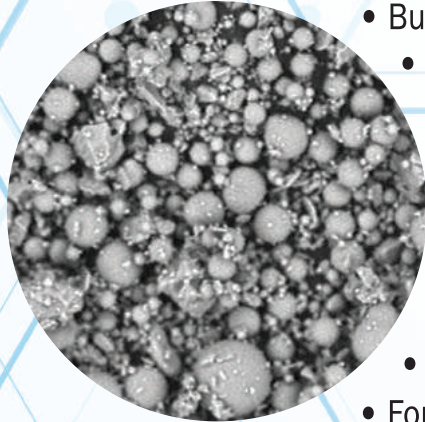


3M Ceramic Microspheres



- Burnish and Scrub Resistance - Enhance Gloss Control
- Enhance Durability and Improve Processability
- Enhance Paint Performance and Longevity
- Improve Viscosity Control - Simplify Mixing
- Chemically Inert - No Crystalline Silica
- Low Surface Area to Volume Ratio - Higher Solids
- UV Transparent down to 250 nm - Enable UV Curing
- Reduce Resin Demand – Maintain Desired Properties
- Formulations with Lower Volatile Organic Compounds (VOCs)

3M Ceramic Microspheres are intrinsically hard, uniquely-shaped fillers, made of Alkali Alumino-Silicate Ceramic, engineered to provide a number of customer-pleasing properties – all while helping paint and coating formulators reduce costs, enhance durability and improve processability. Because of their shape and particle size distribution, 3M Ceramic Microspheres enable lower resin demand and lower viscosities without

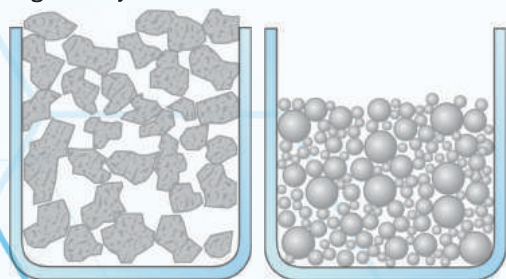
sacrificing filler loading. In addition, the high strength and intrinsic hardness of 3M Ceramic Microspheres help make painted surfaces more durable, to better resist scrubbing and burnishing. From the interior of your home to industrial structures exposed to the elements, 3M Ceramic Microspheres can help add value to a variety of architectural and industrial paints and coatings.

Typical Physical Properties (Not for specification purposes)

True Density (g/cc)	2.4 (20.0 lbs/gal)
Bulk Density (g/cc)	1.5 (12.6 lbs/gal)
Whiteness ("L" Value)	90+ (Hunter L,a,b scale)
Crush strength, 80% survival by volume (psi)	> 4,200 kg/cm ² (> 60,000 psi)
pH (at 5 wt% loading in water)	9.0 – 12.0
Hardness	6 (Mohs scale)
Softening point	1,020°C (1,870°F)
Refractive index: Predominant	1.53
Dielectric constant	3.19
UV light transmission	UV Transparent down to 250 nm
Thermal conductivity (W/mK)	2.3

Reduce Resin Demand

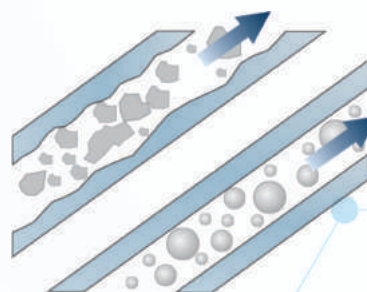
With their low surface area to volume ratio, 3M Ceramic Microspheres can help reduce resin demand and increase volume loading capacity. Smaller particles help fill voids between larger ones for high packing density.



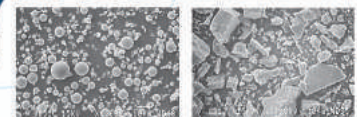
Manage VOC (Volatile Organic Compound) levels

Volatile Organic Compounds (VOCs) can be emitted in the application and cure of solvent-based paints and coatings. By allowing higher solids and lower resin demand, 3M Ceramic Microspheres may help formulators meet the increased consumer demand for low-VOC formulations.

Improve flow



Unlike many irregularly shaped fillers, the smooth shape of 3M Ceramic Microspheres allows them to move more freely for lower viscosity and improved flow.



a) 3M Microspheres W-410 b) Calcium Carbonate



c) Mica d) Wollastonite

Scanning electron microscopy images:
a) 3M Microspheres, b) Calcium Carbonate,
c) Mica, d) Wollastonite

Add Burnish Resistance and Scrub Resistance

The high hardness level and smooth, unique shape of 3M Ceramic Microspheres contribute to increased burnish resistance. With ordinary fillers, soft or jagged particles on the surface more often break or wear away. 3M Ceramic Microspheres help surfaces maintain their appearance longer to save the time and cost of touch-ups or repainting.

Enhance Gloss Control

Incorporating higher levels of 3M Ceramic Microspheres can help incrementally lower gloss levels without significantly increasing viscosity in many applications. 3M Ceramic Microspheres can help formulators balance gloss and other properties to achieve optimal performance.

Provide Exterior Durability

Tight particle packing, combined with high hardness, creates a durable, low-permeation barrier against the weather.



