



*Paint, Powder Coatings,
& Concrete
Applications Guide*

Engineered **7** ways to help you reduce costs and enhance paint, powder coating, and concrete performance.

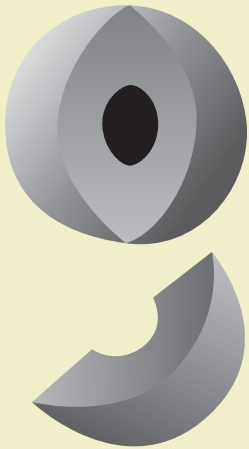
Zeeospheres™ Ceramic Microspheres are high strength, inert fine particles with intrinsic hardness. Zeeospheres™ microspheres are engineered to help you reduce costs, increase solids, enhance properties, and improve processability.



*Typical application—truck under-carriage coating that combines lower VOCs, high solids, and corrosion resistance. (see **5**).*

1 Lower viscosity and improved flow

Unlike many irregularly shaped fillers, Zeeospheres™ microspheres roll easily over one another, similar to ball bearings. This contributes to lower viscosity, better flow, and improved sprayability.



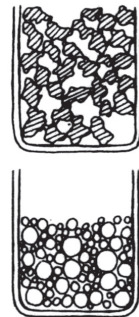
Spherical simplicity to help meet complex challenges.



Typical application—powder coating with spherical dispersion that improves material handling for consistently smooth surfaces.

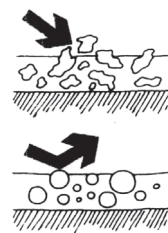
2 Higher filler loading to reduce cost

With the lowest surface area to volume ratio of any shape, microspheres reduce resin demand and increase volume loading capacity. Smaller spheres fill voids between larger ones to enhance packing for higher solids/lower VOCs, and reduced cost.



3 Hardness and abrasion resistance

Mohs 7 hardness and spherical shape contribute to increased hardness and burnish/abrasion resistance of the finished surface. Surfaces stay new looking longer to save the time and cost of touch-ups or repainting. With ordinary fillers, soft or jagged particles on the surface break or wear away.



Typical application—metal surfaces of office furniture exposed to daily use and abuse.



4 Gloss control

Many gloss control materials can increase viscosity. But increasingly higher levels of Zeeospheres™ microspheres can help incrementally lower gloss without significantly increasing viscosity in many applications.

Typical application—military equipment requiring a low gloss camouflage finish that's resistant to abrasion and corrosion.

6 Inertness

Because of their ceramic composition, Zeeospheres™ are chemically inert.

5 Barrier effect

Tight particle packing, combined with hardness and inertness, creates a durable film barrier against weather, corrosion, and chemicals.



Typical application—bridges and other exposed metal structures requiring a physical barrier against harsh environments.

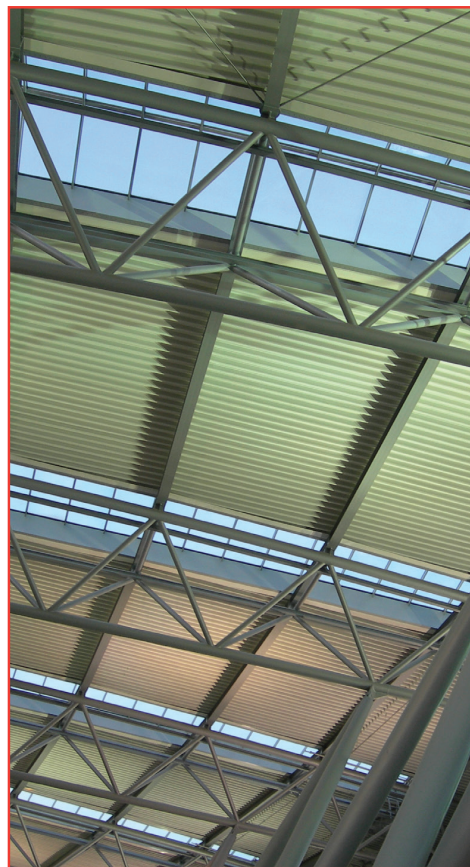


Typical application—chemical storage tanks and piping that need to present a clean, professional image while resisting harsh chemicals.

7 Standard equipment for dispersing

With their high compressive strength, Zeeospheres™ microspheres can be incorporated into the grind phase during production utilizing a high speed Cowles disperser/agitator. For optimum dispersion results, sand, roller, basket, and horizontal media mills are recommended

Equipment wear has been reported to be less than many irregularly shaped mineral fillers of equal or lower hardness.

