EQUIPMENT FOUNDATION SYSTEMS

Understanding the Physical Properties of Epoxy Grout

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Bulletin Description

This bulletin was published to help people choosing epoxy grouting materials to understand some of the terms associated with the physical properties of grout and to understand the benefits and limitations of grout testing.

General

All epoxy resin manufacturers publish figures on at least some of the physical properties of their products. Whether the figures are derived from tests performed in-house or by an independent testing laboratory, the specific value obtained for any one property has little or no value in determining the suitability of a product for a particular application. This is especially true for the various compression tests.

For example, the American Society for Testing and Materials (ASTM) states in its Standard for Compressive Properties of Rigid Plastics:

> *"Compression tests provide a standard method of obtaining data for research and development, quality control, acceptance or rejection under specifications, and special purposes. The tests cannot be considered significant for engineering design in applications differing widely from the load-time scale of the standard test."*

In other words, the tests are relevant for comparing one sample with another, but the values derived do not necessarily relate to how the material will behave in a real application. In addition, the ASTM lists 14 different values that apply to compression tests, whereas epoxy resin manufacturers only publish one or two.

Compressive Strength

The problem with compression tests is that the sample size is dependent upon the practical size of the equipment available to perform the tests. For instance, the ASTM D695 compressive test requires a specimen 1/2" square by 1" high. A typical chocking resin will show a compressive modulus of 5×10^5 psi in this test. The same resin tested as a 4" square by 1" high specimen shows a modulus of 10×10^5 psi, or twice as much for the same material, but in a different configuration. This is due to the viscoelastic behavior of the material and is a function of the ratio of the specimen's volume to its edge area, or "aspect ratio."

Creep Tests

Creep tests are even more constrained by the availability of equipment and time. Creep is defined as a permanent deformation occurring at a stress less than the yield stress, and results from plastic flow. All solid materials, even stone and glass, are susceptible to creep and it is the designer's aim to keep stress below the creep threshold. Because of the high load, long duration, and thermostatic requirements, creep tests are expensive to perform and there probably has not been a controlled test to date on a realistic epoxy grout configuration. Instead, accelerated tests are done in laboratories on small specimens that always show some creep, so it is essential to know how to interpret the results.

The only interpretation that can be made from creep tests is that one formulation is more or less creep resistant than another in that particular specimen form, keeping in mind that all materials are subject to creep. Comparison with a proven grout tested in the same manner gives further guidance, but it is possible for creep rate test results to differ by a factor of three or more, while both of the grouts still have zero creep under practical conditions.

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Designing a grout to achieve unnecessarily high creep resistance in such tests will introduce problems such as limited pour depth, high coefficient of expansion, and stress cracking. Zero creep under real conditions is the criterion; it can't be bettered.

Conclusions

Epoxy grouts and chocking materials are complex proprietary formulations. Each is a compromise of physical properties best suited for its designed application as well as other factors such as cost and availability. The degree of compromise can be reduced significantly by having a range of complementary products, like ESCOWELD 7505/7530, CHOCKFAST ORANGE®, BLACK, BLUE, RED and GRAY. Each of these products is carefully formulated and engineered for a specific purpose. All of them required several years in development to achieve the best possible compromise in physical properties and handling characteristics. Some of the many criteria that had to be considered were: high compressive strength, high creep resistance, deep pour capability, good flowability, high heat resistance, low coefficient of thermal expansion, avoidance of resin rich top surface, and uniform distribution of aggregates without settling during the cure. The end result is a precision blend of ingredients that produces a grout with the best possible combination of characteristics required for industrial machinery and equipment foundations.

ESCOWELD 7505/7530 and CHOCKFAST RED achieve these properties and characteristics without being accompanied by excessive exothermic reaction, stress, cracking and shrinkage as commonly observed with other epoxy grouting materials that may boast having one or two superior physical characteristics as determined by laboratory data.

As the ASTM states, laboratory testing of these formulations is useful for development and quality control, which are the manufacturer's concerns. The only data of practical value comes from actual field experience, and the user should rely on unbiased reports from other users and the advice of reputable manufacturers.

Date

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