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Durability of Building and Construction Sealants and Adhesives

3rd Volume

JAI Guest Editor

Andreas T. Wolf

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Foreword

THIS COMPILATION OF THE *JOURNAL OF ASTM INTERNATIONAL (JAI)*, STP1514, on *Durability of Building and Construction Sealants and Adhesives: 3rd Volume*, contains 19 papers presented at the symposium with the same name held in Denver, CO, June 25–26, 2008 and two additional papers submitted but not presented. All papers were published in JAI. The symposium was sponsored by the ASTM International Committee C24 on Building Seals and Sealants in cooperation with the International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM).

The JAI Guest Editor is Andreas T. Wolf, Dow Corning GmbH, Wiesbaden, Germany.

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Introduction

The Third ASTM International Symposium on Durability of Building and Construction Sealants and Adhesives (2008-DBCSA) was held on June 25–26, 2008 in Denver, Colorado. It was sponsored by the ASTM International Committee C24 on Building Seals and Sealants in cooperation with the International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM). The symposium was held in conjunction with the standardization meetings of the C24 Committee. With presentations from authors representing six countries in North America, Europe, and Asia, the symposium was a truly international event.

The symposium brought together architects, engineers, scientists, researchers and practitioners. One of the stated goals of the symposium was to transfer new ideas, gained from laboratory research and field work, to the study of sealant and adhesive durability and the development of new products and test methods. Of course the symposium did not provide all of the answers. However, it did provide an excellent forum for international experts to discuss their experiences in durability testing and assessment as well as in the application of building and construction sealants and adhesives. Perhaps the greatest value of these symposia lies in these discussions and in the dissemination of the resulting information.

The current series of ASTM symposia on Durability of Building and Construction Sealants and Adhesives is a continuation of tri-annual symposia that were inaugurated by the RILEM Technical Committee 139-DBS Durability of Building Sealants in 1994. Today, this continuing series of symposia provides the best scientific forum globally in the building and construction industry for peer-reviewed papers on all aspects of sealant and adhesive durability. Furthermore, data presented at those symposia over the past 15 years have been the single most important factor influencing ASTM International and ISO standards as well as RILEM technical recommendations related to construction sealant durability.

The increased utilization of sustainable construction practice, i.e., designing for durability by utilizing building science and life cycle analysis as its foundation, as well as mandatory government regulations, such as the European Construction Products Directive, have elevated the importance of the durability and service life performance of building and construction sealants and adhesives. All products, not just those involved in safety-critical applications, must demonstrate the durability of their fitness for purpose. Life cycle costing considerations increasingly drive investment decisions toward products and systems with longer service life cycles and lower maintenance costs.

Against a background of national and international efforts to harmonize testing and approval of building materials and structures, ASTM International and RILEM have been looking for ways of bringing together the experience of international experts gathered in the application and testing of building and construction sealants and adhesives.

As with most scientific disciplines, substantial advances often occur through a series of incremental steps by individual laboratories, each contributing pieces of the puzzle, rather than in giant leaps. This is also the case for the papers presented at the ASTM International Symposium on Durability of Building and Construction Sealants and Adhesives (2008-DBCSA). Many of the papers reflect progress reports on on-going research. At the 2008-DBCSA symposium, we saw several examples of the steady progress being made by leveraging these scientific advances into a new generation of test methods.

This book contains 19 papers presented at the symposium and two papers submitted only for publication in the proceedings, all of which were previously published by the Journal of ASTM International (JAI). JAI is an online, peer-reviewed journal for the international scientific and engineering community. Publication in JAI allows rapid dissemination of the papers as soon as they become available, while publication in this Special Technical Publication (STP) is intended to provide easy access to the condensed information in a single volume for future reference. The contributions condensed in this STP volume represent state-of-the-art research into sealant and adhesive durability and reflect the varying backgrounds, experiences, professions, and geographic locations of the authors. The following major themes are evident in this collection:

- Laboratory Testing and Specialized Outdoor Exposure Testing
- Factors Influencing the Durability of Sealed Joints and Adhesive Fixations
- Development of New Test Methods and Performance-Based Specifications
- Field Experience with Sealed Joints and Adhesive Fixations

Below is a short overview of the papers that were published in JAI in the above four categories.