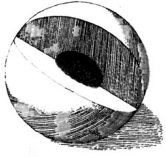


Typical application—industrial roofing.

Application benefits at a glance

Application	Zeeospheres™ Ceramic Microspheres Benefits		
High solids industrial coatings	<ul style="list-style-type: none"> • High loading with low viscosity • Reduced VOC 	<ul style="list-style-type: none"> • Improved hardness • Gloss Control • Abrasion resistance 	<ul style="list-style-type: none"> • Sprayability • Cost Reduction
Water reducible industrial finishes	<ul style="list-style-type: none"> • Increased volume solids • Reduced film permeability/ improved corrosion resistance 	<ul style="list-style-type: none"> • Hardness • Inertness • Abrasion resistance 	<ul style="list-style-type: none"> • Gloss Control • Durability
Maintenance coatings	<ul style="list-style-type: none"> • Chemical and corrosion resistance 	<ul style="list-style-type: none"> • Durability • Abrasion resistance • Lower Film permeability 	<ul style="list-style-type: none"> • High loading • Cost Reduction
Powder coatings	<ul style="list-style-type: none"> • Improved flow • Hardness 	<ul style="list-style-type: none"> • Abrasion resistance • Gloss Control 	<ul style="list-style-type: none"> • Cost reduction
Coil coatings	<ul style="list-style-type: none"> • Flexibility • Abrasion resistance 	<ul style="list-style-type: none"> • Gloss control • Higher solids 	<ul style="list-style-type: none"> • Cost reduction • Hardness
Primers	<ul style="list-style-type: none"> • Improved salt spray, humidity and chemical resistance 	<ul style="list-style-type: none"> • Higher volume solids 	<ul style="list-style-type: none"> • Cost reduction
Architectural coatings	<ul style="list-style-type: none"> • Durability • Scrubability 	<ul style="list-style-type: none"> • Higher PVC • Improved burnish resistance 	<ul style="list-style-type: none"> • Uniformity of sheen
Mastics, grouts	<ul style="list-style-type: none"> • Improved rheology 	<ul style="list-style-type: none"> • Higher loading • Durability 	<ul style="list-style-type: none"> • Reduced shrinkage
UV-cured coatings	<ul style="list-style-type: none"> • High loading with low viscosity 	<ul style="list-style-type: none"> • Cost reduction • Abrasion resistance • Sprayability 	<ul style="list-style-type: none"> • Scrubability • Burnish resistance
Concrete	<ul style="list-style-type: none"> • Higher compressive strength 	<ul style="list-style-type: none"> • Greater pumpability 	<ul style="list-style-type: none"> • Lower Resin Demand

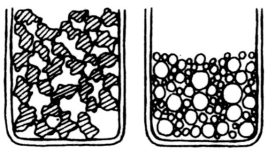
A Breakthrough In Extender Technology



Zeeospheres™ ceramic microspheres are strong, hard, inert, thick walled hollow spheres, unlike any other extender you have ever used. They are available in a variety of size ranges - each with a size distribution which permits very high filler loading.

Zeeospheres™ ceramic microspheres are currently being used with a wide variety of resins to reduce costs, and improve processibility and performance. Here's what they can do for you:

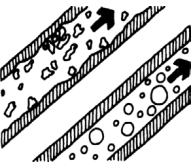
Lower Resin Demand/Higher Loading Potential



Because a sphere has the smallest surface to volume ratio of any shape, Zeeospheres™ ceramic microspheres have extremely low resin demand.

Packing is enhanced by their broad particle size distribution which permits smaller spheres to fill the voids between larger ones. The result... substantially higher filler loading potential with no sacrifice in viscosity or flow, and a savings on increasingly expensive resin.

Lower Viscosity/Improved Flow



Unlike irregularly shaped particles, Zeeospheres™ ceramic microspheres roll easily over one another. They flow through spray nozzles, processing and molding equipment like miniature ball bearings. This not only helps improve moldability, it also saves energy, time, and wear and tear on equipment.

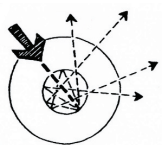
Reduced Shrinkage and Warpage

Because of their high loading potential, efficient packing, high compressive strength, and uniform distribution of stresses, parts containing Zeeospheres™ ceramic microspheres show a marked reduction in shrinkage and warpage.

Hardness/Abrasion Resistance

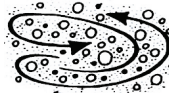
Extremely hard Zeeospheres™ ceramic microspheres can increase hardness and wear resistance. Because they have no sharp, jagged edges, however they won't scratch or wear screws and molds like other hard extenders.

