Zeeospheres™
ceramic microspheres

For resin-based, aggregate-filled construction materials

Introduction

Because of their fine particle size, spherical shape and a particle distribution that contributes to very efficient packing, Zeeospheres™ Ceramic Microspheres have the ability to fill the empty spaces between irregularly-shaped aggregate particles. In so doing, they can enhance flow (because of their "ball bearing" effect that results from their spherical shape), increase particle-to-particle contact and displace a substantial amount of the resin normally required to fill these spaces.

Zeeospheres ceramic microspheres are already widely used in resin-based construction materials, including flooring materials, grouts, sealants, mastics, adhesives and coatings. In these systems, users normally report improvements in cost, strength, application characteristics and surface finish. It was assumed that the addition of Zeeospheres ceramic microspheres would have similar effects in a typical sand-filled epoxy flooring system. To confirm this supposition, an independent laboratory study was commissioned. Following are the results of that study.

Description of Evaluation Techniques

As a starting point, a "typical" sand-filled epoxy flooring formula, based on published starting formulas from several major epoxy resin producers, was selected. Using the technique described below, a formula was developed in which a blend of Zeeospheres™ Ceramic Microspheres and sand was substituted for the pure sand aggregate. The amount of epoxy resin and hardener was reduced to accommodate the lower resin demand of this aggregate blend.

This system was then compared to the control or "typical" system in terms of:

- Raw material cost per pound
- Raw material cost per gallon
- Compressive strength
- Trowelability
- Edge feathering quality
- Appearance

Formulation Results

As shown in the table on the next page, formulating with Zeeospheres ceramic microspheres resulted in a 13% ($.59/gal) cost reduction, along with a 47% increase in compressive strength. The ceramic microspheres system was found to be easier to trowel, and delivered better edge feathering than the conventional or typical system, while its surface was smoother, tighter and less permeable. In appearance, the cured ceramic microsphere system was cement-gray, without the use of expensive colorants.

Although not measured in this study, the addition of Zeeospheres ceramic microspheres typically contributes to:

- Reduced shrinkage
- Improved chemical resistance
- Increased abrasion resistance

			Typical System		Zeeospheres™ Ceramic Microspheres System	
Material	**Product**	**Wt/Gal**	**lbs**	**Gal**	**lbs**	**Gal**
Epoxy Resin	Epon™ 813	9.50	10.00	1.053	7.90	0.832
Hardener	Epi-Cure™ 3072	8.10	3.30	0.407	2.60	0.321
Sand	Wedron™ 320	22.13	57.80	2.612	52.70	2.381
Sand	Wedron™ 710	22.13	28.90	1.306	26.30	1.188
Zeeospheres™ Ceramic Microspheres	G-800	16.70	0	0	10.50	0.629
Aggregate/Binder Ratio			86.7/13.3		89.5/10.5	
Formulation Weight/Gallon			18.59		18.69	
Total Cost/lb			$0.3767		$0.3495	
Total Cost/Gallon			$7.00		$6.51	
Compression Strength			7,300 psi		10,700 psi	

Suggested technique for determining optimum loading levels of Zeeospheres™ Ceramic Microspheres

Because Zeeospheres™ Ceramic Microspheres cost more than many conventional aggregates, they are normally most cost effective when they are used to fill the voids between other, imperfectly-packed aggregate particles. This primarily displaces the epoxy resin, lowering the resin demand of the system. A simple technique to determine the approximate quantity of ceramic microspheres that fills these voids with minimum displacement of aggregate is as follows:

1. Fill a graduated cylinder approximately 75% full with the present aggregate. Tap the cylinder on the bench top several times to allow the aggregate to settle and pack. Record the volume occupied.
2. Pour the contents out of the graduated cylinder and weigh the aggregate.
3. Add a small, weighed amount of ceramic microspheres (1 to 2% initially) to this aggregate and blend thoroughly.
4. Pour this blend of ceramic microspheres and aggregate back into the graduated cylinder. Tap as before to allow it to settle and pack. Record the volume occupied.
5. Pour contents out again; add another weighed amount of ceramic microspheres; blend thoroughly and re-measure the volume occupied.
6. Continue this procedure until the addition of ceramic microspheres produces a considerable increase in total volume occupied.
7. By graphing the total volume occupied of the mix vs. the percent of ceramic microspheres added, it is possible to identify a range in which the addition of ceramic microspheres produces little or no increase in volume occupied by the aggregate plus another range in which the addition of more ceramic microspheres produces a continuous increase in total volume occupied.

Normally, the best combination of cost-effectiveness and physical properties is achieved by using the percentage of ceramic microspheres that begins to produce a noticeable trend in the total volume occupied of the aggregate mix. The initial additions of ceramic microspheres may produce a decrease in the volume occupied by the aggregate as the ball bearing effect of the ceramic microspheres unlocks the irregularly-shaped particles and allows them to pack more efficiently. This technique will provide a reasonable approximation of the optimum level of ceramic microspheres. As in any formulating work, however, a series of finished products should be made up representing several levels of addition of ceramic microspheres around this theoretical optimum. These should then be individually tested to confirm that the desired balance of properties is achieved.

Product Safety and Handling

Please read and follow the precautions and directions for use on the product label and on Material Safety Data Sheets available from Zeeospheres Ceramics, LLC, (985) 532-2541, www.zeeospheres.com.

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