Laboratory Testing and Specialized Outdoor Exposure Testing

While our understanding of the factors influencing the durability of sealed joints and adhesive fixations has progressed substantially over the past decades, there is still much to be learned. Various laboratory accelerated tests have been developed over the years to generate durability data and to duplicate the failure modes occurring in field exposures with the intent to predict the service life of sealed joints and adhesive fixations in less than real time. However, sealants and adhesives have been reported to fail prematurely in the field even though they may have performed satisfactorily when evaluated with these laboratory test protocols. Extensive research efforts are underway to develop laboratory accelerated test protocols that provide better correlation with actual outdoor exposure and in-field service performance. A number of papers therefore focus on this topic.

In their paper, **Pozzi**, **Carcano**, and **Ausilio** report on an attempt at finding a correlation between environmental and accelerated RILEM TC139-DBS weathering for one-component polyurethane sealants applied on mortar. Half of the set of specimens is exposed for 24 months in static conditions (no movement) to the outdoor environment in the urban area of Milan, Italy, while the other half is subjected to accelerated weathering according to the RILEM TC139-DBS procedure in a light-exposure apparatus (xenon-arc type) with water spray and intermittent periods of thermomechanical cycling. Based on the visual inspection of the surface changes that occurred in both sets of specimens, the authors find a good correlation between the results obtained in outdoor exposure and those observed after the RILEM durability cycling. The results demonstrate the importance of achieving an appropriate mix of synergistically acting aging factors in the artificial weathering protocol. Potentially even better correlation may have been expected, if the outdoor weathering was also carried out with simultaneous enforced movement in order to induce cyclic fatigue deformation on the specimens. The authors plan such evaluations for the future.

Joint sealants decisively influence the performance and service life of pavements although they account for only a small fraction of the total investment. Motivated by the damages observed and the resulting, increasing maintenance efforts, the Federal German government recognizes the need for performance-evaluated joint sealing systems with improved capability (fitness for purpose) and durability. In contrast to the existing, predominantly empirical evaluation and selection of joint sealing materials and systems for pavements, **Recknagel** and **Pirskawetz** suggest a methodology aimed at verifying performance under superimposed mechanical and climatic loads. The fatigue behavior of the joint sealants is detected by analysis of the cycle-dependent changes in the mechanical system characteristics. The evaluation methodology further allows investigation of the degradation mechanisms of specific system failures and, thus, enables service life prediction by reproducing the performance of the complete system under realistic conditions. Constructional defects and material flaws can be investigated by this performance-related test methodology, thus allowing identification of possible improvements to material selection and application procedures.

Long-term weather resistance is an important factor to consider when selecting a sealant product for use in exterior weather-sealing applications. **Bull** and **Lucas** in their paper compare the long-term performance of construction sealant products based on silicone polymer, polyurethane polymer, and acrylic terpolymer after a 22-year exposure to outdoor weathering in south Florida. The paper shows that changes in performance attributes such as the toughness, flexibility, and adhesion of the products are good indicators of the physical and chemical degradation (i.e., reversion, cracking, hardening, etc.) occurring in outdoor exposure.

Previous accelerated weathering methods for construction sealants, such as ASTM C1519 and RILEM TC139-DBS, investigated the durability of sealed specimen joints based on their ability to function in cyclic movement while maintaining adhesion and cohesion after repeated exposure to laboratory accelerated weathering procedures. In these test methods, accelerated weathering and mechanical cycling are sequentially imposed on the specimen, and the whole exposure cycle, consisting of weathering and enforcement movement, is repeated iteratively several times. Anecdotal evidence, however, suggests that degradation is substantially accelerated by simultaneously weathering and mechanically cycling the specimen. Recently, two novel test methods have been proposed by RILEM Technical Committee 190-SBJ that allow simultaneous exposure to mechanical cycling and either outdoor weathering or accelerated weathering. In their first paper, **Gorman** and **Klosowski** selectively review previous weathering studies and discuss their thoughts on the development of novel test concepts that involve simultaneous exposure to weathering and joint movement. In their second paper, the same authors explore an alternative sealant weathering test method that also expands on the existing test methodologies. Sealed joint specimens are simultaneously exposed to enforced mechanical movement and either to accelerated weathering or to outdoor weathering in four different climates within the USA. The paper reports on the specific test protocol and the progress of the testing. Correlations of the damage observed after exposure to outdoor climate and in the artificial weathering machines are explored.