Opacity



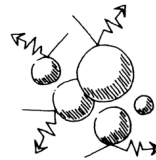
Zeeospheres™ hollow, spherical shape diffuses and scatters light. As a result, they will contribute to the hiding power of your coating.

Dispersibility



In most cases, a standard high speed disperser will achieve the desired grind requirements. For optimum dispersion results, sand, roller, basket and horizontal media mills are recommended

Inertness



The ceramic composition of Zeeospheres™ microspheres makes them extremely durable and chemically inert. They will contribute substantially to the durability, weather resistance, and chemical resistance of the final formulated product

Thermal Stability

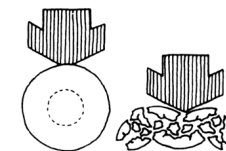
Zeeospheres™ ceramic microspheres are unaffected by temperatures up to 1,200° C. You can use them with confidence when high production temperatures are necessary, or when specifications call for high temperature resistance in finished parts.

Lower Density

Because they have a hollow center, Zeeospheres™ ceramic microspheres can be lower in density than some commonly used mineral extenders. This can result in substantial weight reductions in highly filled systems and an increase in the number of parts produced per pound of compound

Strength

Zeeospheres™ ceramic microspheres are much stronger than



ZEEOSPHERES™

STEEL

conventional glass bubbles or even solid glass spheres. With wall thickness comprising approximately 2/3 of their diameter, they have a compressive strength of over 60,000 psi. That makes them stronger than steel!

Fine Particle Size

Zeeospheres™ ceramic microspheres are available in a wide range of particle sizes to meet your specific application requirements. Product grades with narrow particle size distributions and fine enough for use in films, thin film coatings, and other applications requiring small and carefully controlled particle sizes are available

ZERO-VOC Metal Primer Anti-Corrosive Starting Formulation

Supplier/Product	Pounds	Gallons
A-Side		
Liquid Epoxy Resin (EEW g/eq value 180-190)	309.3	31.89
Epodil [®] 759 (Reactive Diluent)	57.0	7.69
	366.3	39.58
B-Side		
Ancamide 2443 (Modified Amidoamine)	154.9	19.55
Cabosil TS720 (Fumed Silica)	9.2	0.58
Wollastocoat 10ES (Wollastonite)	200.0	8.26
Zeeospheres G-400	100.00	5.45
Halox SZP-391 (corrosion inhibiting pigment)	50.0	1.99
Red Iron Oxide (Pigment)	50.0	1.20
Byk 354 (Leveling Agent)	0.6	0.07
Epodil [®] L (Hydrocarbon Resin)	21.3	2.44
	586.0	39.57

Formulation Properties:

VOC (lb/gal)	0.03
Volume Solids (%)	99.9
Weight per Gallon (lb/gal)	12.03
Mix Ratio (A:B, vol)	1:1
PVC (%)	22.1
Pot Life (hr)	2.25
Initial Viscosity (cP)	1600
Dry to Touch (hr)	>24

Zeeospheres Contributions

- Zero VOC
- 100% Solids
- Superior Corrosion Resistance
- Added Abrasion Resistance
- Reduced Resin Content
- Lower Viscosity

Use of Zeeospheres™ to Reduce Cost and Increase Performance in Highly Filled, Resin Based Construction Compounds

At first glance, Zeeospheres™ ceramic microspheres may appear to be more costly per pound than the typical fillers and aggregates used in adhesives, sealants, grouts, troweled flooring systems, and concrete formulations. In fact, the use of Zeeospheres™ can result in lower overall formulation costs by increasing the system's particle packing and extender content and by reducing the usage level of expensive resins. Fine particle sizes and their spherical shape enables Zeeospheres™ microspheres to insert themselves between other filler and aggregate particles while still retaining good liquid flow and workability properties in the system. This improvement in particle packing also contributes to improved compressive strength and reduced permeability of the finished product, which enhances chemical and corrosion resistance properties. For these reasons, Zeeospheres™ ceramic microspheres have a successful history of usage in a wide variety of high performance flooring and grouting systems.

How Zeeospheres™ enhanced a typical Sand Filled Epoxy Flooring System:

Material	Product	Wt./Gal.	"Typical" System		System "Z"	
			Pounds	Gallons	Pounds	Gallons
Epoxy Resin	Epon 813	9.5	10.00	1.053	7.90	0.832
Hardener	Epi-Kure 3072	8.13	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™	Zeeospheres™ G-800	16.7			10.50	0.629
Total			100.00	5.378	100.00	5.351

	Without Zeeospheres™	With Zeeospheres™
Aggregate/Binder Ratio	86.7/13.3	89.5/10.5
Formulation Weight per Gal.	18.69	18.59
Total Cost per Pound	\$0.2695	\$0.2363
Total Cost per Gallon	\$5.01	\$4.42
Compressive Strength	7,300 p.s.i.	10,700 p.s.i.