Hardness

Mohs 7 hardness and the spherical shape of 3M Ceramic Microspheres contribute to increased hardness of a variety of compounds. Despite such hardness, 3M Ceramic Microspheres have been shown to be less abrasive to equipment than many irregularly shaped mineral fillers of equal or lower hardness.

Corrosion Resistance

In general, the tight particle packing of 3M Ceramic Microspheres can produce coatings with increased corrosion resistance via reduced film permeability in many applications. In salt spray testing of a water-reducible epoxy primer, the results on the right were observed on test panels.

Gloss Control

Many gloss control materials can increase viscosity. But increasingly higher levels of 3M Ceramic Microspheres can help incrementally lower gloss without significantly increasing viscosity in many applications.

Enable UV curing

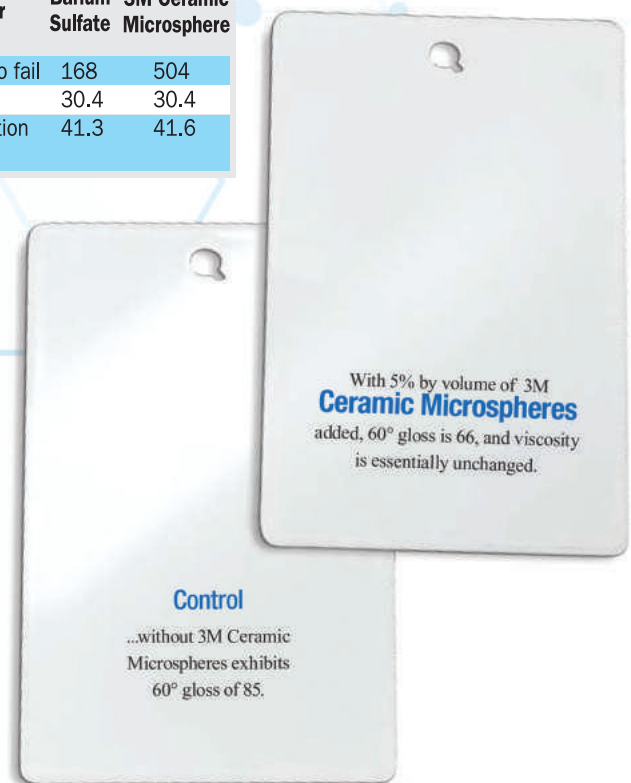
To help improve productivity and depth of cure for UV-curable coatings, 3M Ceramic Microspheres are UV transparent to 250nm. The microspheres allow transmission of the UV energy through the coating.

Simplify mixing

With high compression strength, 3M Ceramic Microspheres can be added during the standard grind. For optimum dispersion, sand, ball and roll mills are preferred. Equipment wear has been reported to be less than many irregularly-shaped mineral fillers of equal or lower hardness.

Salt Spray Testing of Water-Reducible Epoxy Primer

Filler	Barium Sulfate	3M Ceramic Microsphere
Hours to fail	168	504
PVC	30.4	30.4
Application solids	41.3	41.6



Potential Applications and Benefits:

Architectural Coatings

- Durability
- Scrubability
- Higher PVC
- Improved burnish resistance
- Uniformity of sheen

Powder Coatings

- Improved flow
- Hardness
- Gloss control
- Cost reduction

Maintenance Coatings

- Corrosion resistance
- Durability
- Lower film permeability
- High loading
- Cost reduction

Coil Coatings

- Flexibility
- Gloss control
- Higher solids
- Cost reduction
- Hardness

Industrial Coatings

- Durability
- Lower film permeability
- High loading with low viscosity
- Reduced VOC
- Improved hardness
- Gloss control
- Sprayability
- Cost reduction

Primers

- Improved salt spray, humidity resistance
- Higher volume solids
- Cost reduction

Water-reducible Industrial Finishes

- Increased volume solids
- Reduced film permeability/improved corrosion resistance
- Hardness
- Inertness
- Gloss control
- Durability

UV-cured Coatings

- High loading with low viscosity
- Cost reduction mastics, grouts
- Improved rheology
- Higher loading
- Durability
- Reduced shrinkage

Mastics, Grouts

- Improved rheology
- Higher loading
- Durability
- Reduced shrinkage

No crystalline silica

3M Ceramic Microspheres are solid particles and contain no detectable crystalline silica as determined by x-ray diffraction (XRD) technology.

Case Studies

- 3M Ceramic Microspheres: Grade Differentiation
- PVC Study
- Industrial Latex Paint
- Epoxy Coatings
- UV Coatings
- Weathering Study

Grades of 3M Ceramic Microspheres

(Not for Specification Purpose)

Product	True Crush Strength ¹	True Density ²	Hegman Grind ³	Particle Size ⁴ 90th%	Oil Absorption ⁵	Color ⁶	Comments
W-210	>60,000	2,4	7	12	46	white	Finest 3M product, least gloss reduction of any white grade
W-410	>60,000	2,5	6	21	44	white	Medium gloss reduction
W-610	>60,000	2,5	3+	32	32	white	325 mesh most gloss reduction of any 3M white grade

¹90% survival, psi

²g/cc

³ASTM D12-10

⁴Microns by volume

⁵gm oil/100cc microspheres

⁶Unaided eye

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