade off exists between acceleration (speed of obtaining testing results) and confidence (types and rates of degradation are what is actually observed in the end use environment). Figure 10.1 presents one such organization.

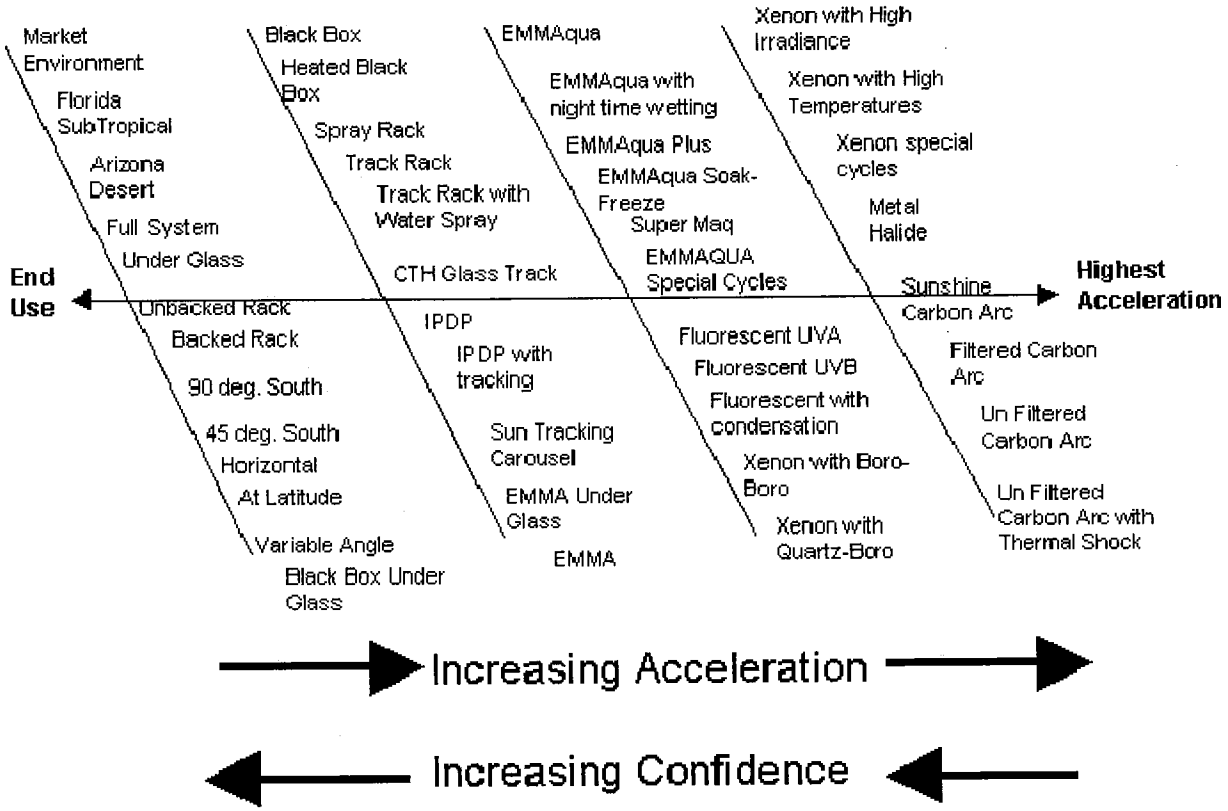


Fig. 10.1 Organization of Weathering Test Methods

The product engineer must weigh alternatives and tradeoffs and decide on an appropriate test matrix. Three general guidelines may assist the engineer. First, relying on several test methods rather than a single method provides robust results. Initiating several smaller tests along different points of the testing continuum in Fig. 10.1, rather than one large complex test program using a single methodology, reduces testing risk and does not put all the eggs in one basket. Comparisons between several test methods and multiple replicates within methods also results in a higher level of information. Secondly, prudent development engineers precede accelerated testing with identical specimens on natural - real-time exposures. Development engineers often need to show how accelerated results directly relate to natural exposures. Only direct comparison between identical specimens exposed to natural and accelerated methods can achieve confidence in the accelerated methods for specific material types, formulations and lots. Thirdly, after initial product approval by a manufacturer, drifts in formulation,

manufacturing process or handling often occur. "Surveillance testing" involves regular sampling from production lots and places samples on natural exposure using a quality control approach. For example, several manufacturers sample production lines once a year and place the samples on natural exposures with a very limited frequency of evaluation. In the unlikely event of customer complaints sometime in the future, reference data from "surveillance testing" is readily at hand. Surveillance data also offers opportunities to anticipate customer dissatisfaction before it arises in the market. Inexpensive, simple, regular surveillance testing provides a level of assurance throughout the product life cycle.

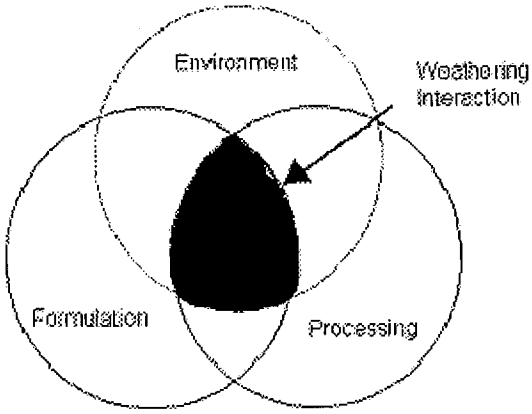


Fig. 10.2 Weathering Interactions

From a design and product engineers standpoint, it may be important to consider materials weathering behavior as an interaction between the formulation, processing and end use environment. A Venn diagram illustrates this interplay in Fig. 10.2.

The test methods presented here within represent a collection of tools for the product engineer. These analytical tools - like all others - if used improperly, can result in erroneous decisions with catastrophic results. Likewise, if used with skill, can enhance product performance and customer satisfaction. This treatment only reviews a number of tools available to the engineer. This treatment does not present application and methodology details. Proper use of these tools includes reviewing procedures, cautions and warnings as specified in appropriate standards.