Zeeospheres™ in a Filler/Aggregate Blend

Bulking Value	G-200	G-400	G-600	G-800	G-850
Lb./Gal.	20.8	20.0	19.2	18.3	17.5
Gal./Lb.	0.048	0.050	0.052	0.055	0.057
Lb./In ³	0.090	0.086	0.083	0.079	0.076

**Although the costs for the ingredients vary,
the formula with the Zeeospheres™ added still provides:**

- Lower relative raw material costs per gallon (13% lower in this example)
- Increased compressive strength (47% higher in this example)
- Easier troweling
- Better edge feathering
- A smoother, tighter, less permeable surface
- A cement gray appearance, without the need to use or deal with carbon black

In addition, users report that the addition of Zeeospheres™ normally also contributes to:

- Reduced shrinkage
- Improved chemical resistance
- Increased wear and abrasion resistance

Application Characteristics

While application characteristics, such as trowelability, are obviously very subjective, users generally report easier, smoother troweling. In comparing the typical and Zeeospheres™ containing flooring systems, the laboratory that did this work reported that they felt the system with the Zeeospheres™ had better troweling characteristics—particularly at cooler temperatures. They also reported that edge feathering was substantially enhanced with the addition of the Zeeospheres™.

Appearance

The typical flooring system produced a surface that was noticeably coarser and more porous than the Zeeospheres™ containing system. The “tighter”, more densely packed surface of the Zeeospheres™ containing system would be expected to contribute to reduced permeability, and increased chemical and corrosion resistance.



Physical Property Comparison for Industrial Fillers and Pigments for Formulated Systems

Material	Shape (Surface Type)	Mohs Hardness (1-10)	Hydrophilic (Y/N)	Inert (Y/N)	Crush Strength (psi)	Melting Point (°C)
Zeeospheres (G Series)	Spherical (smooth)	7	No	Yes	> 60,000 (80% survival by vol)	1,020 (softening point)
Zeeospheres (N Series)	Spherical (smooth)	7	No	Yes	> 60,000 (80% survival by vol)	1,020 (softening point)
Calcium Carbonate	Irregular (rough)	3	Yes	Yes	< 8,700	825 (decomposes)
Barium Sulfate (precipitated)	Irregular (nodular)	4	No	Yes	14,200	1,580 (w/decomposition)
Talcum (Talc)	Irregular (lamellar)	1	No	Yes	Very Low	> 900 (decomposes)
Titanium Dioxide (R902 type)	Regular (tetragonal)	6-7	Yes (under UV light)	Yes	98,600	1,843
White Ceramic Microspheres	Spherical (smooth)	6	No	Yes	> 60,000 (80% survival by vol)	1,020 (softening point)
Thin Wall Ceramic Microspheres	Spherical (smooth)	5-6	No	Yes	1,600 – 3,200 (90% survival by vol)	1,200 - 1,600

Zeeospheres™ microspheres offer significant improvements in hardness, crush strength, hydrophobicity, and overall durability when compared to traditional extender/filler pigments like calcium carbonate, barium sulfate, talcum, and fragile, thin-wall ceramic microspheres

Zeeospheres™ microspheres approach the physical durability performance levels of titanium dioxide and can be successfully utilized to reduce the TiO₂ loading in high performance CASE formulations



Physical Property and Relative Cost Comparison for Industrial Fillers and Pigments for Formulated Systems

Material	Shape (Surface type)	Oil Absorption (g of oil/100 ml)	True Density (g/cc)	True Density (lbs/gal)	Relative Cost* (per lb)	Relative Cost* (per gallon)
Zeeospheres G-200	Spherical (smooth)	30	2.5	20.82	0.60	0.37
Zeeospheres N-200	Spherical (smooth)	30	2.5	20.82	0.46	0.29
Zeeospheres G-400	Spherical (smooth)	25	2.4	19.99	0.53	0.32
Zeeospheres N-400	Spherical (smooth)	25	2.5	20.82	0.41	0.26
Zeeospheres N-800	Spherical (smooth)	25	2.2	18.32	0.29	0.17
Calcium Carbonate	Irregular (rough)	50	2.8 - 2.9	24.15	0.23	0.17
Barium Sulfate (precipitated)	Irregular (nodular)	13	4.5	37.47	0.34	0.38
Talcum (Talc)	Irregular (lamellar)	35	2.8	23.32	0.45	0.18
Titanium Dioxide (R902 type)	Regular (tetragonal)	16.2	4.2	33.40	1.00	1.00
White Ceramic Microspheres	Spherical (smooth)	44	2.4	19.99	1.50	0.89
Thin Wall Ceramic Microspheres	Spherical (smooth)	16 - 18	0.85 - 0.95	7.08 – 7.91	0.86	0.18 - 0.20