Moisture in the form of humidity, condensation, rain, or water immersion is the most commonly encountered element of the service environment and must be considered a critical factor in determining the long-term reliability of sealed or bonded joints. Moreover, the effects of moisture are exacerbated by elevated temperature. For many polymeric systems, warm, moist environments can considerably weaken the bulk or interfacial performance properties of the jointing materials formulated with these polymers. The majority of joint failures in service environments that comprise water exposure occur by degradation of the interfaces between sealant or adhesive, primer, and substrate. Therefore, predicting the interfacial degradation in an actual service environment is of utmost importance. **Wolf** provides information in his paper on the current understanding of the role of water in the failures of adhesive and sealant joints and discusses the usefulness of the Arrhenius relation in predicting the lifetime of immersed sealed or bonded joints based on data generated at elevated temperatures. The paper also suggests some guidelines aimed at improving the reliability of accelerated test and prediction procedures used in the evaluation of the durability performance of sealed or adhered joints in immersed environments.

Historically, joints in glass construction have been bonded with one- and two-component silicones. Ultraviolet (UV) and visible (VIS) light curing acrylates provide further design potential in glass constructions due to their inherent transparency, their rapid bonding capability, and an inherently higher material strength. In their paper, **Weller** and **Tasche** examine the aging behavior of acrylate adhesives by testing bonded joints made of annealed glass and metal substrates. As a first step, the authors investigate the influence of the different surfaces of float glass (atmospheric or tin-bath side) on the tensile strength of bonded joints. Then, adopting the test protocol defined in the European EOTA guideline, the aging resistance of acrylate bonds between untreated annealed glass and metal substrates is examined using seven metal surfaces, i.e., polished-chrome brass; matt-chrome brass; powder-coated brass; turned, polished, and sanded stainless steel; and anodized aluminum. The authors also study the effect of glass surface treatments (pyrolytic silane treatment, sandblast coating, and atmospheric plasma treatment) on the residual strength after water exposure of the acrylate-bonded joints. Furthermore, the study comprises tests on life-size samples (load-bearing capacity and post breakage behavior) according to the guidelines and standards applicable in Germany for safety glazing. These life-size specimens are exposed to outdoor weathering for a period of 5 years, after which their critical safety behavior will be tested again.

Longo and **Vandereecken** compare silicone sealants with newly developed Si-modified organic (polyether, polyurethane, and polyacrylate) polymer-based sealants in their resistance to weathering and thermo-mechanical movement. The sealants are exposed to alternating periods of UV radiation through glass and thermo-mechanical cycling for 1 year. The results of this study show that most Si-modified organic sealants have limited durability in weather-sealing applications. The newly developed silicon-acrylate-based sealants tested during this study show improved durability but still demonstrate poor elastic recovery after exposure to simulated weathering in combination with thermo-mechanical movement. This poor elastic recovery limits their long-term movement capability.

Nakagawa and **Yukimoto** in their paper study the durability and performance of a silyl-terminated (Si-modified) polyacrylate (STPA) based construction sealant in comparison to a typical silyl-terminated polyether (STPE) sealant and a silicone sealant in order to demonstrate the potential of the STPA sealant as a high durability, high performance construction sealant that is also suitable for glazing applications. The study reveals that the polyacrylate backbone of STPA polymer has higher durability, especially UV stability and heat resistance, than the polyether one of STPE polymer, as shown by accelerated weathering tests using carbon-arc or super high irradiance xenon-light sources. Adhesion of the STPA sealant on glass is retained even after 10,000 hours exposure to super high irradiance xenon-light. The authors also compare the performance of the STPA-based sealant to that of the STPE based sealant by testing according to several industrial ISO and JIS standards. The STPA based sealant consistently conforms to a higher durability class specification than the STPE sealant. Furthermore, a cyclic movement test of the STPA-based sealant in a compression-extension machine shows no damage to the sealant even after 200,000 cycles of ±40% movement at room temperature. While, in all likelihood, the sealant products studied by **Longo** and **Vandereecken** are not identical with those studied by **Nakagawa** and **Yukimoto**, the corresponding polymers (silicone and Si-modified polyacrylate) are and it is interesting to note the difference in the behavior of these sealants observed in the two studies. While in the **Nakagawa** and **Yukimoto** study, the Si-modified polyacrylate sealant shows excellent resistance to fatigue aging when exposed to cyclic movement at room temperature without any weathering, the combined weathering and thermo-mechanical cycling studied by **Longo** and **Vandereecken** yields noticeable degradation. Still, both evaluations and previous studies by **Nakagawa** suggest the potential of Si-modified polyacrylate as polymer for durable elastomeric glazing joint sealants, including their use on photocatalytic self-cleaning glass (SCG), if the sealants are not subjected to extreme movements.

Factors Influencing the Durability of Sealed Joints and Adhesive Fixations

Silicone structural glazing has been a proven method of glass attachment to metal curtainwalls for more than 30 years. With the advent of novel substrate materials it is important to note that structural sealant adhesion testing does not qualify a substrate as suitable for the intended use. Since any chain is only as strong as its weakest link, the durability of the substrates involved in structural glazing is of great importance. In his paper, **Carbary** suggests a procedure for evaluating the durability of substrates used in conjunction with structural silicone glazing (SSG). Lap shear and peel adhesion specimens are evaluated after exposures to various conditions. Conditions of exposure include water, sodium hypochlorite (bleach), acetic acid (vinegar), salt fog, UV fluorescent accelerated weathering device, UV exposure, and heat. Evaluation of substrates and their interfaces with the sealant are completed after tensile testing and visual surface analysis. Substrates evaluated include steel, anodized aluminum, galvanized steel, extruded rigid polyvinyl chloride (PVC), glass reinforced thermoplastic resin (fiberglass), and polyvinylidene fluoride (PVDF) coated aluminum. These substrates are tested according to the suggested procedure to show differences in performance and to determine a minimum time frame required for testing. The results and guidelines set forth in this paper provide the foundation for a practice or a substrate specification for use in conjunction with structural silicone attachment methods.

Changing weather conditions prior to the application of sealants on porous substrates, such as the wetting of concrete by unexpected rainfall, can lead to poor sealed joint durability due to adhesion loss. **Gubbels** and **Calvet** study the adhesion of sealants with different chemistries, i.e., silicone, urethane, acrylic, silyl-terminated polyether, and silyl-terminated polyurethane, on wet concrete, when applied at various stages of the drying process. In the first two hours of drying, a drastic reduction of the pH at the concrete surface is observed, which is concurrent with a reduction of the surface humidity. This initial drying period shows the strongest effect on adhesion durability. Therefore, the authors suggest that alkalinity and surface moisture are the major factors responsible for the poor adhesion observed on wet porous alkaline substrates. The critical drying timing also affects the adhesion development of the primer on the wet concrete substrate.

Silicone sealants have been used widely in the waterproofing industry because they resist deterioration. However, residue from silicone sealants (or from pre-formed silicone seals) can be difficult to remove from adjacent surfaces, if it contacts these surfaces inadvertently from improper application or fluid run-down. The paper by **Klosowski**, **Breeze**, and **Nicastro** focuses on the challenge of removing silicone residue from window glass. Several of the likely sources of the silicone residue are discussed, along with the difficulty of measuring the presence of the colorless and odorless thin residue film. The testing evaluates commercially available cleaners and digesters in their effectiveness of removing the silicone residue. The results obtained by the authors are mixed and largely inconclusive; however, the test methodology developed can be used for further evaluation by other laboratories.

The paper by **Krelaus**, **Wisner**, **Freisinger**, **Schmidt**, **Böhm**, and **Dilger** demonstrates that ultra-high performance concrete (UHPC), with its unique material properties, is a suitable substrate for adhesive bonding. The authors present results that were generated as part of a research project aimed at investigating the properties of UHPC adhesive joints in terms of reliability, safety, and load-bearing capacity. Information on strength and durability of 14 adhesives are presented considering varying conditions of substrate surface pretreatment and different UHPC compositions. Exposure conditions include hygrothermal, freezing, and salt spraying exposures. A great variation of fracture pattern is observed; however, the authors demonstrate that the most critical situation of adhesive failure at the interface to the substrate can be avoided by bonding on mechanically pretreated UHPC surfaces. The results emphasize the need for a pretreatment of the UHPC form surface prior to adhesive bonding.

In her paper, **Hagl** details some of the investigations currently occurring within Germany with regard to the application of complex bonding geometries for structural engineering purposes. The author reports information on silicone adhesive material behavior in various bonding geometries resulting from the use of L- and T-type steel elements. Tensile, compression and shear tests are performed on aged and unaged specimens in order to analyze the impact of an aggressive environment. Several degradation modes are induced into the specimens in order to evaluate the load-bearing capacities and failure mechanisms of the different bonding geometries and to assess their behavior in the view of partial failure. **Hagl** presents an overview of the experimental and finite element analysis (FEA) modeling results. Former results obtained for U-type bonding geometry are reviewed in the light of the new experimental findings. Finally, the paper concludes by directly comparing all investigated bonding geometries with respect to durability considerations.