*Relative cost where the current market price of titanium dioxide (R902 type) is set at a value of 1.00

Zeeospheres™ microspheres offer lower oil absorption levels and an additional improvement in viscosity reduction effects due to their smooth, spherical shape when compared to traditional, irregular extender/filler pigments like calcium carbonate, barium sulfate, talcum, and fragile, thin-wall ceramic microspheres

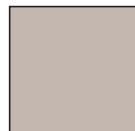
Zeeospheres™ microspheres also provide an excellent cost per unit volume profile when compared to traditional extender/filler pigments, titanium dioxide, and white ceramic microspheres, offering potential for significant cost savings

Zeeospheres™ Products

Product Type	Target Crush Strength (90% survival, psi)	True Density (gm/cc)	Particle Size Distribution Percentiles (Microns)			Comments	Application Recommendations
			50th	90th	95th		
G-200 PC	>60,000	2.5	4	10	12	Refined version of G-200. 7+Hegman Grind	Thin film and powder coatings, refined top particle size results in a smooth surface.
G-200	>60,000	2.5	5	12	14	Finest standard product, least gloss reduction. 7+Hegman Grind.	Industrial paints and powder coatings.
G-400	>60,000	2.4	8	18	23	Medium gloss reduction. 6+Hegman Grind.	
G-600	>60,000	2.3	10	25	35	325 mesh. 3+Hegman Grind	Maintenance paints and adhesives.
G-800	>60,000	2.2	14	60	95	Broad distribution.	Mastics, Grouts and Building Coatings
G-850*	>60,000	2.1	50	125	160	Fewer fines than G-800. Same color as N-Series*.	
N-200 PC	>60,000	2.5	4	10	12	Refined version of N-200. 7+Hegman Grind	Thin film and powder coatings, refined top particle size results in a smooth surface.
N-200	>60,000	2.5	5	12	14	Finest standard product, least gloss reduction. 7+Hegman Grind.	Industrial paints and powder coatings.
N-400	>60,000	2.4	8	18	23	Medium gloss reduction. 6+Hegman Grind.	
N-600	>60,000	2.3	10	25	35	325 mesh. 3+Hegman Grind	Maintenance paints and adhesives.
N-800	>60,000	2.2	30	115	150	Broad distribution. 75 mesh	Mastics, Grouts and Building Coatings
N-1000	>60,000	2.6	42-50	115	150	Lowest cost product for concrete applications	Concrete and Cementitious Applications
N-1200	>60,000	2.6	20-35	115	150		

pH range typically 7-8

G- Series color sample



N- Series color sample



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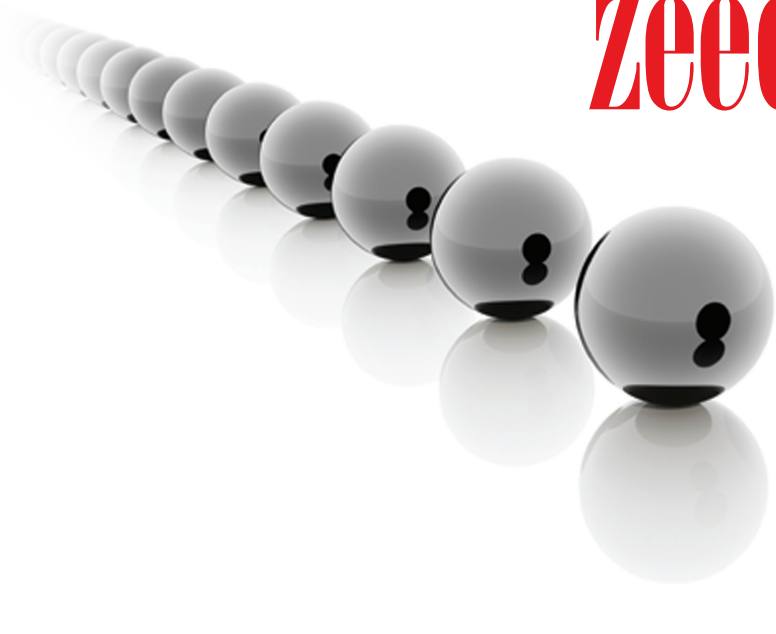
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