Development of New Test Methods and Performance-Based Specifications

With the recent threat of terrorist attacks, there has been an increased use of windows designed to mitigate the impact of bomb blasts. Due to the high strength and durability characteristics of silicone sealants, structural silicone sealants have been utilized in new bomb blast mitigating window designs. Effective bomb blast mitigating window designs allow the window system to withstand a moderate bomb blast without causing substantial injury to building occupants from the blast itself or flying glass shards. The occupants are protected because laminated or filmed glass, which can withstand the blast, is attached in the framing with a silicone sealant. Silicone sealants provide unique benefits to these window designs due to their strength properties and their ability to anchor the laminated glass in the framing during a blast situation. In their paper, **Yarosh**, **Wolf**, and **Sitte** report on the evaluation of three commercially available high strength structural silicone sealants at applied load velocities (movement rates) up to 5.0 m/s. These elevated load velocities are intended to simulate loads encountered during a bomb blast. Sealant joints are fabricated to evaluate the sealant in tension, shear, and combined tension and shear loads. Sealant joints are also exposed to accelerated weathering (heat, water, and artificial light through glass). Results show that the sealant strength values increase substantially at elevated rates of applied load. The paper discusses the effect of joint configuration, load velocities, and accelerating weathering on the performance and durability of the silicone sealants tested. The results and test method discussed in this paper provide the foundation for a specification for structural silicone attachment methods in bomb blast mitigating glazing.

The paper by **Enomoto**, **Ito**, and **Tanaka** presents information on the weatherability of construction sealants based on a newly developed test specimen design that allows simultaneous exposure of the sealant to forced compression and extension movement in a single specimen. In their study, exposure to cyclic movement and weathering is carried out simultaneously. Furthermore, an evaluation method for surface cracks induced by weathering is presented that allows an assessment of the overall "degree of degradation", a single number characterizing the state of degradation of the sealant surface. In order to study the effects of the amplitude of extension and compression as well as the regional exposure factors on the degree of degradation, 12 sealants are exposed to outdoor weathering for 4 years at three exposure sites, located in the northern, central, and southern areas of Japan. The evaluation of surface cracks is carried out according to the rating provided in ISO 4628-4, with the modification, that new rating criteria are introduced to evaluate minute cracks. A mathematical equation determining the "degree of degradation" is obtained for each sealant, which is based on a component reflecting aging under static conditions and on another component reflecting the dynamic conditions induced by mechanical movement and regional exposure factors. This equation provides a reasonable relationship between the experimental observation and calculated degradation over the exposure period. Based on the results of this study, the novel test specimen design has already been adopted in the RILEM TC190-SBJ Technical Recommendations and the ISO TC59/SC8 committee intends to use this design in a future international standard on sealant durability testing.

Rheological instruments have the capability to characterize the dynamic mechanical behavior of elastomeric materials undergoing oscillatory (cyclic) deformation under controlled test conditions and, therefore, provide a laboratory tool for assessing durability. Cyclic testing can be conducted under controlled strain (deformation) conditions at frequencies that simulate joint movement due either to thermal expansion differentials or seismic events, or under controlled stress (load) that model hurricane-force wind loads or design pressures. **Gordon**, **Lower**, and **Carbary** report on a durability study of four condensation-cure silicone sealants using rheological methods. The test specimens are allowed to cure in situ to optimize material/substrate contact with the rheometer plate fixtures at ambient conditions for one week under static conditions. For future considerations the authors note that rheometers can also be used to cure specimens under dynamic conditions while simultaneously measuring the change in rheological properties over time. In the absence of other artificial degradation effects, the authors attribute the initial stress reduction observed in sealants undergoing controlled strain sinusoidal deformation to the Mullins effect. The stress-softening phenomenon occurs within the first 24 hours of cycling; however, three of the four sealants subsequently exhibit signs of recovery during the remainder of the testing period. Under controlled-load cyclic testing at their design load (0.138 MPa) the sealants exhibit an ultimate deformation within the test cycle well below their rated movement capability with no apparent signs of fatigue. Therefore, the sealant materials tested should be acceptable in an impact-resistant assembly, if the frame remains rigid and the stresses induced from the design wind pressures are transferred to the fully cured and adhered sealant joints. A next step to further characterize the sealants is to ascertain that the cyclic strains or stresses imposed upon the sealants in real systems are quantified properly so that the rheology test methods presented can better assess the performance and durability of an individual material. The paper demonstrates the potential of rheology test methods as a screening tool to isolate and evaluate the mechanical durability of elastomeric silicone sealants in building assemblies undergoing cyclic deformation.

White, **Hunston**, and **Tan** examine the effects of applied strain on sealants exposed to outdoor weathering for two sealant formulations. Both static and dynamic strains are applied to the sealants during the summer in an outdoor location. Both sealants exhibit a reversible change in equilibrium distance. Stress relaxation studies reveal differences in the mechanisms that affect modulus changes in the sealants. For one sealant, exposure without applied strain increases the modulus, while additionally applied strain decreases the modulus; for the other sealant only one mechanism that decreases the modulus is observed.

To fully understand accelerated aging of externally bonded carbon fiber reinforced polymer (CFRP) applications without testing each resin individually, researchers must develop an understanding of the mechanical and chemical bond properties of the CFRP system and the influence of water content and temperature on bond. Presently the proposed strength reduction factor for durability is the strength ratio of specimens submerged in water at 60°C for 60 days, which provides a lower bound durability strength reduction factor for CFRP applications. The paper by **Deng**, **Tanner**, **Dolan**, and **Mukai** examines the development of test methodology and specimen for both flexure and direct tension behavior of bonded CFRP materials using a specimen submerged in a water bath subject to elevated temperature. Test results of three commercial CFRP systems are presented. A discussion of accelerated aging is included in the developmental effort. Further research may provide a logical categorization of CFRP composite systems based on better defined mechanical and chemical properties of adhesive materials and different environments.

Considerable work has focused on the deterioration of jointing compounds used to seal building joints, while less emphasis has been placed on understanding the consequences of seal failure, particularly in respect to watertightness. Water entry at sealed joint deficiencies may lead to a number of different deteriorating effects on the building fabric that may induce failure of other envelope components or premature failure of the joint sealant. Joints are also subjected to substantial wind-driven rain loads in particular atop multi-storey buildings. The approach taken in the study by **Lacasse**, **Miyauchi**, and **Hiemstra** focuses on determining the fault tolerance of joint systems of a simulated wall panel when subjected to watertightness tests that emulate heightened wind-driven rain loads. Vertical and horizontal joint seals in which cracks along the sealant to substrate interface have been introduced artificially are subjected to water spray and air pressure. Rates of water entry across the joint are determined for cracks of different lengths and size. Results on vertical joints indicate that water readily enters open cracks in relation to the crack size, quantity of water present at the crack, and pressure across the opening. The study demonstrates that water may also penetrate cracks of non-extended closed joints. If the crack length in a joint of an actual building is known or verified from a field inspection and the climate loads impinging on the façade have been established, an estimate of the rate of water leakage can be calculated by using the information provided in this paper.

Field Experience with Sealed Joints and Adhesive Fixation

The paper by **Demarest**, **Liss**, **Queenan**, and **Gorman** compares the outdoor weathering behavior of a laboratory prepared high performance acrylic sealant to that of a commonly used, commercially available two-part polyurethane sealant. Both sealants are installed in alternating joints around the perimeter of a tilt-up warehouse located in El Paso, Texas, USA. Furthermore, the sealants are subjected to a range of laboratory tests, including tensile testing, sealant specification testing, paintability, and accelerated weathering in both xenon-arc light and fluorescent UV weathering devices. The 3-year El Paso exposure results, in combination with the laboratory, weathering, and application test results, demonstrate the performance advantages of the high performance acrylic sealant and highlight its inherent suitability for use in low rise industrial applications such as tilt-up warehouses. After 3 years of exterior exposure the polyurethane sealant continues to function as a sealant, with good adhesion and adequate joint movement capability for the application. However, the polyurethane sealant exhibits considerable crazing, chalking and softening as the result of exposure and the function of at least one sealant joint appears to have been compromised by crazing through to the underlying backer rod.

Closure

As we publish this volume, I look forward to the next Symposium on Durability of Building and Construction Sealants and Adhesives (2011-DBCSA) and the associated flurry of papers in this dynamic industry. I encourage all readers to participate in the work of the ASTM C24 committee, to attend the future symposia, and to contribute new papers. Your participation and feedback help to advance the industry and, as a result, we will all benefit from improvements to our built environment.

In closing, I would like to gratefully acknowledge the outstanding quality of the contributions made by the authors as well as the dedicated efforts of the 2008 session chairpersons, the peer reviewers, the staff of ASTM and AIP, and the associated editor of JAI, who all helped to make the 2008 symposium and the publication of the associated papers possible.

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